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ABSTRACT BOOK

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FP.01.01

THE POSSIBILITY OF INTRAOPERATIVE ARTHROSCOPIC IMAGES TO PREDICT RETEAR AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR USING DEEP LEARNING: A NOVEL WAY TO PREDICT RETEAR

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Background: It is still challenging to predict retear after arthroscopic rotator cuff repair (ARCR) with many factors. Arthroscopic image has never been used or even been considered an important tool for predicting the prognosis of ARCR.

Methods: A total of 1394 arthroscopic intra-operative images were retrospectively obtained from 580 patients. Repaired tendon integrity was evaluated by magnetic resonance imaging (MRI) for all patients within two years after surgery. Images taken immediately after the rotator cuff repair were included. We compared three different deep learning (DL) architectures to evaluate the ability of arthroscopic imaging to predict retear. Three pre-trained DL algorithms (VGG16, DenseNet, and Xception) were used for transfer learning. Training and test sets were split into 8:2. Three-fold stratified validation was used to fine-tune the hyperparameters using the training data set. The validation results of each fold were revealed. The performance of each model in the test set was described in terms of accuracy, area under the receiver operating characteristic curve (AUC), F1 score, sensitivity, and specificity.

Results: The number of arthroscopic images obtained was 1138 from 514 patients for the non-retear group, and 256 from 66 patients for retear group. The mean validation prediction accuracy of each model using arthroscopic images was 83% for VGG16, 89% for Xception, and 91% for DenseNet. The accuracy in the test set is 76% for VGG16, 87% for Xception, and 91% for DenseNet. In terms of the AUC, the highest value was DenseNet at 0.91, while VGG16 and Xception showed the values of 0.83 and 0.91 for each. The specificity and sensitivity were 0.93 and 0.84 for DenseNet in the test set, while 0.89 and 0.84 for the Xception, and 0.70 and 0.80 for the VGG test sets.

Conclusions: The intra-operative arthroscopic image can predict retear through deep learning algorithms with high accuracy without other additional factors.

FP.01.02

EARLY POSTOPERATIVE MRI EVALUATION OF A FASCIA LATA AUTOGRAFT WITH AND WITHOUT POLYPROPYLENE MESH AUGMENTATION AFTER SUPERIOR CAPSULAR RECONSTRUCTION

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Background: Recently, a polypropylene mesh has been introduced and reported to improve the clinical outcomes after superior capsular reconstruction (SCR) using a fascia lata autograft (FLA). However, mesh-related events such as a foreign response may trigger inflammation, which might affect graft healing and remodeling.

Methods: Patients who had undergone SCR using an FLA with and without a mesh between March 2013 and August 2021 were retrospectively analyzed. Follow-up MRI was performed at three months. A total of 78 patients (24 in the FLA group and 54 in the FLA + Mesh group) with intact grafts were included. Graft remodeling was evaluated by analyzing the signal/noise quotient (SNQ) at the humeral (SNQh), mid-substance (SNQm), and glenoid (SNQg) sites. Theoretically, lower SNQ ratios indicate higher strength and better healing of the graft.

Results: The mean SNQ was 30.603 (range, 11.790–72.710) in the FLA group and 18.367 (range, 4.464–69.500) in the FLA + Mesh group ($P < .001$). Furthermore, significant differences were found between the two groups at the humeral and mid-substance sites (37.863 [range, 5.092–81.187] vs 15.512 [range, 1.814–80.869] ($P < .001$) and 29.168 [range, 6.103–73.900] vs 16.878 [range, 2.454–92.416] ($P = .003$), respectively). However, there was no difference between the two groups at the glenoid site (25.346 [range, 7.565–86.353] vs 20.354 [range, 3.732–88.468], $P = .057$).

Conclusions: At the 3-month follow-up, the FLA + Mesh group showed a lower MRI signal intensity than the FLA group. The healing and remodeling of an FLA may be enhanced when a mesh is used.

FP.01.03

LOAD-INDUCED GLENOHUMERAL TRANSLATION AFTER ROTATOR CUFF TEARS DURING A 30° ARM ABDUCTION AND ADDUCTION MOVEMENT

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Background: Glenohumeral joint instability is associated with rotator cuff tears (RCT), yet to date a sound knowledge of glenohumeral motion is missing. We aimed to investigate glenohumeral translations after RCT during an abduction test with additional weights.

Methods: Twenty-five patients with unilateral RCT (64.3 ± 10.2 years), 24 asymptomatic subjects (55.5 ± 8.2 years) and 25 healthy subjects (26.1 ± 2.3 years) participated in this study. Inferior-superior glenohumeral translations were measured relative to the glenoid during motion bilaterally from fluoroscopy images during a 30° scapular plane abduction and adduction movement with handheld weights (0, 2 and 4kg). A linear mixed model (loads, shoulders) with random effects (subjects) was applied to the translations during abduction and adduction, with the dominant side of healthy subjects as reference. The Constant Score was acquired and t-tests with Bonferroni correction were used to assess differences.

Results: Mean superior translations during abduction at 0kg ranged from 1.9 to 3.2mm and at 4kg from 2.6 to 4.0mm, with the lowest values for healthy subjects and the highest for patients. Similar values indicating an inferior translation were observed during adduction. Glenohumeral translation showed a significant main effect for load during adduction ($p=0.010$). During abduction, we observed a main effect for the asymptomatic side of patients ($p=0.014$) and significant interaction effects of load for the symptomatic side of patients ($p=0.046$). Post-hoc tests revealed differences during abduction at 4kg between the symptomatic side of patients and both sides of healthy subjects (non-dominant $p=0.005$, dominant $p=0.021$), and for the symptomatic side of patients between 0-2kg and 0-4kg ($p<0.001$). Differences in Constant Scores were found between the symptomatic side of patients (74.4 ± 10.3 points) and all other shoulders (mean range 83.1-88.7 points) and between the asymptomatic side of patients and both shoulders of healthy subjects ($p<0.005$).

Conclusions: Stabilisation of the glenohumeral joint depends on the magnitude of load, and these load-induced glenohumeral translations are greater in symptomatic RCT. The Constant Scores is lower for symptomatic RCT but does not account for load-dependent activity. Further investigations of joint stability as a function of load are needed to better understand glenohumeral motion during activities of daily living.

FP.01.04

AUTOMATED 3-DIMENSIONAL MRI SEGMENTATION FOR THE POSTEROSUPERIOR ROTATOR CUFF TEAR LESION USING DEEP LEARNING ALGORITHM

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Background: Rotator cuff tear (RCT) is a challenging and common musculoskeletal disease. Magnetic resonance imaging (MRI) is a commonly used diagnostic modality for RCT, but the interpretation of the results is tedious and has some reliability issues. In this study, we aimed to evaluate the accuracy and efficacy of the 3-dimensional (3D) MRI segmentation for RCT using a deep learning algorithm.

Methods: A 3D UNet convolutional neural network (CNN) was developed to detect, segment, and visualize RCT lesions in 3D, using MRI data from 303 patients with RCTs. The RCT lesions were labeled by two shoulder specialists in the entire MR image using in-house developed software. The MRI-based 3D UNet CNN was trained after the augmentation of a training dataset and tested using randomly selected test data (training: validation: test data ratio was 6:2:2). The segmented RCT lesion was visualized in a 3D MRI image, and the performance of the 3D UNet CNN was evaluated using the Dice coefficient, sensitivity, specificity, precision, F1-score, and Youden index.

Results: A deep learning algorithm using a 3D UNet CNN successfully detected, segmented, and visualized the area of RCT in 3D. The model's performance reached a 94.3% of Dice coefficient score, 97.1% of sensitivity, 95.0% of specificity, 84.9% of precision, 90.5% of F1-score, and Youden index of 91.8 %.

Conclusions: The proposed model for 3D segmentation of RCT lesions using MRI data showed overall high accuracy and successful 3D visualization. Further studies are necessary to determine the feasibility of its clinical application and whether its use could improve care and outcomes.

FP.01.05

COMPARISON OF CLINICAL AND RADIOGRAPHIC OUTCOMES BETWEEN ONLAY AND INLAY LOWER TRAPEZIUS TENDON TRANSFER FOR MASSIVE IRREPARABLE CUFF TEARS

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Background: Lower trapezius tendon transfer (LTT) was developed for patients with irreparable posterosuperior rotator cuff tears (RCTs) with some promising results because it has the advantage of being in phase with the infraspinatus, allowing for recruitment and ease of rehabilitation. There were two types of LTT, onlay and inlay techniques been published to date. However, there was a paucity of literature comparing these two techniques. The aim of this study is to compare the clinical and radiological results between onlay and inlay LTT in patients with irreparable posterosuperior RCTs.

Methods: From September 2019 to August 2021, patients received onlay LTT with an allogenic Achilles tendon graft and inlay LTT with an autologous semitendinosus tendon or peroneus longus tendon in our institution were enrolled in this retrospective comparative study. Preoperative and postoperative X-ray and MRI were used to determine the tear pattern of the related RCTs, Hamada classification, and acromiohumeral distance (AHD). ASES, quick-DASH, and SANE score were collected from the patients via questionnaire.

Results: A total of 18 patients (thirteen inlay group, and five onlay group) were enrolled. Eleven of them were male. The mean age was 64.3 ± 6.4 years and BMI 25.7 ± 3.5 . There were six Hamada 1, eleven Hamada 2 and one Hamada 3 in the study. All associated subscapularis tendon tears were repairable (thirteen intact, two Lafosse 1, two Lafosse 2, and 1 Lafosse 3 subscapularis tear) The Onlay group had significantly better ASES (78.4 ± 14 vs. 69.1 ± 13.6 , $p < 0.001$), Quick-DASH (7.7 ± 8 vs. 16.7 ± 13.7 , $p = 0.013$) scores. There were no significant differences in AHD (8.1 ± 2.6 mm vs. 5.2 ± 2.3 , $p = 0.265$), and SANE score (81.4 ± 11.9 mm vs. 73 ± 14.4 , $p = 0.119$) between onlay and inlay groups.

Conclusions: Onlay and inlay LTT provide satisfactory clinical outcomes for massive irreparable RCTs. Patients in the onlay LTT group had better ASES and Quick-DASH score than inlay LTT group.

FP.01.06

HIGHER RE-OPERATION RATES FOLLOWING PRIMARY ROTATOR CUFF REPAIR AUGMENTED WITH BIOLOGIC PATCH FOR FULL-THICKNESS ROTATOR CUFF TEARS

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Background: Due to the aging population in the United States, the prevalence of rotator cuff tears and their surgical management continues to increase. Despite advances in rotator cuff repairs, patients continue to experience inadequate postoperative tendon healing, re-tears, and ultimately repair failure. Biologic augmentation patches have been developed with the purpose of improving local healing and increasing the strength of repair. However, there is a paucity of literature that observes its clinical efficacy following primary repair for full-thickness tears. Therefore, the purpose of this study was to observe clinical and patient-reported outcomes (PROM) of patients who underwent rotator cuff repair augmented with a novel collagen patch derived from bovine tendons when compared to those who underwent repair without a patch.

Methods: A retrospective analysis of patients who underwent primary arthroscopic repair of full-thickness rotator cuff tears by a single surgeon after January 2015 was conducted. These patients were stratified to those who underwent repair with the REGENETEN™ Bioinductive Implant augmentation and those who did not. These cohorts were propensity matched for age, sex, tear size, and mass index (BMI). Variables assessed included demographics, range of motion (ROM), subjective shoulder value (SSV), American Shoulder and Elbow Surgeon (ASES) scores, Visual Analog Scale (VAS) pain scores, and incidence of re-operation. Postoperative assessment was performed at three months, six months, one year, and two years.

Results: After propensity matching, 45 patients were included in both cohorts. There was no difference in preoperative demographics, ROM, and PROMs ($p > 0.05$ for all). At one-year follow-up, there was no difference in ASES, VAS, SSV, or ROM between groups ($p > 0.05$ for all). Within two years of surgery, the incidence of reoperation was significantly higher in the patch cohort (13.3%) when compared to the control (0%; $p = 0.026$). The patch re-operations were not indicated for re-tears but rather inflammation, pain, and stiffness.

Conclusions: Within two-years, the biologic augmentation patch was associated with significantly higher re-operations for pain, inflammation, and stiffness, with no shown efficacy in graft strength or patient reported outcomes. For primary repairs, this study does not recommend the utilization of biologic augmentation patches.

FP.01.07

INJECTION OF AUTOLOGOUS CONDITIONED PLASMA COMBINED WITH A COLLAGEN SCAFFOLD MAY IMPROVE SHOULDER IMPINGEMENT SYNDROME- A PROSPECTIVE STUDY

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Background: Shoulder Impingement Syndrome (SIS) is one of the most common diseases of the shoulder and can be addressed with various therapeutic concepts. Orthobiological agents such as platelet rich plasma with a low side effect rate gain importance in the conservative treatment of SIS. Currently, the knowledge about success rate influencing factors, such as the growth factors (GF) concentration or acromion type, is limited. Therefore, we investigated the SIS therapy outcome using autologous conditioned plasma combined with recombinant human collagen scaffold (ACP/STR) injection, depending on the GF concentration, age and acromial morphology, in comparison to a corticosteroid-local anesthetic (CSA) injection.

Methods: This prospective trial recruited 58 patients with SIS who received an ultrasound-guided subacromial injection either an ACP/STR or a CSA followed by physical therapy. Follow up (FU) was performed at 6 weeks, 3 and 6 months. The outcome was assessed with Constant-Murley Score, Disability of Arm, Shoulder and Hand Score and Simple Shoulder Test. The concentration of GF was measured using ELISA.

Results: During the FU the improvement of outcome measures was observed with no differences between both groups. Shoulder force was significantly increased in the ACP/STR group ($p < 0.01$). We found no correlation between the amount of GF and age or gender in the ACP/STR patients. An acromion Bigliani type III predisposes for therapy failure ($p < 0.001$, OR=56) in both treatment groups.

Conclusions: Patients with SIS benefit regarding to PROMs after both ACP/STR and CSA injection and physical therapy. Patients who received ACP/STR obtained superior improvement in force. The quantity of GF did not vary depending on the age, so that ACP/STR can be a treatment option for chronic SIS in elderly patients with multimorbidity. The presence of an acromion type III seems to be a predictive factor for limited effectivity of injections in the clinical management of SIS.

FP.01.08

DOES PREOPERATIVE FATTY INFILTRATION OF THE INFRASPINATUS MUSCLE AFFECT CLINICAL OUTCOMES FOLLOWING SUPERIOR CAPSULE RECONSTRUCTION USING FASCIA LATA AUTOGRAFTS IN IRREPARABLE ROTATOR CUFF TEARS?

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Background: We aimed to assess whether fatty infiltration (FI) severity of infraspinatus muscle (ISP) affected clinical outcomes following superior capsule reconstruction (SCR).

Methods: This retrospective multi-institutional study included 154 patients (79 women and 75 men; mean age, 69.9 years; age range, 49–87 years) with irreparable rotator cuff tears (RCTs) who underwent arthroscopic SCR using a minimum 6-mm thick fascia lata autograft and who completed a minimum 2-year follow-up. The severity of FI of the ISP was evaluated by preoperative magnetic resonance imaging (MRI) according to the Goutallier classification and was classified into grades 0-5. We then compared American Shoulder and Elbow Surgeons (ASES) scores, active elevation, active external rotation, and the graft tear rate among five groups.

Results: MRI scans revealed 12 shoulders with grade 0 FI of ISP, 37 with grade 1 FI of ISP, 46 with grade 2 FI of ISP, 22 with grade 3 FI of ISP, and 37 with grade 4 FI of ISP. ASES score significantly improved after SCR in all groups (grade 0, 42.9 to 92.4; grade 1, 41.0 to 92.4; grade 2, 39.6 to 93.0; grade 3, 38.8 to 89.6; grade 4, 40.6 to 87.3; all $P < 0.01$). Active elevation and external rotation also significantly improved after SCR in all groups (grade 0, 99.6 to 151.3, 32.1 to 42.9; grade 1, 100.0 to 159.1, 32.6 to 50.5; grade 2, 97.5 to 157.7, 28.8 to 45.8; grade 3, 83.4 to 155.5, 27.5 to 42.0; grade 4, 100.7 to 149.7, 21.9 to 39.3; all $P < 0.01$). Postoperative ASES score, active elevation, and active external rotation did not differ significantly among five groups. Graft tear rate in shoulders with grade 4 FI of ISP was relatively higher than that in other groups, but the difference was not found to be significant (grade 0, 8.3%; grade 1, 8.1%; grade 2, 6.5%; grade 3, 9.1%; grade 4, 24.3%; $P = 0.10$.)

Conclusions: Clinical outcomes significantly improved after SCR regardless of the severity of FI of the ISP. Therefore, arthroscopic SCR is a reliable surgical option for irreparable posterior-superior RCTs even in patients with grade 4 FI of ISP.

FP.02.01

CLINICAL AND RADIOGRAPHIC OUTCOMES AND GRAFT INCORPORATION RATE ASSESSED BY CT SCAN AFTER REVERSE SHOULDER ARTHROPLASTY WITH GLENOID STRUCTURAL BONE GRAFT RECONSTRUCTION

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Background: Reverse shoulder arthroplasty (RTSA) with structural bone graft has been described as a technique in addressing glenoid bony defects. Studies have demonstrated acceptable outcomes in the use of structural autograft or allograft. However, most of these studies are small and rarely evaluate bone graft incorporation with CT scan. The aim of this study is to assess clinical and radiographic outcomes as well as report on graft incorporation assessed on CT scan following RTSA in shoulders where structural bone autograft or allograft was utilized to augment the reconstruction of the glenoid.

Methods: 35 patients undergoing RTSA with structural bone graft were retrospectively enrolled and 32 patients were prospectively enrolled. Preoperative American Shoulder and Elbow Surgeons (ASES) Score and Visual analog scale (VAS for pain) and radiographs were obtained preoperatively and postoperatively. Patients were invited to undergo a CT scan at least 1 year postoperatively to evaluate bony incorporation of the graft.

Results: Thirty-five patients were enrolled retrospectively (52.2%) and 32 prospectively (47.8%). Subjects had an average age of 69.0 years (range, 37.8-87.4 years). Mean clinical survey follow-up was 31.0 (SD 10.4) months for the retrospective cohort and 24.8 (SD 2.0) months for the prospective cohort. Autograft was utilized in 46 cases (68.7%) and allograft in 21 cases. Mean ASES score improved from 33.1 (SD 18.5) to 78.2 (SD 22.4), $p < 0.0001$. On postoperative radiographs, 63 cases (94%) showed stable RTSA constructs while 4 cases (6.0%) developed glenoid baseplate subsidence. Postoperative CT scan was performed in 50 patients and assessed by a board-certified radiologist for graft incorporation. Complete graft incorporation was noted in 45 (90.0%) while partial incorporation was noted in 4 (8.0%) and in 1 case (2.0%) there was no graft incorporation. There was no correlation between baseplate subsidence and graft type (autograft vs allograft) or primary vs revision surgery.

Conclusions: Reverse Shoulder Arthroplasty with structural bone autograft and allograft is reliable for glenoid augmentation in patients undergoing RTSA in both primary and revision settings. Clinical outcomes improve significantly and rate of bony incorporation of autograft and allograft as evaluated on radiographs and CT scan is predictably high.

FP.02.02

A MULTI-CENTRE, RANDOMIZED CONTROLLED TRIAL COMPARING A SECOND-GENERATION UNCEMENTED TRABECULAR METAL-BACKED VS CEMENTED POLYETHYLENE GLENOID COMPONENT IN TOTAL SHOULDER ARTHROPLASTY: FIVE-YEAR RESULT

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Background: Previously, we reported two-year findings from a randomized controlled trial comparing a second-generation uncemented trabecular metal-backed (TM) glenoid versus cemented polyethylene glenoid (POLY) in patients undergoing a total shoulder arthroplasty (TSA). The purpose of the current study is to report five-year results from this trial.

Methods: Approval was obtained from our ethics board. Five surgeons from three centres participated. Patients 18-79 years with a primary diagnosis of glenohumeral osteoarthritis were screened for eligibility and invited to participate. Randomization to an uncemented TM or cemented POLY glenoid was performed intra-operatively after adequate bone stock was confirmed. Study intervals were baseline, two- and five-years postoperative. The primary outcome was the Western Ontario Osteoarthritis Shoulder (WOOS) score. Secondary outcomes included the ASES score, EQ5D, SF-12, clinical and radiographic exams. Radiographic images were reviewed for metal debris according to Endrizzi. Sample size was 34 patients per group based on the WOOS. An additional 14 patients per group were recruited to account for attrition. Mixed effects repeated measures ANOVA for within and between group comparisons were performed.

Results: Of the 104 patients consented, 93 were randomized (46 TM; 47 POLY). There were no group differences at baseline (TM: 66.5yo (6.4); 24M/22F and POLY: 68.4yo (5.5); 23M/24F). No statistical differences were found with patient-reported or functional outcomes between groups at five-years postoperative. Mean (SD) WOOS scores at baseline, two- and five-years were: TM: 32 (21), 92 (13), 93 (11) and POLY: 27 (15), 93 (11) and 93 (10), respectively. Metal debris was observed in 11 (23.9%) patients, but outcomes were not negatively impacted. Debris severity was minor (Grade 1-2). Seven patients in each group experienced a complication. Of these, 6 (13%) TM and 4 (8.5%) POLY required a re-operation or revision. Only one patient experienced a glenoid-related complication that required revision (a TM glenoid that loosened due to infection).

Conclusions: At five-years postoperative, there were no statistically or clinically significant differences between implants with respect to patient-reported outcomes, shoulder function, and complication rates. Metal debris was observed in 23.9% of patients with a TM glenoid but did not negatively influence implant survival, patient-reported outcomes, or shoulder function.

FP.02.03

GLENOID LATERALIZATION AND SUBSCAPULARIS REPAIR ARE INDEPENDENT PREDICTIVE FACTORS OF IMPROVED INTERNAL ROTATION AFTER REVERSE SHOULDER ARTHROPLASTY

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Background: Reverse Shoulder Arthroplasty (RSA) has demonstrated improvements in clinical outcomes for various conditions, but some have expressed concerns regarding the restoration of active internal rotation (AIR). The current study assesses the preoperative and intraoperative predictive factors of AIR in patients operated with a Grammont-style RSA with a minimum 5-year follow-up.

Methods: Retrospective multicentric study including patients operated with a 155° Grammont-style RSA for cuff-related pathology or primary osteoarthritis with posterior subluxation and/or associated cuff tear. Patients were clinically evaluated at a minimum of 5 years follow-up. Patients with previous surgery and those who had undergone a tendon transfer with the RSA were excluded. Demographic parameters, BMI, preoperative notes and operative reports were harvested from medical records. AIR was graded according to the Constant score system from 0 to 10.

Results: A total of 280 shoulders in 269 patients (mean age at surgery, 74.9 ± 5.9 years) met the inclusion criteria and were analyzed. The average follow-up was 8.1 years (range, 5–16 years). Overall, AIR increased from 4.2 (SD 2.5, range 0 to 10) preoperatively to 5.9 (SD 2.6, range 0 to 10) at the final follow-up. At the last follow-up, AIR increased in 56% of cases, remained unchanged in 26% and decreased in 18%. In 188 shoulders (67%) internal rotation was functional and allowed patients to reach the level of L3 or higher. Multivariable linear regression found the following preoperative clinical factors to be predictive of worse AIR after RSA: male gender ($\beta = -1.25$ [-2.10; -0.40]; $p = 0.0042$) and higher values of BMI ($\beta = -0.085$ [-0.17; -0.0065]; $p = 0.048$). Two surgical factors were associated with better AIR after RSA: glenoid lateralization with BIO-RSA technique ($\beta = 0.80$ [0.043; 1.56]; $p = 0.039$) and subscapularis repair ($\beta = 2.02$;0.29] 1.16]; $p = 0.0092$).

Conclusions: At a mean of 8 years follow-up (5 to 16 years), internal rotation was functional (L3 level or higher) in 67% of the operated shoulders after Grammont-style RSA, but 2 patients out of 10 experienced decreased AIR after surgery. Male patients and patients with higher BMI have poorer AIR, and glenoid lateralization (with BIO-RSA technique) and subscapularis repair are predictive factors of increased AIR after RSA.

FP.02.04

INCREASED ECONOMIC BURDEN AND CLINICAL IMPACT OF INCIDENTAL FINDINGS FROM PREOPERATIVE COMPUTED TOMOGRAPHY FOR TOTAL SHOULDER ARTHROPLASTY

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Background: 3D planning software for shoulder arthroplasty recently emerged for aiding in intraoperative determination of native glenoid. These protocols often require increased scan resolution, however, raising the question of an increased prevalence and clinical impact of incidental findings (IFs) from preoperative imaging.

Methods: A retrospective review of preoperative shoulder CT reports was conducted for 333 consecutive patients planning anatomic or reverse total shoulder arthroplasties. Patients with thin-sliced CT scans (1.25 mm) were compared with those with standard CT scans (2.5 mm). Poisson regression was performed with baseline characteristics and potentially pathologic IFs (PPIFs).

Results: IFs were present in 131 of the 333 scans (39.3%), and 38 of the 333 scans (11.4%) included PPIFs. Only 8 of the 333 scans (2.4%) required workup, with 2 of the 333 (0.6%) leading to new cancer diagnoses. Thin-sliced CT scans detected a higher mean number of IFs (1.12 versus 0.22, $P = 0.001$) while the mean number of PPIFs remained similar (0.13 versus 0.10, $P = 0.43$).

Conclusions: IFs are frequent; however, only 0.6% scans led to new cancer diagnoses. Comparison of thin-sliced with standard CT scans revealed a higher frequency of IFs but similar PPIFs, indicating increased burden of IFs without the benefit of identifying additional malignancies. As demand rises for shoulder arthroplasties, surgeons should consider the potential hidden costs of IFs when using 3D planning programs.

FP.02.05

HOW DOES HUMERAL LATERALIZATION AFFECT JOINT FUNCTION? A BIOMECHANICAL OBSERVATION USING A "SMART" RSA

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Background: Optimizing soft tissue tension during Reverse Total Shoulder Arthroplasty (RTSA) is crucial to patient outcome. The objective of this study was to evaluate the force transmission change and the effects on motion using two different liner thicknesses in a humeral tray. We hypothesized that with increasing lateralization, there would be an increase in observed intra-articular force and a corresponding loss in passive range of motion.

Methods: A biomechanical study was performed on a single cadaveric specimen using a smart RTSA prototype (Goldilocks® - Statera Medical). This system is designed with an internal proprietary sensing system, and adjustment mechanism inside the metal tray and allows real-time monitoring of intra-articular pressures and joint kinematics. We assessed joint pressures and kinematics at 20° and 40° of flexion, 20° of extension and 30° of abduction. For each position, the arm was initially internally rotated followed by external rotation. The load (Newtons) and the direction of the resultant force applied on the implant were compared for different thicknesses (0 mm and 1.5 mm). Each sequence of movements was repeated three times.

Results: When increasing construct thickness, we noted a significant increase of the average loads on the implant in external rotation for each elevation (20° extension: increase of 25.1% (20.658 N); 30° abduction: increase of 40.8% (16.490 N); 20° flexion: increase of 25.4% (14.488 N); 40° flexion: increase of 19.9% (11.957 N)) with a re-centralization and a decrease in the load dispersion towards the center of the humeral liner. Finally, we found a limitation of range of motion in external rotation. In fact, given a fixed external rotation angle we notice a significant increase in the magnitude of force for each elevation (20° extension: increase of 57.7% (42.420 N); 30° abduction: increase of 153.2% (37.965 N); 20° flexion: increase of 42.6% (26.254 N); 40° flexion: increase of 34.4% (24.316 N)).

Conclusions: This preliminary biomechanical analysis provides the first insights into joint loads and kinematics as a function of implant thickness. Data obtained using this type of device (Goldilocks® - Statera Medical) could guide surgeons in finding the proper implant balance during RTSA.

FP.02.06

INFLUENCE OF DESIGN OF REVERSE SHOULDER ARTHROPLASTY ON AXIAL ROTATION: A SYSTEMATIC REVIEW

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Background: Restoration of external and internal rotation (ER and IR) after Grammont-style reverse shoulder arthroplasty (RSA) is often unreliable. One purported solution is the use of lateralized implants. The objective of this meta-analysis was to compare axial rotation after RSA based on degree of implant lateralization.

Methods: We conducted a systematic review per PRISMA recommendations. A bibliographic search was performed for MEDLINE, Embase, Scopus, Web of Science, and Cochrane Library. Study quality was assessed per MINORS criterion. Inclusion criteria were studies evaluating axial rotation (ER, IR, or both) after RSA with a defined implant design. Our primary aim was to compare postoperative ER and IR between globally lateralized versus medialized implants after RSA. Implant classification was adopted from Werthel et al. Demographics and outcomes were reported as weighted means and pooled proportions. Meta-analysis was conducted using a random-effects model.

Results: Thirty-nine studies reporting 3,184 shoulders were included. Included patients had a weighted mean age of 72 years, mean follow-up of 48 months, minimum follow-up of 29 months (range: 21-62), and 64% were female. The subscapularis was repaired in 84% (n=2,690) shoulders; this was performed at a marginally higher rate when a lateralized implant was used (88% vs. 82%, P<0.001). Postoperative ER was reported by 97% (n=38) of studies and had a weighted mean of 30.7° (range: 9.9-47.6°). Both pre- and postoperative ER were reported by 77% (n=30); the weighted mean improvement in ER was 12.8° (range: -0.3-42°). The weighted mean improvement in ER was 14.5° for lateralized and 9.7° for medialized implants. Meta-analysis of postoperative ER was possible for 27 studies reporting 2,213 shoulders; we found significantly greater postoperative ER with a globally lateralized versus medialized implant (37°[95%CI:34-40°] vs. 26°[22-31°], P<0.001). Mean postoperative IR was reported by 54% (n=21) of studies. Mean postoperative IR achieved the minimum necessary internal rotation by 56% with lateralized (n=858, 8 studies) versus 35% (n=166, 4 studies) with medialized implants (P<0.001). Heterogeneity in reported IR prohibited quantitative analysis.

Conclusions: Lateralized RSA produces superior rotation compared to medialized designs. Standardization of IR reporting after RSA is needed for future meta-analyses.

FP.02.07

EARLY MORBIDITY AND MORTALITY AFTER ONE-STAGE BILATERAL SHOULDER ARTHROPLASTY

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Background: One-stage bilateral shoulder arthroplasty allows a single hospitalization with a single anesthesia and has been little reported compared to 1-stage bilateral hip and knee arthroplasty, which have demonstrated their interest. The aim of the present study was to determine peri- and early post-operative morbidity and mortality, which has not been clearly assessed. The study hypothesis was that peri- and early post-operative morbidity and mortality in 1-stage bilateral shoulder arthroplasty is low in selected patients and that satisfaction is high.

Methods: It was a monocentric retrospective study that assessed the peri- and early post-operative morbidity and mortality in 1-stage bilateral shoulder arthroplasty. Twenty-one patients, under 80 years old with ASA score less than or equal to 3, were consecutively included between 1999 and 2020 for total shoulder arthroplasty. Perioperative complications and postoperative subjective and objective outcomes were noticed at a mean follow-up of 6 ± 3 months.

Results: No early deaths were noticed. The intraoperative complication rate was 7% with one brachial plexus palsy with spontaneous recovery, one glenoid fracture that required intraoperative adaptation and one drill-bit broken in glenoid. The mean blood loss was 145 ± 40 cc, surgery time was 164 ± 63 min, and the hospital stay was evaluated at 4 ± 5 days. Only 1 patient required a postoperative transfusion. Functional results at 6 months showed significantly improved mean range of motion: $+58^\circ$ ($p<0.001$) of anterior elevation, $+23^\circ$ ($p<0.001$) of external rotation and $+4/10$ of internal rotation ($p<0.001$). The satisfaction was overall good with 95% patients "very satisfied" or "satisfied". No post operative prosthesis dislocation or sepsis was reported.

Conclusions: One-stage bilateral shoulder arthroplasty was feasible in selected patients. Mortality was null and morbidity was low. Surgery time was reasonable and required no repositioning. Bilateral shoulder replacement requires good blood optimization but can be performed even in cases of associated comorbidities in patients with an ASA score less than or equal to 3. Postoperative adapted management is mandatory for patient satisfaction during rehabilitation.

FP.02.08

USE OF CUSTOM GLENOID COMPONENTS FOR REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: Severe glenoid bone loss in reverse total shoulder arthroplasty (RTSA) presents substantial challenges, with high failure rates with bone grafting. Custom glenoid components have been reported to be a viable solution for those with large bone defects. However, the strengths and limitations of using these implants have not previously been described. The purpose of the present study was to evaluate short-term clinical outcomes and complications after RTSA when using a custom glenoid baseplate.

Methods: This is a retrospective case series from a single institution of 29 patients for whom a custom glenoid component was created between 2017 and 2022 for extensive glenoid bone loss. 25 were studied retrospectively between 1 and 51 months, with 9 having a minimum of 2-year follow-up. Patient-reported outcome measures were recorded preoperatively for all patients and repeated at 1 and 2 years postoperatively. All intraoperative and postoperative complications were reported.

Results: Of the 25 patients who underwent the procedure, a custom implant was unable to be matched in 3. For these patients, the length of time from CT scan to implantation of their respective glenoid components averaged 7.6 months, compared with 5.5 months for those implanted with no difficulty. There were 7 intraoperative complications: 5 greater tuberosity fractures, 1 proximal acromial fracture, and 1 medial calcar fracture. There was no failure of the glenoid component in any patient, including the 9 with at least 2-year follow-up.

Conclusions: Custom glenoid components show promise in the treatment of substantial glenoid bone loss but are not without challenges. This study showed that a prolonged time of >6 months from CT scan to device implantation resulted in bone loss that rendered the implants unusable. When the device does fit the glenoid, satisfactory short-term radiographic and clinical follow-up at a minimum of 2 years were achieved.

FP.03.01

THROWING ARM KINETICS AND BALL VELOCITY IN HIGH SCHOOL PITCHERS WITH 'OVERALL FAST' AND 'OVERALL SLOW' CUMULATIVE JOINT/SEGMENT VELOCITIES

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Background: Individual maximum joint and segment velocities (ie. pelvis rotation, trunk rotation, shoulder internal rotation, etc.) have shown positive associations with throwing arm kinetics/ball velocity in baseball pitchers. The purpose of this study was to observe how cumulative maximum joint and segment velocities, irrespective of sequence, may impact ball velocity/throwing arm kinetics in high school pitchers.

Methods: High school (n=55) pitchers threw 8-12 fastball pitches while being evaluated with 3D-motion capture (480 Hz). Maximum joint and segment velocities (lead knee extension, pelvis rotation, trunk rotation, shoulder internal rotation, forearm pronation) were calculated for each pitcher. Pitchers were classified as 'Overall Fast', 'Overall Slow', or 'High Velocity' for each joint or segment velocity subcategory, or as 'Population', with any pitcher eligible to be included in multiple subcategories. Kinematic and kinetic parameters were compared among the various subgroups via T-tests with post-hoc regressions and multi-variable regression models created to predict throwing arm kinetics and ball velocity, respectively.

Results: The Lead Knee Extension and Pelvis Rotation velocity subgroups achieved significantly higher normalized elbow varus torque ($p_{max}=0.016$) and elbow flexion torque ($p_{max}=0.018$) compared to Population, with equivalent ball velocity ($p_{max}=0.118$). For every 1 standard deviation increase in maximum pelvis rotation velocity ($87^\circ/s$), normalized elbow distractive force increased by 4.7% Weight (BW) (B: 0.054, β : 0.290 p : 0.013). The 'Overall Fast' group was older (16.9 ± 1.4 vs. 15.4 ± 0.9 yrs. respectively, $p=0.007$), had 8.9 MPH faster ball velocity (32.7 ± 3.1 vs. 28.7 ± 2.3 m/s respectively, $p=0.002$), and had significantly higher shoulder internal rotation torque (4.7 ± 0.6 vs. $3.7\pm 0.8\%$ BWx Height [BH] respectively, $p=0.003$), elbow varus torque (61.8 ± 16.4 vs. $41.6\pm 11.4\%$ BWx BH respectively, $p=0.001$), and elbow flexion torque (3.5 ± 0.4 vs. $2.5\pm 0.5\%$ BWx BH respectively, $p<0.001$) compared to the 'Overall Slow' group. A multi-regression model for ball velocity based on maximum joint and segment velocities and anthropometrics predicted 53.0% of variance.

Conclusions: High school pitchers with higher combined maximum joint and segment velocities, irrespective of sequence, demonstrated older age and faster ball velocity at the cost of increased throwing shoulder/elbow kinetics. Pitchers and coaching staff should consider this trade-off between ball velocity and greater throwing arm kinetics with faster joint and segment velocities.

FP.03.02

PREMATURE LATERAL COMPARTMENT PHYSEAL CLOSURE IN OSTEOCHONDRITIS DISSECANS OF THE ELBOW

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Background: The status of capitellar physeal closure is critical to determine treatment plans in adolescent osteochondritis dissecans (OCD). The purpose of this study is to identify bilateral differences of physeal closure of the lateral compartment of the elbow in osteochondritis dissecans (OCD) and related factors with early premature physeal closure.

Methods: Initial anteroposterior radiographs of the bilateral elbows in 40 baseball players with capitellar OCD (mean age: 12.8 years, Group I) were reviewed for the status of physeal closure of the lateral compartment; capitellum, radial head, lateral epicondyle. Radiographs of 40 baseball players with medial epicondylar apophysitis without OCD (mean age: 12.2 years, Group II) were enrolled as control. As compared with nondominant elbow, we defined the relative status of physeal closure of dominant elbow as early, same, and delayed. Statistical differences between groups were evaluated regarding the status of physeal closure. In OCD group, bilateral differences of the status of physeal closure were analyzed according to the associated demographic factors, radiographic stages and the extent of OCD lesions.

Results: Significant bilateral differences of physeal closure of the lateral compartment were found between groups ($p=0.002$). In group I, early physeal closures were identified in capitellum (55%), in radial head (53%) and in lateral epicondyle (38%) of dominant elbows. In group II, 38 players (95%) showed the same status of physeal closure of the lateral compartment. In group I, increased BMI ($p=0.654$), position of players ($p=0.346$) were not statistically significant factors associated with early physeal closure, but OCD players with longer career length showed early closure ($p=0.011$). Players with advanced radiographic stage (stage II, $p=0.024$ and III, $p=0.001$) or extended lateral lesion ($p=0.012$) showed significant early physeal closure of the lateral compartment, especially in capitellum and radial head.

Conclusions: In the initial presentation, over the half of the adolescent baseball players with OCD demonstrated early radiocapitellar physeal closures in dominant elbow. Players with longer career length, more advanced or extensive lesions may exhibit premature closure of the lateral compartment physes. In addition to the altered articular congruity caused by OCD lesion, premature physeal closure may also contribute to development of arthritis without appropriate radiocapitellar remodeling.

FP.03.03

ASSESSMENT OF ULNAR COLLATERAL LIGAMENT OF ELBOW BY SHEAR WAVE ELSTOGRAPHY ULTRASOUND IN COLLEGE BASEBALL PLAYERS

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Background: The ulnar collateral ligament(UCL) is known to be a primary stabilizer against valgus stress in overhead throwing athletes. The purpose of this study was to evaluate the elasticity of the UCL of elbow by shear wave (SW) elastography in college baseball players under resting and valgus stress conditions.

Methods: 27 college baseball players with sixty elbows were enrolled (mean age 20.48 ± 1.34 years). The thickness of UCL at two points (just above the coronoid process and at the center of ulno-humeral joint) and the gap of the ulnohumeral joint were measured. Elastography of UCL were obtained two ROIs at the same point in resting and valgus stress condition. The elbows are divided into two groups; throwing arm vs. non-throwing arm, lax arm vs. non-lax arm. Correlation analysis and multiple regression analysis were used to identify relationship between evaluation parameters and changing rate of ulno-humeral gap in valgus stress.

Results: Throwing arms had increased ulno-humeral gap at resting and valgus stress condition than non-throwing arms ($p=0.022$, $p=0.002$). The mean thickness of UCL at the center of ulno-humeral joint were 0.76 ± 0.27 mm in throwing arm and 0.58 ± 0.17 cm in non-throwing arm ($p=0.009$). There were no significant differences in thickness and SW velocity between lax arm and non-lax arm. However, in throwing arms, SW velocity of lax arm (45.01 ± 21.09 kPa) was significantly decreased than non-lax arm (72.97 ± 26.75 kPa) ($p=0.005$). The thickness and SW velocity of UCL at the center of ulno-humeral joint were significantly correlated with the changing rate of ulno-humeral gap. ($r= 0.334$ and -0.317 , $p = 0.014$ and $p = 0.019$). The thickness and SW velocity of UCL were significantly and independently correlated with the changing rate of ulno-humeral gap.

Conclusions: Valgus laxity of elbow joint can be evaluated by elasticity of ulnar collateral ligament measured with shear wave elastography at resting condition. Even with thick ulnar collateral ligament, the function can be decreased, so the physicians should not evaluate the joint status only with radiographic findings.

FP.03.04

CONSERVATIVE TREATMENT OF CAPITELLAR OSTEOCHONDRITIS DISSECANS IN YOUNG BASEBALL PLAYERS: IS ANNUAL ULTRASOUND ELBOW SCREENING EFFECTIVE?

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Background: Capitellar OCD can be diagnosed by ultrasonography, and we have been recommending annual ultrasound (US) elbow screening for young baseball players in our community since 2008. The purpose of this study was to compare the results of conservative treatment of OCD detected by US elbow screening with those of OCD diagnosed only after a direct visit to a hospital and to investigate the usefulness of US elbow screening for young baseball players.

Methods: During 2009-2019, 263 baseball players were diagnosed with capitellar OCD and 250 cases were followed up longer than 12 months were enrolled in this study (follow-up rate; 95.1%). The patients were divided into a US screening group and a hospital group according to whether the diagnosis of OCD was made by US elbow screening or direct hospital visit. Stage of the OCD, results of conservative treatment were studied. The results were statistically compared between the two groups. A p-value of <0.05 was considered significant.

Results: There were 158 patients in the US screening group and 92 patients in the hospital group. In terms of the stage of the OCD at the time of initial examination, percentage of the patients in the US screening group of the stage I, II and III were 60.8%, 31.0%, and 8.2%, respectively, while 21.5%, 41.9%, and 35.5% of the patients in the hospital group were in the stage I, II, and III, respectively. The results of conservative treatment showed that 60.8% of patients in the US screening group had complete healing, 12.0% had partial healing, and 27.2% had surgery. On the other hand, 18.5% of patients in the hospital group resulted in complete healing, 10.9% resulted in partial healing, and 70.7% underwent surgery. Complete healing was significantly more common in the US screening group, and surgery was significantly more common in the hospital group ($p < 0.01$).

Conclusions: The efficacy of US elbow screening is that it can detect capitellar OCD at an early stage and lead to conservative healing of the lesion in a higher percentage of patients. US elbow screening had a positive impact on the outcome of conservative treatment of capitellar OCD.

FP.03.05

SHOULDER AND ELBOW INJURIES IN TAIWAN ELITE HIGH SCHOOL BASEBALL PITCHERS. A DESCRIPTIVE EPIDEMIOLOGY STUDY

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Background: Early detection of potential risk factors for elbow injuries like ulnar collateral ligament (UCL) injuries in young baseball players is important, especially in early stage. Ultrasonographic structural abnormalities have been regarded as a “pre-injury” status of elbow injuries. Also, some studies report the relationship between elbow injuries and shoulder/elbow range of motion (ROM). To determine the relationship between shoulder/elbow ROM and elbow ultrasonographic structural abnormalities in Taiwan high school baseball players.

Methods: A total of 533 Taiwan high school baseball players were included in this study. The demographic data were recorded. Physical examinations including measurements on shoulder/elbow ROM and elbow sonographic examinations were performed and recorded by professional physicians. The analyses were conducted in three subgroups, all players pooled, pitchers-only, and fielders-only, due to several demographic differences among these subgroups. In all the subgroups, univariate analyses were conducted separately for participants with and those without elbow ultrasonographic structural abnormalities, and then multivariate analyses were conducted to identify factors significantly related. The odds ratios (ORs) were used to estimate the risk of elbow ultrasonographic structural abnormalities.

Results: Demographic data showed that taller height ($p < 0.001$) and greater elbow flexion/extension ROM ($p < 0.001$) were related to being pitchers. One year younger starting to play baseball (all players: OR, 1.202; $p = 0.003$), one more year of official baseball attendance (all players: OR, 1.154; $p = 0.008$ | pitchers: OR, 1.342; $p = 0.004$), one less degree of shoulder total rotation angle (all players: OR, 1.007; $p = 0.050$ | pitchers: OR, 1.016; $p = 0.006$), and one less degree of elbow total flexion/extension angle (all players: OR, 1.052; $p = 0.003$ | pitchers: OR, 1.075; $p = 0.004$), were significantly related to ultrasonographic elbow structural abnormalities, while there was no significant risk factor in fielder subgroup.

Conclusions: For Taiwan high school baseball players, especially in pitchers, longer official baseball experience, decreased shoulder total rotational angle, and decreased elbow total flexion/extension angle, were related to ultrasonographic structural abnormalities, which may serve as pre-injury status of elbow.

FP.03.06

THE FLEXION INITIATION TEST AND AN EVIDENCE-BASED DIAGNOSTIC ALGORITHM FOR DISTAL BICEPS TENDON TEARS

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Background: The purpose of this study was (1) to assess the flexion initiation test's (FIT) ability to detect distal biceps tendon tears (DBTT) in a cohort of consecutive patients presenting with elbow pain and (2) to generate a reliable evidence-based diagnostic algorithm using a combination of both the FIT and hook tests.

Methods: We performed a retrospective review of 125 consecutive patients who presented with elbow pain, all of which had the FIT and hook test performed prior to imaging/further intervention. The integrity of the tendon was determined during surgery or by magnetic resonance imaging. Sensitivity, specificity, positive predictive value, and negative predictive value were determined for the FIT and hook test.

Results: Our evidence-based diagnostic algorithm showed that when both test results are in agreement, there is a 100% diagnostic accuracy for detecting what prior have termed surgically indicated tears (complete ruptures and high-grade partial tears) and biceps pathology that can be treated with nonoperative management. The FIT demonstrated 100% sensitivity for surgically indicated tears. The hook test demonstrated 100% sensitivity for complete ruptures, but 18% sensitivity for diagnosing partial tears.

Conclusions: The FIT, which is aimed at improving diagnostic acuity of high-grade partial thickness tears, demonstrated a 93% sensitivity and 96% specificity overall and a 100% sensitivity for complete ruptures and high-grade partial tears. The evidence-based diagnostic algorithm using the combination of the FIT and hook test demonstrates high accuracy for the diagnosis of both complete and high-grade partial DBTTs. The methodology may help to prevent diagnosis delays, improve patient education, and preserve the option for timely primary surgical repair in the treatment of DBTTs.

FP.03.07

COMPARISON OF POSTOPERATIVE RESULTS OF OSTEOCHONDRAL AUTOGRAFT TRANSFER FOR CAPITELLAR OSTEOCHONDritis DISSECANS ACCORDING TO LESION SITE

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Background: Surgical treatment is generally used for capitellar osteochondritis dissecans (OCD) when conservative treatment has failed. Although good postoperative results have been reported for centrally located OCD, they are not always good for laterally located (lateral spread) OCD, and the choice of surgical technique is controversial. We perform osteochondral autograft transfer in patients with International Cartilage Repair Society (ICRS) grade 3 or 4 and lesions larger than 10 mm. The purpose of this study was to investigate the postoperative results of osteochondral autograft transfer according to the lesion location.

Methods: The patients were 81 young male athletes (average age, 13.4 years) who underwent osteochondral autograft transfer (6- or 8-mm diameter taken from the unloaded portion of the external femoral condyle) of OCD and were available for follow-up for more than 1 year. Treatment outcomes were evaluated by return-to-play rate, elbow range of motion (ROM), Japanese Orthopaedic Association-Japan Elbow Society Elbow Function (JOA-JES) score, and Timmerman-Andrews (T-A) score. Patients were divided into two groups: 40 patients with laterally located type (L-type) and 41 patients with centrally located type (C-type), and postoperative results of two groups were examined and compared.

Results: All patients returned to competition in both groups. From preoperative to postoperative, ROM was 128° flexion to 132° and -12° extension to -3.7° in L-type, 130° flexion to 134° and -5.6° extension to -1.4° in C-type, and JOA-JES score improved significantly from 53.7 to 90.0 in L-type and from 64.1 to 91.8 in C-type, and T-A score improved from 149 to 193 in L-type and from 166 to 196 in C-type. Only postoperative ROM in extension was slightly worse in L-type than in C-type ($P < 0.05$), but there were no significant differences in other parameters between two groups.

Conclusions: Osteochondral autograft transfer has provided good results regardless of the site of the OCD lesion. This technique may be useful for many ICRS grades 3 and 4 OCD lesions, but may require long-term follow-up to ensure that there is no future progression, such as arthropathic changes.

FP.03.08

ALL ARTHROSCOPIC AUTOLOGOUS OSTEOCHONDRAL GRAFTING FOR OSTEOCHONDRITIS DISSECANS OF THE HUMERAL CAPITELLUM

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Background: An osteochondritis dissecans of the humeral capitellum causes elbow pain during throwing motion. Capitellar OCD lesions classified as International Cartilage Repair Society (ICRS) category III (complete discontinuity) or IV (defect with a dislocated fragment) cannot heal without surgery. The objective of this study was to investigate clinical outcomes and rate of complete return to previous sports after all arthroscopic autologous osteochondral grafting (harvesting and inserting graft arthroscopically) for capitellar OCD lesions of ICRS category III or IV.

Methods: Ten competitive overhead athletes (mean age of 14.6 years; range, 13–16) who had undergone all arthroscopic autologous osteochondral grafting participated in this study. Of the 10 patients, there were 9 baseball players (6 infielders, 2 catchers, 1 pitcher) and 1 tennis player. Average career of baseball or tennis were 7.7 years (range, 4–10 years). Arthroscopic examination showed ICRS III in 4 players and ICRS IV in 6 players, and central type in 7 players, lateral type in 1 player, and both central and lateral types in 2 players. The OATS (Osteochondral Autograft Transfer System, Arthrex) is used for osteochondral grafting. The size and number of osteochondral grafts are determined from the size of the lesion. Cylindrical osteochondral grafts (6 to 10 mm in diameter and 10 to 15 mm long) are harvested arthroscopically from the superior lateral edge of the lateral femoral condyle. The harvested osteochondral grafts were inserted arthroscopically into the capitellum. Elbow range of motion (ROM), JOA-JES sports score, rate of complete return to sports, surgical complication, and healing rate were assessed.

Results: Elbow ROM and JOA-JES sports score were significantly increased after surgery (extension: -10 to -2 degrees, $p=0.01$, flexion: 124 to 138 degrees, $p=0.02$, JOA-JES sports score: 52.4 to 98.5, $p<0.0001$). All ten patients (100%) had healed grafts in postoperative CT and/or x-ray and returned to sports completely without any elbow and knee pain at 6.6 months (6–9 months) after surgery. No surgical complication was found.

Conclusions: For osteochondritis dissecans of the humeral capitellum in ICRS III or IV, all arthroscopic autologous osteochondral grafting could provide pain relief, functional improvement and high rate of complete return to sports without any surgical complication.

FP.04.01

CONSERVATIVE TREATMENT ACHIEVES COMPARABLE CLINICAL RESULTS IN PATIENTS WITH ACUTE ROCKWOOD TYPE V AC-DISLOCATIONS COMPARED TO AN ARTHROSCOPICALLY-ASSISTED ACROMIO- AND CORACOCCLAVICULAR STABILIZATION

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Background: Little evidence supports the claim, that patients with acute Rockwood type V acromioclavicular dislocation would significantly benefit from surgical treatment compared to conservative treatment. Our aim was to evaluate clinical and radiological outcomes of these patients treated conservatively and compare to patients treated operatively with an arthroscopically-assisted acromio- and coracoclavicular stabilization.

Methods: Patients with an acute Rockwood type V dislocation, who were treated conservatively and had a minimum follow-up of 1 year were included (N=32) and matched according to their age, sex and affected side with patients, who underwent an arthroscopically-assisted acromio- and coracoclavicular stabilization because of an acute Rockwood type V dislocation (N=32). Associations between radiological (coracoclavicular (CC) difference ratio between injured and healthy side) and clinical outcome parameters, including Constant Score (CS), Subjective Shoulder Value (SSV), Taft score (TS), Acromioclavicular Joint Instability (ACJI) Score, Nottingham Clavicle Score (NCS) and visual analog scale (VAS) were evaluated.

Results: Mean age and mean follow-up of both groups did not differ (43.4 ± 16 vs 43.7 ± 14 years, $p=0.7$ and 57 ± 46 vs. 54 ± 40 months, $p=0.5$, respectively). No statistically differences were seen in mean PRO scores except constant score in favor of conservative group: CS: 92 ± 7 vs. 87 ± 13 , $p=0.047$; SSV: 90 ± 10 vs. 92 ± 9 , $p=0.5$; TS: 10 ± 1.5 vs. 10 ± 2 , $p=0.9$; ACJI: 76 ± 13 vs. 72 ± 16 , $p=0.3$; NCS: 91 ± 7 vs. 87 ± 15 , $p=0.2$; VAS: 0.8 ± 1 vs. 1.2 ± 2 , $p=0.4$. CC difference ratio has significantly decreased in conservative group at the time of last follow-up compared to day of diagnosis (1.7 ± 0.5 vs. 2.3 ± 0.4 , $p<0.001$, respectively) and all patients except 3 were downgraded to a Rockwood type III dislocation at the last follow-up.

Conclusions: Both conservative and surgical treatment lead to excellent restoration of shoulder function and patient satisfaction with no difference between both treatment options in patients with acute Rockwood type V AC dislocations. There seems to be a spontaneous downgrading from type V to III over time if treated conservatively.

FP.04.02

BRISTOW VERSUS LATARJET IN HIGH-DEMAND ATHLETES WITH ANTERIOR SHOULDER INSTABILITY: A PROSPECTIVE RANDOMIZED COMPARISON

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Background: Traumatic anterior shoulder instability is a common disease. The Latarjet and Bristow techniques are nonanatomical surgeries indicated in cases at a high risk for recurrence and in the presence of associated bone lesions, but they have important differences, and should not be considered synonymous. The objective of this study was to prospectively compare the Bristow and Latarjet techniques in high-demand athletes. Hypothesis: Bristow and Latarjet techniques lead to similar results.

Methods: Thirty-seven athletes (41 shoulders; three athletes underwent bilateral surgery) with anterior recurrent dislocation of the shoulder that was surgically treated using the Bristow or Latarjet technique were prospectively analyzed. The follow-up time was 5 years. The mean age was 26.4 years (range: 16-46 years). In 17 cases (41.5%), the dominant side was not affected.

Results: Elevation and external rotation (passive and active) decreased in the early postoperative period and achieved values in the final follow-up similar to those found in the preoperative period. The mean postoperative scores at 5 years were as follows: ASES, 79.1 (range: 66-95); ASORS, 77.8 (range: 60-100); WOSI, 52.6 (range: 18-77); and VAS, 1.88 (range: 0-6). All of the results presented statistical significance. There was a complication rate of 9.75% in the follow-up period. There were no new dislocations after the surgery. Most (75%) of the athletes returned to the sport after the surgery, and there was no correlation between poor results and any of the variables studied. There was a statistically significant difference in passive external rotation in favor of the Latarjet technique four weeks after surgery ($P = .01$). We also found a statistically significant difference in passive elevation in favor of the Latarjet technique eight weeks after the surgery ($P = .04$). When we compared the Bristow and Latarjet techniques regarding the ASES, ASORS, and WOSI scores, we found no statistically significant difference. In the comparison regarding whether the athletes returned to sports, we found no statistically significant difference.

Conclusions: The Bristow and Latarjet techniques lead to good results in athletes with no new dislocation episodes and are suitable for treating patients with anterior recurrent dislocation of the shoulder.

FP.04.03

RECURRENT ANTERIOR DISLOCATIONS IN ELDERLY PATIENTS WITH MASSIVE IRREPARABLE CUFF TEARS: OUTCOMES OF THE ARTHROSCOPIC TRILLAT PROCEDURE

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Background: The association of massive irreparable rotator cuff tears (MIRCTs) with recurrent anterior shoulder dislocations is a rare combination, mainly observed in older patients (over 40 years). The purpose of the present study is to report the results of the arthroscopic Trillat procedure for the treatment of recurrent anterior instability in patients with chronic MIRCTs and conserved active shoulder motion, where RSA is not indicated.

Methods: Twenty-one consecutive patients (mean age 61 years) were identified and retrospectively reviewed. All patients had recurrent anterior dislocations with no shoulder pain and conserved active forward elevation (AFE) and active external rotation (ARE). The MIRCTs included a retracted (stage 3) supraspinatus tear in 14%, a supra- and infraspinatus tear in 76.5%, and a 3-tendon tear in 14%. A closed wedge osteotomy of the coracoid was performed, and the coracoid was fixed above the subscapularis with a cannulated screw (10 cases) or suture-buttons (11 cases). We followed patients with x-rays, CT scan at 6 months, Subjective Shoulder Value, VAS, Walch, Constant, and Rowe scores. The mean clinical and radiographic follow up was 58 months (24-145 months).

Results: Overall, 96% (20/21) of the patients had a stable and functional shoulder and were satisfied with the procedure; no patient lost active shoulder motion. Only one patient was revised to RSA because of a fall after surgery. The Subjective Shoulder Value increased from 44% (10-75) to 94% (80-100), $p < 0.001$. The Constant and Rowe scores improved from 60 (25-81) to 81 (66-96) and from 54 (35 to 65) to 92 (70-100), respectively ($p < 0.001$). Among the 13 patients practicing sports before surgery, 10 (77 %) went back to sports.

Conclusions: The arthroscopic Trillat procedure is a valuable and durable option for the treatment of recurrent anterior dislocations in patients with chronic MIRCTs and conserved active shoulder motion.

FP.04.04

BIOMECHANICAL ANALYSIS OF ANTEROINFERIOR BANKART REPAIR ANCHOR TYPES: HAS TECHNOLOGY SURPASSED SURGEON TECHNIQUE?

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Background: All-suture anchors and knotless anchors are increasingly used in repair of anteroinferior labral tears in patients with shoulder instability. Optimal repair constructs may limit recurrent instability. Our purpose is to perform a quantitative biomechanical comparison of three labral fixation devices for soft-tissue Bankart lesions: soft tensionable knotless anchor (SB knotless), knotted soft anchor (SB knotted), knotless interference polyetheretherketone (PEEK) hard anchor (HB knotless).

Methods: Twenty-one glenoid cadavers were randomized to 3 groups: SB knotless, SB knotted, and HB knotless. Artificial Bankart lesions were created at the anteroinferior labrum. Anchors were placed at the 3:30, 4:30, and 5:30 positions, and sutures were passed through 1cm of tissue. Anchors were tested simultaneously as one construct by pulling the capsular tissue connected to the anteroinferior quadrant. Cyclic loading (5-25 N, 100 cycles) was followed by load-to-failure testing (15mm/min). Mechanical testing variables were collected, and failure mechanisms were recorded per individual anchor.

Results: There were no differences in baseline cadaver characteristics. There was no difference in cyclic elongation during cyclic loading ($p=0.40$). Ultimate load to failure between SB knotless (309.7 ± 125.6 N), SB knotted (226.40 ± 34.8 N), and HB knotless (256.5 ± 90.5 N) did not significantly differ ($p=0.25$). Failure mechanisms significantly differed among groups; mechanisms included anchor pull-out (SB knotless 33.3%; SB knotted 23.8%; HB knotless 28.6%), suture pull-through (SB knotless 66.7%; SB knotted 38.1%; HB knotless 33.3%), and anchor fixation failure, defined as knot failure for knotted anchors or locking mechanism failure for knotless anchors (SB knotless 0%; SB knotted 38.1%; HB knotless 38.1%) ($p=0.008$).

Conclusions: The SB knotless, SB knotted, and HB knotless labral fixation anchors studied exhibit comparable elongation during cyclic loading, stiffness, and ultimate loads to failure. However, the SB knotless anchor avoids the risk of knot failure and interference failure inherent to SB knotted and HB knotless interference anchors, respectively, while providing enhanced benefits to the surgeon.

FP.04.05

IDENTIFICATION OF THE PATHOANATOMIC METRICS OF THE GLENOHUMERAL BONY LESIONS IN THE EPILEPTIC PATIENTS WITH ANTERIOR SHOULDER INSTABILITY: A COMPARATIVE STUDY

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Background: Wrong management of the bone lesions in shoulder instability is a cause of surgical failure. Chronic epilepsy may cause important bipolar bony lesions. We aim to compare the specific pathoanatomic metrics of the bony lesions in chronic shoulder instability that occur in the epileptic population vs non epileptic population. Our hypothesis was that in a population of patients with recurrent shoulder instability, epileptic patients have larger and more engaging bone lesions than non-epileptic patients.

Methods: From 2006 to 2020, we included epileptic and non-epileptic patients with anterior recurrent shoulder instability. We randomly adjusted the patients of the two groups according to the sex, age and type of management. We finally included 50 patients. For each included patient, we performed an in-depth CT-scan analysis and comparison of the glenoid bone loss: PICO method using the best-fit circle on the sagittal view; and the Hill-Sachs lesion: the depth and width were given as a percentage of the humeral head diameter on an axial view. We also evaluated the engaging character of the involved lesion using the On-track/Off-track analysis. Those characteristics were compared between the two groups.

Results: We found a glenoid bone loss in 32 patients (18 in the epileptic group and 14 in the non-epileptic group). Glenoid bone loss was not significantly greater in patients with epilepsy ($p=0,052$). A Hill-Sachs lesion was found in 42 patients (22 in epileptic group and 20 in non-epileptic group). Hill-Sachs lesions were significantly deeper and larger in the epileptic group. (depth: 22% vs 9%, $p=0,0001$; width: 43% vs 28%, $p=0,003$). In the epileptic group 90% of the bone lesions were OFF-track versus 30% in the non-epileptic group. Thus, the epileptic patients presented more engaging bony lesions than non-epileptic patients ($p=0,001$) (OR=23).

Conclusions: In a population of epileptic patients, Hill-Sachs lesions are larger and deeper than in patients with non-epileptic shoulder instability. By contrast, there is no significant difference regarding the characteristics of the glenoid bone loss if present. This implies that bone lesions in instable shoulders of epileptic patients' (previously stabilized neurologically) need at least a bony stabilization procedure on the humeral side in the majority of cases.

FP.04.06

ANATOMIC RECONSTRUCTION OF THE INFERIOR GLENOHUMERAL LIGAMENT DURING THE LATARJET PROCEDURE: A CADAVERIC FEASIBILITY STUDY

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Background: Although the Latarjet procedure has a high success rate, some studies report an 18% rate of persistent apprehension and 7% of recurrence. Multiple modifications have been described in the literature to achieve better outcomes. No reports in the literature describe the transfer of the coracoacromial ligament (CAL) for the anatomic reconstruction of the anterior band of the inferior glenohumeral ligament (AB-IGHL) as a Latarjet modification. Therefore, we present a cadaveric study to assess the feasibility of performing this technique.

Methods: Eleven shoulders from fresh human cadavers were prepared. A classic Latarjet procedure was performed, but instead of harvesting 1 cm of the CAL, a subperiosteal detachment was performed at its acromial insertion to obtain its full length. After coracoid positioning, the obtained CAL was prepared with Krackow stitches and fixed with an anchor to the humeral footprint of the AB-IGHL with the arm at 90 degrees of external rotation and 90 degrees of abduction (ER2), when possible (anatomical group). In cases when it wasn't long enough to reach the footprint, it was fixed directly to the subscapularis tendon (non-anatomical group).

Results: The mean length of the CAL was 38.09 ± 9.26 mm. Non-anatomical fixation was possible in 100% of cases, while anatomical fixation was possible in 73%. The difference in the average length of the CAL between the groups was statistically significant: 41.75 ± 7.88 versus 28.33 ± 3.78 mm; ($P=0.02$).

Conclusions: The anatomical reconstruction of the AB-IGHL using the CAL during the Latarjet procedure is feasible in 73% of the cases without limiting the normal range of motion of the glenohumeral joint.

FP.04.08

LEARNING CURVE AND SHORT-TERM COMPLICATIONS OF ARTHROSCOPIC LATARJET PROCEDURE WITH DOUBLE SUTURE-BUTTON FIXATION: THE FIRST LATIN AMERICAN EXPERIENCE

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Background: The arthroscopic Latarjet with suture-button fixation is a recently described procedure to address the anterior shoulder instability with anterior glenoid bone loss. This new fixation system avoid the potential hardware-related complications described with screws and has shown to be safe, reliable and with a low complication rate in a recent European experience publication.

Purpose: The aim of this study is to analyze the learning curve and describe the intraoperative and postoperative problems and complications encountered with the Arthroscopic Latarjet procedure during the first Latin American Experience reported with double suture-button fixation.

Methods: This was a prospective, nonrandomized and monocentric study that included 21 patients (18 males) with a mean age of 28 years underwent an arthroscopic Latarjet procedure with suture-button fixation for recurrent post-traumatic anterior shoulder instability performed between 2019 and 2022. The mean operative time and the adverse events (problems and complications) during the intraoperative and the postoperative period were reported.

Results: The first ten cases (48%) were intraoperatively converted to open in order to complete the procedure. In this group, the mean operative time was 208 min. The following eleven cases (52%) were completely performed under arthroscopy with a mean operative time of 193 min. The mean follow-up was of 18 months (24 months in the converted group and 12 months in all-arthroscopic group). Overall, the problem rate was 28,5% (10% in the converted group and 45% in the all-arthroscopic group) and the complication rate was 14,3% (20% in the converted group and 9% in the all-arthroscopic group). No major complications (infection or neurovascular injuries) and no hardware related-complications were observed.

Conclusions: The Arthroscopic Latarjet with double suture-button fixation is a safe and reliable procedure that exhibit similar complication rate as reported with open or all-arthroscopic screws fixation technique, with no implant-related complications. In our experience, it does not increase significantly the surgical time if conversion to open procedure is needed.

FP.05.01

THE INLAY STRUCTURE USED IN THE MODIFIED BRISTOW PROCEDURE ACCELERATED BONE UNION: A COMPARISON OF THE CHINESE UNIQUE INLAY BRISTOW PROCEDURE AND MODIFIED BRISTOW PROCEDURE

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Background: The Chinese Unique Inlay Bristow procedure (Cuistow) is a modified Bristow surgery in which an inlay (Mortise and Tenon) structure is added to the contact surface between the coracoid tip and the glenoid. The aim of this study was to compare the clinical and radiographic outcomes following the arthroscopic Cuistow procedure and the arthroscopic Bristow procedure.

Methods: We studied the records of 69 patients who underwent either the Cuistow procedure or the Bristow procedure (70 shoulders, 35 in Cuistow group and 35 in Bristow group) between January 2017 and March 2018. Clinical assessment for a minimum of 24 months, including VAS for pain, UCLA score, ASES score, ROWE score, SSV and active range of motion, was completed and compared to scores collected preoperatively. Radiological evaluations with 3D CT scans were performed preoperatively, immediately after the operation, and postoperatively at 3/6/12 months and during the final follow-up.

Results: The mean follow-up duration was 34.41 ± 5.99 (24-50) months. The VAS for pain and instability, ROWE score, and SSV score were significantly improved in both groups at the last postoperative follow-up compared with the preoperative values ($P < 0.001$). At the final follow-up, there were no statistically significant differences between the two groups in any clinical score. The three-month postoperative bone union rate of patients in the Cuistow group was significantly higher than that in the Bristow group (82.9% vs 51.4%, respectively, $P = .003$), and the bone union rates 2 years postoperatively were 94.1% and 85.7%, respectively ($P = .449$).

Conclusions: Patients receiving the Cuistow procedure had equivalent clinical outcomes and a higher bone union rate at 3 months and 2 years postoperatively than those in the Bristow group. The inlay structure used in the Cuistow procedure accelerated bone union.

FP.05.02

INNOVATIVE ARTHROSCOPIC HILL-SACHS FILLING (HSF) TECHNIQUE USING AN INTERFERENCE SCREW IN ANTERIOR SHOULDER INSTABILITY: EVALUATION OF FUNCTIONAL OUTCOMES AND PRELIMINARY RESULTS

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Background: The aim of the present study was to analyse and compare the clinical and radiological results after filling of the Hill-Sachs lesion with interference screws (HSF procedure) in a short-term follow-up. The material of the screws consists in an advanced biocomposite material or peek and was used to fill the bone defect until the proximal part of the screw is at the same level of the cartilage surface of the remaining humeral head. The HSF technique is an alternative, entirely arthroscopic procedure that is simple to perform for an experienced surgeon and, compared to other techniques, allows restoration of the humeral anatomy in bipolar bone defects. Methods: consecutive patients with recurrent anterior glenohumeral dislocation, glenoid bone loss < 10% and off-track Hill-Sachs lesion categorized according to Calandra arthroscopic classification in III grade, who were operated with arthroscopic Bankart repair and Hill-Sachs Filling between 2019 and 2022. Patients were evaluated radiologically with CT scan and clinically for shoulder instability, range of motion, and scored as the Rowe score (RS), Western Ontario Shoulder Index (WOSI) and the Constant-Murley score (CMS) were used for clinical evaluation. The minimum follow-up was at least 2 years.

Methods: Thirty patients were included in the study. The average age of the patients was 27 years (range, 16- 36 years), with 90% (n = 27) male patients and 10% (n = 3) female patients. The range of motion at follow-up was comparable with the normal side, without loss of movement and strength assessments were normal in all cases. Significant improvement was observed in all the scores with good to very good overall results in the subjective as well as the objective scores. A failure rate of 3,33% (1 patient with a re-dislocation) was seen. In all the cases, with the CT scan was assessed the status of the filling at 12 and 24 months post-operatively.

Conclusion: The HSF technique can be a successful treatment option for recurrent shoulder instability with humeral bone defects. This series showed a very low rate of recurrent dislocations with return to sport and activities. Although clinical trials with long-term follow-up are needed, we believe that the described arthroscopic procedure is safe, is easily reproducible, minimally invasive and allows restoration of joint stability and humeral anatomy

FP.05.03

ARTHROSCOPIC ANATOMIC GLENOID RECONSTRUCTION DOES NOT AFFECT SUBSCAPULARIS MUSCLE COMPARED TO LATARJET

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Background: The Latarjet technique has been the gold standard treatment for glenoid bone loss following anterior shoulder instability due to its low recurrence rate, but other techniques including arthroscopic anatomic glenoid reconstruction (AAGR) have shown similar outcomes with fewer complications. The Latarjet requires a subscapularis split or take-down for placement of the coracoid, which may compromise post-operative subscapularis quality and strength. The AAGR is a subscapularis-sparing technique that obviates the need for a subscapularis split by using a far medial (Halifax) portal for graft placement. The purpose of this study was to compare subscapularis muscle changes before and after surgery between Latarjet and AAGR patients.

Methods: This study was a retrospective analysis of patients treated surgically with AAGR and Latarjet that had pre- and post-operative CT scans. Patients' charts were reviewed to obtain demographic information, as well as CT scan cross-sectional area measurements of the subscapularis muscle on pre- and post-surgery scans. We used a pre-existing validated formula ($\text{volume} = [0.06(A+C)] - 13.02$) for calculating the volume of the subscapularis pre- and post-operatively based on the cross-sectional area of the muscle.

Results: Our cohort included 40 patients in each group with pre- and post-operative CT scans. On average, patients had a CT scan one year post-operatively. Pre-operatively, patients were estimated to have similar subscapularis volumes ($p > 0.05$). We found that the change in medial area of the subscapularis muscle was significantly higher in the Latarjet group (-325.8 mm^2) compared to the AAGR group (-73.2 mm^2) ($p < 0.05$). We found that AAGR patients had a 3% increase in subscapularis volume post-operatively, while the Latarjet patients had 3% decrease in volume ($p < 0.05$).

Conclusions: The AAGR technique is subscapularis-sparing both in surgical technique and structural outcomes, resulting in comparable subscapularis cross-sectional area and volume pre- and post-operatively. Latarjet using a subscapularis split results in lower subscapularis medial volumetric area.

FP.05.04

LATARJET PROCEDURE FOR ANTERIOR SHOULDER INSTABILITY: A 24 YEAR FOLLOW UP STUDY

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Background: Different surgical techniques (open and arthroscopic) have been described for the treatment of post-traumatic recurrent anterior instability. The aim of the surgery is to restore when possible, normal shoulder anatomy by repairing the underlying pathology responsible for the instability. Sometimes other surgical techniques are indicated.

The purpose of this retrospective study was to investigate the long-term clinical and radiographic results and complications of the open Latarjet procedure after a minimum follow-up of 24 years.

Methods: A retrospective study was performed for 67 patients treated with an open Latarjet procedure in a single center. Forty of these 67 patients returned for follow-up evaluation and clinical/radiological examination during the year 2018, having had a minimum of 24-year follow-up. Clinical outcomes were analyzed using two functional scores, in addition to the ROM and strength assessment. Radiographic evaluation included several views (AP views in neutral, internal and external rotation and a comparative Bernageau view).

Results: A total of 40 patients underwent an open Latarjet procedure. All the patients were available for follow-up at an average of 25.6 years. Clinically, no patient reported any episode of dislocation at the time of follow-up. The mean Rowe score and the Walch-Duplay score were 84.5 (range 45-100) and 83.5 (range 55-100), respectively. Non-union/fibrous union was reported in 12.5% of cases, partial resorption of the graft was found in 7.5% of cases, while total resorption was found in 5% of cases. Osteoarthritis was identified in 52.5% (21) of the patients.

Conclusions: This long-term follow-up study demonstrated that the open Latarjet procedure is a safe and reliable technique for recurrent anterior shoulder instability. The Latarjet procedure provides good long-term stability although associated with a slight limitation in external rotation.

FP.05.05

ARTHROSCOPIC LATARJET PROCEDURE: CLINICAL OUTCOMES OF A PROSPECTIVE STUDY OF 254 CONSECUTIVE CASES

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Background: The coracoid transfer procedure (Latarjet) has been performed since 1954, with an all-arthroscopic technique described in 2007. We began performing arthroscopic Latarjets in December 2011. Our technique involves the addition of a capsulo-labral repair over the classic bony transfer. In this study we present our clinical outcomes.

Methods: 254 consecutive shoulders (212 males/42 females, 137 right/117 left) were prospectively enrolled over a 10-year period (2011-2021). 31 patients (12.2%) were lost to follow-up at a mean of 4.5 ± 2 months. The remaining 223 patients were contacted for follow up at a minimum of 12 months. Measures included stabilisation outcomes, range of motion, clinical scores (OSIS, WOSI, Quick-DASH, ASES, Constant, EQ-5D-UK), surgical complications, and reoperation rate.

Results: At any time after the procedure, 5 patients (2.2%) reported symptoms of persistent instability without dislocation. Another 5 (2.2%) patients reported re-dislocation without radiologic evidence. Apprehension tests were positive in 14 patients (6.3%). Forward flexion improved from $154^\circ \pm 34^\circ$ to $170^\circ \pm 20^\circ$ ($p < 0.001$) and abduction improved from $150^\circ \pm 41^\circ$ to $167^\circ \pm 26^\circ$ ($p < 0.001$), without loss of external rotation ($54^\circ \pm 22^\circ$ to $55^\circ \pm 22^\circ$, $p = 0.327$) and internal rotation (remained mid-thoracic level, $p = 0.091$). Overall, improvements in clinical scores were as follows: OSIS: 19 ± 8 to 37 ± 11 ($p < 0.001$); WOSI score: 1312 ± 381 to 504 ± 494 ($p < 0.001$); Quick-Dash score: 35 ± 21 to 13 ± 19 ($p < 0.001$); ASES: 59 ± 22 to 85 ± 19 ($p < 0.001$); Constant score: 63 ± 20 to 80 ± 17 ($p < 0.001$); and EQ5D (UK): 0.66 ± 0.24 to 0.86 ± 0.21 . Infection occurred in 4 patients (1.8%) and stiffness complicated 21 cases (9.4%). 4 cases developed neurologic complications (1.8%): 2 transient ulnar nerve irritations, 1 dynamic median nerve irritation, and 1 complete axillary nerve palsy confirmed with electromyography. The latter underwent a nerve transfer. There were 39 (17.5%) reoperations, including 8 (3.6%) remplissage procedures. The majority of the remaining procedures were arthroscopic releases and screw removals.

Conclusions: Arthroscopic Latarjet procedure coupled with capsulo-labral repair is safe and has a high success rate stabilising the shoulder. A secondary procedure may be required to address stiffness and screw-related complications.

FP.05.06

MANAGEMENT OF THE FAILED LATARJET PROCEDURE: IDENTIFICATION OF THE CAUSE OF FAILURE IS THE KEY TO SUCCESS

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Background: Aim: to analyze the causes of failure after a Latarjet procedure and to evaluate the results of revision surgery.

Methods: Single-cohort, retrospective, observational study. Fourteen patients (13 males, mean age at the Latarjet procedure 35 years (range, 18-54)) with anterior glenohumeral instability who underwent a revision surgery for a failed Latarjet procedure were reviewed. Failure was defined as subluxation or dislocation. Demographic features, the reason for failure, type of lesions observed, and postoperative clinical and functional status were recorded.

Results: Recurrence occurred in the first year following the Latarjet procedure in 11 (78.6%) patients. The indication for revision of Latarjet surgery was postoperative recurrent dislocation in all cases. The causes of failure were a graft's avulsion in 2 cases, fracture in 1, a malposition of the coracoid in 2 cases, a not healed graft in 2 and in 4 cases it showed advance osteolysis. In 3 cases no identifiable cause of failure but patient's generalized hyperlaxity was found. Hyperlaxity was observed additionally to other potential causes of failure in 4 patients. Regarding revision surgery after the Latarjet procedure, 5 patients underwent an arthroscopic modified Eden-Hybinette procedure, in 2 patients the graft was repositioned. In the remaining 7 patients an extraarticular capsular reinforcement was performed. Regarding the latter, 4 patients suffered new dislocations and required an additional revision surgery (Eden-Hybinette). All patients remained stable after the revision surgery except two who reported subluxations after an arthroscopic Eden-Hybinette and an extraarticular capsular reinforcement, but no additional surgical procedure was required. Functional status after revision surgery was also satisfactory, with a ROWE mean score noted at 78 (10-100), WOSI score at 758 (225-1425) and a SSV scale at 68 points (40-90).

Conclusions: Bone graft malpositioning, avulsion and resorption, and generalized hyperlaxity have been identified as contributors to recurrence of instability following a Latarjet procedure. According to our results, an extraarticular capsular reinforcement could be indicated in patients with hyperlaxity but no graft's damage or bone defects. Reposition of the graft, when the graft is suitable, or an Eden-Hybinette procedure might be performed when the graft is avulsed, fractured or malpositioned or persistent off-track lesions are found.

FP.05.07

CLINICAL RESULTS WITH 2D AND 3D CT STUDY OF CORACOID PLACEMENT IN A CONSECUTIVE SERIES OF 100 CASES OF ARTHROSCOPIC LATARJET USING A BICORTICAL ROUND-BUTTON

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Background: Latarjet procedure represents the gold standard to treat anterior shoulder instability

Hypothesis 1: Use of a guided button arthroscopic technique may improve coracoid placement while reducing screw-related complications.

Hypothesis 2: Comparison of 2 d and 3d CT and arthroscopic vision for evaluation of coracoid positioning.

Methods: Patients undergoing Latarjet surgery were recruited from 2018-2022.

Pre-op evaluation, included a clinical evaluation, ROM apprehension test, and ISIS score.

Postoperative evaluation included a CT scan in the postoperative, with evaluation of coracoid positioning in the axial plane, sagittal plane and contact angle of the coracoid on the glenoid and

Clinical follow-up included a clinical evaluation, ROM apprehension test, and a CT scan beyond 6 months to evaluate the consolidation of our graft.

The scores used were the SSV and Rowe in the pre-postoperative

Results: Fifty patients were recruited, with an ISIS Score > 4. The median age was 30 yr (IQR 25-40). Follow-up was 40 months (IQR 14-45). Surgical time was 90min with a marked decrease in surgical time to 60 min after the 20th procedure. Stat. significant ROWE and SSV improvement with preserved ROM in all patients.

Negative apprehension test was observed in 85/100 patients

No infection and complications related to the media

1 case of button loosening without clinical consequences was observed

1 case with transient axillary deficit, 1 case of round button failure, revised with screws.

Coracoid consolidation was observed in 90/100 patients after 6 months.

At the CT study, the positioning of the coracoid in the sagittal plane was optimal in the sub-equatorial half in 96/100 patients. In the axial plane in 87/100pc it was tangent to the glenoid as it rises to 96/100 at 3 D reconstruction. And the contact between the coracoid and glenoid was optimal in 90/100 patients.

Conclusions: Arthroscopic button latarjet represents a safe reliable surgical technique with excellent short- and mid-term results. Post-op evaluation of coracoid positioning appears to be more accurate with 3D CT reconstruction and arthroscopic visualization than 2D CT study.

FP.05.08

COMBINED TREATMENT OF TRAUMATIC SHOULDER INSTABILITY WITH BANKART REPAIR, REMPLISSAGE AND SUBSCAPULARIS AUGMENTATION IN ADOLESCENT ATHLETES. RESULTS FROM A SERIES WITH A MINIMUM FOLLOW-UP OF 24 MONTHS

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Background: Literature suggested that the combination of Bankart repair, Remplissage and ASA reduces the risk of recurrence and revision but does not improve shoulder function-related quality of life in young athletes with traumatic glenohumeral instability (GHI). The rationale of the present study is that the association of these techniques effectively stabilizes the shoulder by preventing recurrences of dislocation, without stiffness, particularly in young patients with immature connective tissue.

Methods: we conducted a prospective evaluation of 25 athletes (Tegner greater than or equal to 6), with age ranging from 14 to 18. Fifteen subjects completed the 24-months follow-up and were included in the analysis. All patients were operated with a combined Bankart + Remplissage + ASA technique for traumatic unidirectional GHI, in the absence of significant glenoid bone loss. At follow-up, ROM in all planes, ASES, DASH and SF-12 clinical scores were assessed.

Results: 15 patients with an average follow-up of 19 months (range 15 to 26) showed a return to sports activity at an average of 6 months after surgery, with an average pre-operative Tegner scale of 6.2 and post-operative 8.2 points. At the final follow-up, no patient reported dislocation recurrences. Postoperative outcomes showed a mean ASES of 58 ± 17.6 points, a mean DASH of 4.8 ± 4.9 points. SF-12 showed a mean psychological score (PCS-12) of 55.4 ± 4.5 points and a motor score (MCS-12) of 54.5 ± 7.2 points. The ROM was restored, with no limitations or stiffness, except for external rotation with adducted arm with a mean interlimb difference of 15° at 6 months follow-up.

Conclusions: results showed that the combined technique in adolescents prevents from dislocation recurrence, leads to good clinical and functional results, without relevant limitations of ROM. Patients achieved a higher level of physical activity than preoperatively, possibly due to a renewed confidence in shoulder function and the absence of constraints. From the results obtained, we can argue that the triple technique should be taken into consideration in clinical practice on young active subjects and possibly also evaluated in clinical studies on the largest number of patients and with a comparative design.

FP.06.01

LIPOSOMAL BUPIVICAINE + BUPIVIAINE VERUS BUPIVICAINE INTERSCALENE NERVE BLOCK EFFECT ON PAIN AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR: A RANDOMIZED CONTROL TRIAL

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Background: Interscalene nerve blocks (ISB) have improved postoperative pain control following shoulder surgery. Bupivacaine has historically been the primary medication used in ISBs. Liposomal bupivacaine (Exparel) more recently has been approved by the FDA for use in interscalene nerve blocks. This formulation allows for potentially a longer duration of analgesic effect as the bupivacaine is stored in liposomes, which allows for slow release over time. This study aims to identify the effect ISBs using Bupivacaine alone (B) versus liposomal Bupivacaine+Bupivacaine (LBB) on postoperative pain control after an arthroscopic rotator cuff repair.

Methods: A prospective, double-blinded randomized controlled trial was conducted from January 2020–November 2022. Eighty-five patients were randomized into the B only group (15cc of Bupivacaine and 10cc of normal saline) versus the LBB group (10cc liposomal bupivacaine + 15cc bupivacaine). Inclusion criteria included patients above 18 years of age undergoing an arthroscopic rotator cuff repair. Exclusion criteria included: pre-existing liver disease, allergies to either drug, or preoperative narcotic use. Demographics, comorbidities, daily morphine milligram equivalents (MME) consumed, and daily visual analog scale (VAS) scores for 14 days was collected. Data analysis included chi-square, T-tests, and Mann-Whitney U test. P value < 0.05 threshold was utilized.

Results: Seventy-one patients were included in the final analysis. Thirty-six patients were randomized to the LBB group and 35 to the B group. No significant differences were noted between age, sex, and ASA scores. Patients in the LBB group consumed on average less MME within the first 14 days postoperatively (median (IQR) of 22.5 (1.88, 84.38)) compared with the B group (37.5 (7.5, 75.00)) but this did not reach statistical significance (p= 0.652). No significant difference was found between groups on individual daily MMEs consumed at any time point. Patients receiving liposomal bupivacaine did not demonstrate statistically significant improvement in VAS scores on postoperative days 1 through 14.

Conclusions: The use of liposomal bupivacaine in ISBs does not lead to a significant difference in opioid consumption and VAS scores compared to standard bupivacaine during the first 14 days following rotator cuff repair or arthroscopy shoulder surgery.

FP.06.02

A SYNTHETIC GRAFT WITH MULTILAYERED CO-ELECTROSPINNING NANO-SCAFFOLDS FOR BRIDGING THE MASSIVE ROTATOR CUFF TEAR IN RAT MODEL

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Background: Graft bridging was used in massive rotator cuff tear (MRCT); however, the integration of graft-tendon and graft-bone is still a challenge. The co-electrospinning nano-scaffold of polycaprolactone with enthesismimic structure could bridge MRCT, facilitate tendon regeneration, and improve the graft-bone healing.

Methods: Firstly, the cytocompatibility of the electrospinning nano-scaffolds, including aligned polycaprolactone (aPCL), nonaligned PCL (nPCL), aPCL-collagen I, nPCL-collagen II, and nPCL-nanohydroxyapatite (nHA) was analyzed. Then, in the group mimic, nPCL-collagen II and nPCL-nHA was electrospun layer by layer at one end of the aPCL-collagen I; while the nPCL was electrospun on the aPCL in the group blank. Forty mature male rats underwent resection of both supraspinatus and infraspinatus tendons to create MRCT, and were divided randomly into group mimic and group blank. In both groups, the layer-by-layer structures were fixed on the footprint of rotator cuff, while the other end was sutured with tendon stump. The animals were sacrificed to harvest tissues for histological and biomechanical analysis at 4-weeks and 8-weeks postoperatively.

Results: All scaffolds showed good cytocompatibility in vitro. The graft-tendon tissue in group mimic had more regularly arranged cells, denser tissue, significantly higher tendon maturing score and more birefringence than that in group blank at 8 weeks post-operation. Newly formed fibrocartilage could be observed at the graft-bone interface in both groups by 8 weeks, but the group mimic had higher graft-bone healing score, significantly more newly formed fibrocartilage than group blank. An enthesismimic structure with transitional layers was observed in group mimic at 8 weeks. Biomechanically, the value of maximum failure load and stiffness of tendon-graft-bone complex of group mimic were significantly higher than those of group blank at 8 weeks.

Conclusions: The co-electrospinning nano-scaffold of aPCL-collagen I could be used as a bridging graft to improve the early graft-tendon healing for MRCT in the rat model, and would enhance the early enthesismimic reconstruction in combination with layer-by-layer structure of nPCL-collagen II and nPCL-nHA.

FP.06.03

ARTHROSCOPICALLY-CONFIRMED SUBSCAPULARIS TEARS ARE UNRECOGNIZED BY RADIOLOGISTS IN THE MAJORITY OF CASES

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Background: Subscapularis tears are common, but can be challenging to diagnose and have received little attention relative to other rotator cuff tendons. This study aimed to compare radiologists' and surgeons' magnetic resonance imaging (MRI) interpretations of subscapularis tears among patients with intraoperatively confirmed subscapularis tears.

Methods: Patients with preoperative shoulder MRIs and intraoperatively confirmed subscapularis tears were retrospectively identified from our institutional registry. The radiologists' assessments of subscapularis integrity were extracted from the MRI reports. Several radiologists reviewed the reports, including several with musculoskeletal training. One high-volume fellowship-trained shoulder surgeon assessed all MRIs for the presence or absence of subscapularis tears at the time of the initial clinical evaluation. The radiologist and surgeon MRI-based assessments were compared against the diagnostic gold-standard (intraoperative arthroscopic examination) and classified according to the Lafosse classification.

Results: A total of 145 patients were included, with an average age of 61.2 years. Radiologist MRI-based interpretation of subscapularis tears identified 37.7% of intraoperatively-confirmed subscapularis tears, while surgeon MRI-based assessment identified 63.5% of intraoperatively-confirmed tears ($p < 0.001$). Most Lafosse type 1 tears, or partial-sided tears, were missed by both the radiologist and surgeon on MRI. The surgeon recognized most full-thickness tears involving the upper 50% of the tendon footprint, whereas the radiologists did not recognize the majority of tears until the pattern involved the entire footprint of the subscapularis tendon (type IV or V). The sensitivity for diagnosis was lower among radiologists compared to the surgeon for all types of Lafosse tears: type 1 tears (18.6% vs 35.7%, respectively; $p = 0.02$), type 2 (43.5% vs 70.8%, $p = 0.01$), type 3 (33.3% vs 81.8%, $p < 0.001$), type 4 (65.5% vs 96.6%, $p = 0.01$) and type 5 (62.5% vs 88.9%, $p = 0.03$).

Conclusions: Most partial articular-sided subscapularis tears are unrecognized on MRI. Moreover, radiologists did not recognize the majority of tears until the tear involved the entire subscapularis footprint. MRI diagnosis can be improved by a surgeon review who has clinical knowledge of the subjective symptoms and physical exam. These findings support avoiding overreliance on MRI reports for the diagnosis of subscapularis tears and additionally highlight the importance of careful arthroscopic examination of tendon integrity when surgery is indicated.

FP.06.04

PREDICTABILITY AND FUNCTIONAL IMPACT OF PREOPERATIVE 2D PLANNING ON THE CORRECTION OF THE CRITICAL SHOULDER ANGLE IN PATIENTS WITH ROTATOR CUFF REPAIR AND LATERAL ACROMIOPLASTY

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Background: Rotator cuff tears and critical shoulder angle (CSA) association has been reported. There is controversy regarding whether the morphology of the acromion influences its incidence, as well as whether acromioplasty would impact the results of a rotator cuff repair (RCR). Lateral acromioplasty aims to correct the deltoid vector. According to some publications, this would achieve less loading on the repaired rotator cuff, a lower retear rate, and better function. CSA correction with lateral acromioplasty can be planned with radiography (2D), but its predictability has not been fully studied. The primary objective of this study is to evaluate the predictability of 2D planning with radiography in CSA correction in patients with RCR. The secondary objective is to analyze the association between the correction of the CSA and the functional outcomes.

Methods: This single-center prospective observational analytic study included candidates for arthroscopic RCR with a CSA > 35°. With a preoperative radiograph, the degrees of planned correction were calculated to achieve a CSA = 35°, as well as the millimeters of resection required. A lateral acromioplasty was performed according to this plan. Postoperative CSA and effective correction were measured. Planning error (planned-effective) and planning error rate ($[(\text{planned-effective})/\text{planned}]$) were calculated. At the end of follow-up, visual analog scale (VAS), subjective shoulder value (SSV), and quick disabilities of the arm, shoulder, and hand (Quick-DASH) scores were evaluated.

Results: 41 cases were included, 43.9% were men. The mean age was 55.5 ± 8.6 years. The mean preoperative and postoperative CSA were $39.6 \pm 1.9^\circ$ and $35.7 \pm 2.3^\circ$ respectively. The 41.5% achieved a postoperative CSA $\leq 35^\circ$. The mean planning error and the mean planning error rate were \pm° and $\%28.8 \pm 45.7$ respectively. 33 (78.6%) had a functional evaluation, with an average follow-up of 41 ± 6.8 months. The mean VAS, Quick-DASH, and SSV were 0.9 ± 1.6 , 5.3 ± 7.5 , and 92.7 ± 10.6 respectively. There was a significant difference in Quick-DASH ($P=0.01$) and SSV ($P=0.02$) according to whether a postoperative CSA $\leq 35^\circ$ was achieved.

Conclusions: In lateral acromioplasty, planning of CSA correction with radiography (2D) is imprecise. Reaching a CSA $\leq 35^\circ$ positively influences functional results.

FP.06.05

NOVEL MRI-BASED VO SHOULDER - ROTATOR CUFFLUMETRIC ASSESSMENT OF ROTATOR CUFF PATHOLOGY DEMONSTRATES STRONGER CORRELATION WITH PRE-OPERATIVE FUNCTIONAL STATUS WHEN COMPARED TO THE GOUTALLIER GRADING SCHEME

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Background: The Goutallier classification (GC) is widely used to assess rotator cuff (RC) tears, yet there are several well-described limitations. A novel MRI-based volumetric score (VS) has been developed in order to address these limitations and provide more holistic characterization of RC pathology. The purpose of this study was to: (1) describe the correlation between the GC and VS for supraspinatus muscle changes in RC tears; characterize the chronicity of RC tears in terms of muscle changes using the collective VS measurements; and compare the GC and VS to determine which method most closely corresponds with preoperative functional patient reported outcome measures (PROMs).

Methods: Eighty-seven patients who underwent arthroscopic RC repair were retrospectively examined using sagittal shoulder MRI. Pre-operative Patient-Reported Outcomes Measurement Information System (PROMIS) scores were collected, as well as GC scores by two independent surgeons. Volumetric scores included fat infiltration, muscle size and relative volume contribution for each RC muscle. Univariate and multivariate linear regression models were performed.

Results: The mean age was 54.8 ± 8.6 years with 64% male and 70% GC grade 0 or 1. There was a moderate positive correlation between GC grade and the volumetric assessment with respect to fat infiltration ($r=0.24$, $p=0.03$). Strong negative correlations were observed between the GC grade and the volumetric assessment with respect to RC muscle size ($r=-0.73$, $p<0.001$) and relative volume contribution ($r=-0.73$, $p<0.001$) on evaluation of the supraspinatus. A negligible correlation was observed between GC grade and pre-operative PROMIS physical function (PF) ($r=0.08$, $p=0.45$) and pain interference (PI) ($r=0.06$, $p=0.582$). On multivariate analysis, supraspinatus muscle size ($p<0.05$) and relative contribution ($p<0.05$) were positive and negative predictors, respectively, of pre-operative PF ($r=0.27$, $p=0.18$), while subscapularis muscle size ($p<0.05$) and teres minor relative contribution ($p<0.05$) were negative predictors of pre-operative PI ($r=0.37$, $p=0.06$).

Conclusions: A strong correlation between supraspinatus GC and volumetric scores was observed. Although considered the gold standard in evaluation of RC pathology, GC scores demonstrated negligible correlation with pre-operative PROMIS PF and PI scores. Alternatively, several volumetric scores were moderate predictors of PF and PI, suggesting this 3D volumetric measurement modality may provide a more holistic assessment of RC pathology.

FP.06.06

INFLUENCE OF EPERISONE AS AN ADJUNCT TO POST-OPERATIVE ANALGESIA REGIME FOLLOWING ARTHROSCOPIC REPAIR OF SMALL-TO-MEDIUM - SIZED ROTATOR CUFF TEARS

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Background: Addressing post-operative pain remains crucial in the realm of arthroscopic rotator cuff repair. Poorly controlled early post-operative pain is a risk factor for shoulder stiffness, due to limited progress in rehabilitation, thereby affecting functional and satisfaction outcomes. Eperisone is a central acting muscle relaxant, with additional analgesic properties. We aim to investigate the effect of Eperisone on post-operative pain and outcomes in patients undergoing arthroscopic rotator cuff repair.

Methods: A prospective cohort study was conducted for patients undergoing arthroscopic rotator cuff repair between January to September 2022. Patients with labral injuries, fractures and adhesive capsulitis were excluded. Patients eligible for the study were separated based on their analgesia regimes. Group 1 included patients who received Paracetamol and Etoricoxib strictly for two weeks, and Tramadol for breakthrough pain. Patients who had addition of Eperisone for the initial two weeks, were placed in Group 2. Visual analog scale (VAS) for pain, amount of opioid usage, University of California at Los Angeles (UCLA) Shoulder score and shoulder range of motion were used as outcomes measures. Statistical analysis was performed to compare outcomes between the 2 groups.

Results: 40 patients were recruited for our study: 17 patients in Group 1 (without Eperisone), and 23 patients in Group 2 (with Eperisone). Both groups had similar demographics. There were no significant differences in VAS scores at post-operation day 1, day 7, 2 weeks and 6 weeks [Group 1 = 3.53, Group 2 = 3.22, $p=0.637$]. Average dosage of breakthrough medications used in Group 2 was slightly lower, however this was not statistically significant. There were no significant differences in UCLA score [Group 1 = 23, Group 2 = 22.3, $p=0.584$] and range of motion between the two groups at 6 weeks.

Conclusions: Eperisone had demonstrated beneficial impacts on patients with lower back pain and muscle spasms, in decreasing pain scores and improving function. Eperisone has also shown to reduce pain scores for patients post- total knee arthroplasty. For arthroscopic rotator cuff repair, addition of Eperisone as an adjunct to post-operative analgesia regime did not result in a significant improvement in pain scores or early functional outcomes.

FP.06.07

EVALUATION OF PREDICTIVE FACTORS FOR SHOULDER RANGE OF MOTION IN PATIENTS WITH CHRONIC MASSIVE ROTATOR CUFF INJURY

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Background: The definition of pseudoparalysis is still controversial, as well as the benefits and indications for operative and non-operative treatment. Therefore, the aim of this study was to evaluate factors associated with pseudoparalysis, which may aid in the individualization of the treatment of patients with chronic and atraumatic extensive injury of the rotator cuff.

Methods: A single-center cross-sectional study was carried out with patients with extensive chronic and atraumatic rotator cuff injuries. Patients were categorized into three subgroups. Patients presenting active shoulder flexion greater than 90 degrees formed the non-pseudoparalysis group (n=41). Patients with active flexion of less than 90 degrees (n = 29) were submitted to subacromial injection of local anesthetic (2% lidocaine) and were reassessed thereafter. Of these, 15 reversed the pseudoparalysis, composing the false pseudoparalysis group; and 14 maintained the paralysis, thus constituting the true pseudoparalysis group. Range of motion of the injured shoulder, demographic data, physical examination, and imaging data were collected.

Results: The presence of the shoulder shrug sign, complete lesion of the subscapularis tendon, and stage 3/4 of fatty infiltration in the subscapularis muscle according to the Goutallier grading system were risk factors for the occurrence of pseudoparalysis. Compensatory hypertrophy of the teres minor muscle was associated with a greater range of active shoulder flexion. The extent of the lesion, according to the Wieser method, was significantly different, with the true pseudoparalysis group presenting with a greater anterior extent of the lesion (of the subscapularis) and a greater global lesion. Injury to the tendon of the long head of the biceps brachii muscle did not differ between groups.

Conclusions: Our results suggest that pain should be relieved prior to assessing shoulder motion. Furthermore, patients with functioning subscapularis and compensatory hypertrophy of the teres minor muscle may benefit more from conservative treatment. Patients with a shoulder shrug and Goutallier grade III or IV fatty infiltration in the subscapularis muscle belly may benefit more from surgical treatment, as these are risk factors for the occurrence of true pseudoparalysis.

FP.06.08

GLENOHUMERAL JOINT CENTRE TRANSLATION AND GLENOHUMERAL JOINT CONTACT POINT PATH TRANSLATION DURING A 30° ARM ABDUCTION IN AN EX VIVO EXPERIMENT

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Background: Rotator cuff tears (RCT) have been associated with glenohumeral (GH) joint instability. However, in-depth knowledge of glenohumeral (GH) motion is lacking. The aim of this study was to investigate the superior-inferior translatory motion of the GH joint in shoulders with RCT during an abduction test with additional weights.

Methods: Ten fresh-frozen human shoulders were clamped into an advanced muscular, force-controlled shoulder simulator. A total of ten periarticular tendons including the rotator cuff (RC) (subscapularis (SSC) 2x), the deltoid (3x), the pectoralis major, and the latissimus dorsi were connected to a motorized pulley system, through which muscle forces were applied. A 30° scapular plane abduction-adduction cycle was performed simulating motion with both an intact RC and with different types of RCT (supraspinatus (SSP), superior portion of SSC (SSCsup), infraspinatus (ISP), SSP&SSCsup, SSP&ISP and SSP&SSCsup&ISP) at four different load levels (additional weights: 0–3 kg). The GH joint centre was determined using the instantaneous helical axis, and the GH contact point identified. Weight-dependency during abduction was tested using linear regression models for each RCT-type.

Results: In shoulders with an intact RC, mean values for superior GH joint centre translation during loaded abduction with 0–3 kg ranged from 3.3–6.8 mm. In shoulders with simulated SSP&SSCsup&SSP tears mean values ranged from 4.0–9.3 mm. The glenohumeral joint centre superior translation depended significantly on the weight-induced load (Healthy $p=0.0128$, SSP&SSCsup&SSP $p=0.007$). Mean values for superior GH contact point translation in shoulders with intact RC during loaded abduction with 0–3 kg ranged from 6.7–7.6 mm. In shoulders with simulated SSP&SSCsup&ISP tears mean values ranged from 12.3–10.4 mm. The glenohumeral contact point superior translation did not depend on the weight-induced load (Healthy $p=0.4393$, SSP&SSCsup&SSP $p=0.337$).

Conclusions: In a laboratory setting, both the presence of RCT and additional weights increase superior translation of the GH joint centre during abduction and thus the instability of the joint. The translation of the GH contact point presumably depends primarily on GH joint congruence and is therefore not weight dependent. In vivo confirmation of these findings would be of high clinical interest.

FP.07.01

Downsizing Effect of a Modular Radial Head Prosthesis on the Lateral Collateral Ligament of the Elbow: A Cadaveric Study

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Background: Radial head prosthesis with a smooth-stemmed modular concept has been recently reported to have satisfactory long-term outcomes. However, it remains whether or not morphologic variations in the implant consisting of the head and stem component affect the biomechanics at the radiocapitellar joint. The purpose of this study was to investigate the impact of the head and stem diameters of radial head prosthesis on the mechanical properties of the lateral collateral ligament measured by strain changes during elbow and forearm motions.

Methods: Eight cadaveric specimens were secured to the device, which allows elbow flexion-extension and forearm pro-supination. Using six different implant combinations comprising 2 sizes for the head (long- and short-axis of the native head) and 3 sizes for the stem (press-fit, -1 mm, and -2 mm downsizing), the prostheses were attached via the posterior Wrightington's approach. A differential variable reluctance transducer placed on the central portion of the radial collateral ligament were used for strain measurement with elbow flexion at °60, °30, °0, and °90. At each position, strain patterns with the forearm in the neutral and 45° pro-supination positions were also assessed.

Results: Specimens implanted with the long-axis head component showed greater increases in the ligament strain during elbow flexion than intact specimens or those implanted with a short-axis head. Compared to the press-fit stem, implants with downsizing to -1 mm approximated strain patterns during pro-supination with elbow extension to the intact condition.

Conclusions: Morphologic variation of the head and stem components led to altered strain patterns in the lateral collateral ligament during elbow and forearm motions. A short-axis head component can be used to prevent excessive strain changes after the prosthesis application. Downsizing of the stem component might be an option for approximating the biomechanics at the radiocapitellar joint during forearm rotation to the intact elbow.

FP.07.02

INFLUENCE OF TYPE I COLLAGEN POLYMORPHISMS AND RISK OF TENDINOPATHY IN ATHLETES

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Background: Recent studies have shown the influence of single nucleotide polymorphism on the susceptibility of tendinopathy. COL1A1 and COL1A2 genes are polymorphic and may alter the expression or biological function of type 1 collagen. Tendons are composed of a dense extracellular matrix with low cellularity, but with high content of structural proteins, mainly type I collagen. The aim of the present study was to evaluate the influence of polymorphisms on genes encoding type I collagen and the genetic susceptibility of tendinopathy in Brazilian athletes.

Methods: Case-control study involving 242 Brazilian athletes from different sports modalities (55 cases of tendinopathy and 187 controls). The polymorphisms COL1A1 (rs1107946) and COL1A2 (rs412777, rs42524, and rs2621215) were analyzed by the TaqMan system. Odds ratio (OR) with their 95% confidence intervals (CIs) were calculated using a nonconditional logistic regression model.

Results: The mean age was 24.0 ± 5.6 years old and 65.3% were men. Of the 55 cases of tendinopathy, 25.4% had >1 affected tendon: 30.9% rotator cuff and 30.9% elbow or hand flexors. Age and amount of time of sports practice were associated with a higher chance of presenting tendinopathy (5 and 8 times, respectively). The frequency of variant alleles in control and case patients, respectively, was: COL1A1 rs1107946 24.0 and 29.6%; COL1A2 rs412777 36.1 and 27.8%; rs42524 17.5 and 25.9%; and rs2621215 21.3 and 27.8%. After adjusting for confounding factors (age and years of sports practice), COL1A2 rs42524 and rs2621215 polymorphisms were associated with increased risk of tendinopathy (OR=5.5; 95% CI=1.2-24.6 and OR=3.9; IC95%=1.1-13.5, respectively). The haplotype COL1A2 CGT was associated with low risk for disease development (OR=0.5; 95% CI=0.3-0.9).

Conclusions: Age, time of sports practice and polymorphisms in the COL1A2 gene increased the risk of developing tendinopathy. Individualized programs of injury prevention using genetic information can contribute to the promotion of the health and well-being of individuals, besides being useful diagnostic tools in the clinical practice of the orthopedist.

FP.07.03

BIOMECHANICAL STABILITY OF LATERAL ULNAR COLLATERAL LIGAMENT RECONSTRUCTION AND REPAIR OF THE ELBOW: THE ROLE OF LIGAMENT BRACING ON GAP FORMATION AND STABILIZATION

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Background: Augmented (internal braced) lateral ulnar collateral ligament (LUCL) repair has been biomechanically compared to reconstruction techniques in the elbow. However, LUCL repair alone has not yet been compared to augmented repair and reconstruction techniques.

Hypothesis: Internal bracing of LUCL repair improves time-zero stabilization regarding gap formation, stiffness, and residual torque compared to repair alone and reconstruction techniques to restore native elbow stability.

Methods: Overall, 24 cadaveric elbows were used for either internal braced LUCL repair (Repair-IB) or single- and double-strand ligament reconstruction with triceps (Recon-TR) and palmaris-longus tendon graft (Recon-PL), respectively. Laxity testing in external rotation was consecutively performed at 90° of elbow flexion on the intact, dissected, and repaired conditions and using the previously assigned techniques. First, intact elbows were loaded up to 7.0-Nm external torque to evaluate time-zero ligament rotations at 2.5, 4.0, 5.5, and 7.0-Nm. Rotation-controlled cycling was performed (total of 1000 cycles) for each surgical condition. Gapping, stiffness, and residual torque were analyzed. Finally, these and eight additional intact elbows underwent torque to failure testing (30-deg/min).

Results: The dissected state showed significant ($p < 0.001$) highest gap formation and lowest peak torques. While gap formation of Repair-IB ($p < 0.021$) was significantly lower to Repair at all rotation levels, gaps of Recon-PL were similar and Recon-TR was significantly higher than Repair-IB except for the highest torsion level. Residual peak torques at specific rotation angles between Native and Recon-TR (a2.5), Recon-PL (a4.0), and Repair-IB (a5.5) were similar; all other comparisons were significantly different ($p < 0.027$). Torsional stiffness of Repair-IB was significantly higher at all rotation angles measured. Analysis of covariance showed significantly less gap formation over residual peak torques for Repair-IB ($P < 0.001$) compared to all other groups. The native failure load was significantly higher than both, Recon-PL and Recon-TR, with similar stiffness to all other groups.

Conclusions: Repair-IB and Recon-PL of the LUCL showed enhanced torsional resistance to restore posterolateral stability to the native state. Recon-TR demonstrated lower residual peak torques although providing near-native rotational stiffness. Internal bracing of LUCL repair may reduce suture tearing effects through tissue and provide sufficient stabilization for healing throughout accelerated and reliable recovery without the need for a graft.

FP.07.04

PURE VARUS POSTEROMEDIAL ROTATORY INSTABILITY OF THE ELBOW: RADIOGRAPHIC FINDINGS, TREATMENT, AND OUTCOMES

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Background: The aim of this study was to investigate radiographic findings, treatments, and outcomes of a large series of varus posteromedial rotatory instability (VPMRI) and to propose its treatment guidelines.

Methods: We retrospectively reviewed 91 pure VPMRI cases with anteromedial coronoid facet (AMCF) fracture (O'Driscoll anteromedial type) which were treated at 6 fellowship training hospitals. Clinical and radiographic outcomes were evaluated for a mean follow-up period 46.8 months (range, 12-192 months) using the Mayo Elbow Performance Score (MEPS), and the Quick Disabilities of the Arm, Shoulder and Hand (Quick-DASH) score, and serial plain radiographs.

Results: In AMCF fracture, there were 4 cases of subtype 1, 67 cases of subtype 2, and 20 cases of subtype 3. On MRI, complete tears of lateral ulnar collateral ligament and medial collateral ligament were observed in 83.1% (59/71 cases) and 33.8% (24/71 cases). Operative treatment was performed in 68 cases (74.7%) including both side fixation in 39 cases (57.4%), medial side fixation only in 16 cases (23.5%), and lateral side fixation only in 13 cases (19.1%). Nonoperative treatment was performed in 23 cases (25.3%). Overall, the mean MEPS and Quick-DASH scores at the final follow-up were 93.7 ± 12.2 and 7.9 ± 15.6 . Complications (22.0%) after treatment included hardware irritation in 6 cases, elbow stiffness in 6 cases, ulnar neuropathy in 5 cases, arthritic change with recurrent dislocation in 1 case, screw penetration into the joint in 1 case, cubitus varus in 1 case. Reoperation was performed in 15 cases (15.8%). No significant differences regarding all final clinical scores and ROMs were observed between the operative group and the nonoperative group, but significant differences were observed regarding number of fragment ($p=0.109$), displacement ($p=0.002$), complication rate ($p<0.001$).

Conclusions: Depending on the pattern of the coronoid fragment and the degree of the lateral ligamentous injury, operative treatment of unstable VPMRI using various fixation techniques including either medial or lateral fixation, or both, yielded satisfactory final clinical outcomes. However, the surgeons should be aware high complication and reoperation rates. Stable VPMRI with AMCF fracture that has small number of fragment and minimal displacement can be treated nonoperatively.

FP.07.05

OPTIMAL ANCHOR PLACEMENT FOR COLLATERAL LIGAMENT RECONSTRUCTION IN ELBOW TRAUMA: A 3D MODELING STUDY

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Background: Anchor fixation in the medial and lateral columns of the distal humerus is a critical step in many variations of MUCL and LCL repair in elbow trauma and post-traumatic reconstruction. Correct placement of surgical implants in these procedures is critical for optimal healing, recovery of function, and avoiding complications that would result in revision surgery. With the novel advancement of 3D modeling software, there exists an opportunity to analyze anchor placement with precision.

Methods: 25 CT scans of the humerus were reconstructed from DICOM stacks in Blender software to analyze anchor placement. Data was collected relating to optimal anchor depth, angle and position in the medial and lateral columns of the distal humerus. Hemispheric visualizations of deviations in anchor insertion-angle were performed utilizing heat maps to illustrate safe-zones.

Results: LCL fixation in the distal humerus can be undertaken with a 19.1mm fixating anchor. Insertion angle cannot deviate anteriorly from the sagittal axis of the humerus more than ($27.62^{\circ} \pm 4.26^{\circ}$) without breaching the surface of the humerus. Deviation posteriorly cannot exceed ($55.52^{\circ} \pm 6.62^{\circ}$). Deviation of anchor insertion proximally cannot exceed ($31.12^{\circ} \pm 14.39^{\circ}$) and distally cannot exceed ($39.23^{\circ} \pm 8.78^{\circ}$). MUCL fixation in the distal humerus can be undertaken a 15.8 mm anchor. Insertion angle cannot deviate anteriorly to the mid coronal plane of the humerus more than ($12.31^{\circ} \pm 2.52^{\circ}$) or posteriorly ($36.86^{\circ} \pm 7.35^{\circ}$). Proximal deviation cannot exceed ($14.09^{\circ} \pm 3.71^{\circ}$) and distal deviation cannot exceed ($104.61^{\circ} \pm 14.29^{\circ}$). If lateral anchor deviation encounters the olecranon fossa (n=3) it occurs at ($31.47^{\circ} \pm 6.07^{\circ}$) of lateral deviation from ideal anchor placement. Anchor angle deviation from medial and lateral epicondyle insertion points were illustrated with heat maps to visualize safe zones in surgical approaches.

Conclusions: Anterior deviation of lateral column anchors and anterior and proximal deviation of medial column anchors requires the fewest degrees of rotation before cortical breach. Hemisphere visualization can highlight safe zones for anchor placement. This study provides parameters for optimal anchor positioning in the lateral and medial columns of the distal humerus.

FP.07.06

ELBOW LATERAL ULNAR COLLATERAL LIGAMENT RECONSTRUCTION BY TRANSPOSITION OF LOCAL EXTENSOR FASCIA SEPTUM: SURGICAL TECHNIQUE AND PRELIMINARY RESULTS

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Background: The lateral ulnar collateral ligament (LUCL) is a primary lateral stabilizer of the elbow that originates from the isometric centre of the capitulum and inserts into the supinator crest of the ulna. LUCL injury may be due to trauma, chronic strain or iatrogenic lesion. In patients with symptomatic LUCL insufficiency and recurrent posterolateral rotatory instability, surgical reconstruction can restore elbow stability. We describe a new LUCL reconstruction technique based on the transposition of the local extensor fascia septum and report the preliminary result in a series of patients aged 50 years or less.

Methods: From 2017 to 2019, 10 consecutive patients with chronic PLRI of the elbow – 7 men and 3 women – underwent LUCL reconstruction with transposition of the local extensor fascia septum at our institution.

Results: At the last follow-up, 9 patients (90%) reported a completely stable elbow. The tenth described a marked improvement compared with his preoperative condition, but was unable to return to his previous level of sport activity because he felt that his elbow could not lift weights as before the trauma. All clinical measures improved significantly ($p < 0.05$): the mean MEPS from 79 (79.5 ± 8.32) to 98 (98.5 ± 4.74); the mean Quick DASH score from 15.4 (15.47 ± 4.76) to 0.9 (0.91 ± 1.58) and the mean VAS score from 3.6 (3.6 ± 2.32) to 0.2 (0.2 ± 0.63).

Conclusions: To the best of our knowledge, there are no studies describing local extensor fascia septum transposition as a reconstruction technique for chronic LUCL lesions. If ligament quality is poor, this is a useful alternative to other approaches using tendon autografts / allografts. Our experience with a mean follow-up of two years showed that the approach can stabilize the lateral compartment. Comparison of larger patient groups managed by this and other autograft / allograft reconstruction techniques is clearly needed to establish the respective medium- and long-term outcomes.

FP.07.07

INTEROSSEUS MEMBRANE RECONSTRUCTION FOR LONGITUDINAL INSTABILITY INJURIES OF THE FOREARM

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Background: Acute and chronic injuries of the interosseus membrane can result in longitudinal instability of the forearm. Reconstruction of the central band of the interosseus membrane helps restore the anatomic and biomechanical stability within the forearm. Different methods have been used to reconstruct the central band ranging from tendon grafts, bone-tendon-bone grafts and synthetic grafts. This study aims to review the clinical results of reconstruction using a synthetic braided graft secured at either end with an Endobutton to restore the longitudinal association between the bones of the forearm.

Methods: A retrospective review was conducted of a consecutive series of 21 patients with longitudinal instability injuries treated with anatomical interosseus membrane reconstructions between 2011 and 2019. Patients with less than 12 months follow up were excluded leaving 10 female and 10 male patients with an average age of 48 years were identified. Pre-operative clinical and radiographical assessments were compared with prospectively gathered data using range of movement and the quick DASH functional outcome score.

Results: 20 patients were included with a mean follow up of 96 months. Mean flexion-extension arc of motion improved significantly from 80° preoperatively to 139° at latest follow up ($p=0.01$) and mean pronosupination arc of motion improved between 115° preoperatively to 122° at latest follow up ($p=0.528$). Quick DASH functional scores improved from 79.8 preoperatively to 51.3 following reconstruction ($p=0.016$). Radiographic assessment showed an improvement in ulnar variance 4.2mm to 2.6mm ($p=0.115$) with an interbutton distance stable (79mm to 77mm) since first X-ray postoperative to the latest follow up ($p=0.364$). Despite addressing the longitudinal dissociation of the forearm, 6 patients patients required a revision surgery. 4 patients underwent an ulnar shortening osteotomy with a mean interval of 16 months from reconstruction. 2 patients underwent a total elbow replacement due to degenerative changes in the ulnohumeral joint with a mean interval of 93 months from reconstruction.

Conclusions: Interosseus membrane reconstruction using a synthetic braided graft can improve patient rated arm function and range of movement but significant deficits remain particularly in chronic injuries.

FP.07.08

WHAT IS THE LATERAL ULNAR COLLATERAL LIGAMENT? AN ANATOMICAL STUDY

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Background: To improve the clinical results of lateral ulnar collateral ligament (LUCL) reconstruction of the elbow joint, better understanding of the anatomy of the aponeuroses and joint capsule could be relevant. This study considers the previously described anatomy of the LUCL in relation to the related aponeuroses and joint capsule rather than as a discrete ligament. We hypothesized that the deep aponeuroses of the superficial extensor muscles and supinator form a relevant portion of the joint capsule previously defined as the LUCL.

Methods: Twenty-four elbows (12 right) from 21 embalmed cadavers (age at the time of death, 54 to 99 years) were included in the study. Twenty elbows were studied macroscopically and 4, histologically. The joint capsule was detached from the bones, and local thickness was quantitatively analyzed using micro-computed tomography (micro-CT).

Results: The supinator aponeurosis and joint capsule intermingled to form a thick membrane (mean and standard deviation, 4.8 ± 1.2 mm), which we termed "the capsulo-aponeurotic membrane." It was thicker than the anterior (1.3 ± 0.4 mm) and posterior (2.5 ± 0.9 mm) parts of the capsule of the humeroradial joint ($p < 0.001$). The capsulo-aponeurotic membrane had a wide attachment on the distal part of the extensor digitorum communis and extensor digiti minimi (EDC/EDM) origin of the humerus, the lateral part of the coronoid process, and the posterior part of the radial notch of the ulna. The humeral attachment had a fibrocartilaginous structure. The deep aponeuroses of the EDC and extensor carpi ulnaris (ECU) were connected to the capsulo-aponeurotic membrane.

Conclusions: The capsulo-aponeurotic membrane was composed of the supinator aponeurosis and joint capsule and was attached to the lateral epicondyle of the humerus, radial side of the coronoid process, and posterior part of the radial notch on the ulna. The entire structure appeared identical to the commonly defined lateral collateral ligament. The most posterior part was connected to the EDC and ECU aponeuroses, which is commonly labeled the LUCL but does not exist as a discrete ligament. Consideration of the accurate anatomy of the extensive attachment of the capsulo-aponeurotic membrane could provide useful clues for improvement in techniques of LUCL reconstruction.

FP.08.01

THE REVERSE SHOULDER ARTHROPLASTY ANGLE IN MAGNETIC RESONANCE IMAGING: IMPACT OF THE ARTICULAR CARTILAGE IN THE ESTIMATED INCLINATION OF THE INFERIOR GLENOID

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Background: The reverse shoulder arthroplasty angle (RSA angle) was described in computed tomography (CT) to better estimate the inclination of the inferior portion of the glenoid. In some cases, the presence of articular cartilage at the inferior glenoid rim may vary this estimation. The purpose of this study is to describe the RSA angle in Magnetic Resonance Imaging (MRI) and compare the angle formed using bony landmarks (Bony RSA angle or B-RSA angle) with another angle formed using the cartilage margin as reference (Cartilage RSA angle or C-RSA angle).

Methods: A sample size of 61 shoulders was calculated as sufficient with a margin of error of 1.5°, 80% power, and 95% confidence. Adult patients with a shoulder MRI obtained in our hospital between July 2020 and July 2021 were included. After obtaining basic demographic data the C-RSA angle and B-RSA angle were measured. Morphologic characteristics of the sample were recorded. All images were independently assessed by four evaluators. Intraclass correlation coefficient (ICC) was determined for the B-RSA and C-RSA to evaluate interobserver agreement.

Results: Sixty-one patients were included, with a median age of 59 years (ranging between 17 and 77 years old), 52.4% (32) female, 69% (42) right shoulders. C-RSA angle was significantly higher than B-RSA ($25.4^\circ \pm 0.7$ vs $19.5^\circ \pm 0.7$ respectively) with a p-value <0.001 . Articular cartilage at the inferior glenoid rim was in average 1.3 mm thicker than at the level of the supraspinatus fossa ($p < 0,01$). The overall agreement was considered "good" for C-RSA (ICC = 0.74 [IC95% 0.61 - 0.83]) and "excellent" for B-RSA angle (ICC = 0.76 [IC95% 0.65 - 0.85]).

Conclusions: C-RSA angle is significantly higher than B-RSA angle. Resecting the articular cartilage or accounting for this difference may be advisable before positioning RSA instrumentation guides at the inferior glenoid rim in patients with preserved articular cartilage.

FP.08.02

CAN PREOPERATIVE PLANNING PREDICT CLINICAL POST-OPERATIVE RANGE OF MOTION DIFFERENCES BETWEEN TWO HUMERAL DESIGNS IN REVERSE SHOULDER ARTHROPLASTY?

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Background: We aim to predict a clinical difference in the postoperative range of motion (ROM) between two RSA implant designs INLAY-155° and ONLAY-145° using a preoperative planning software. We hypothesized that preoperative planning could anticipate the differences in postoperative clinical ROM between two humeral stem designs and by keeping the same glenoid implant.

Methods: Thirty-seven patients (14 men and 23 women, 76±10yo) underwent a BIO-RSA (Bony Increased Offset-RSA) with the use of preoperative planning and an intraoperative 3D-printed patient specific guide for glenoid component implantation between January 2014 and September 2019 with a minimum follow-up of 2 years. Two types of humeral implants were used: Inlay with 155° inclination (Inlay-155°) and Onlay with 145° inclination (Onlay-145°). Glenoid implants remained unchanged. RSA-angle and Lateralization shoulder angle (LSA angle) were measured to confirm the good positioning of the glenoid implant and the global lateralization on postoperative X-rays. Correlation between simulated and clinical ROM were studied. Simulated and last follow-up active anterior elevation (AAE), abduction and external rotation (ER) were compared between the two types of implants.

Results: No significant difference in RSA and LSA was found between planned and postoperative radiological implants' position. Clinical ROM at last follow-up were always significantly different from simulated preoperative ROM. A moderate but significant correlation existed for AAE, abduction and ER (respectively $r=0.45$, $r=0.47$ and $r=0.57$, $p<0.01$). AAE and abduction were systematically underestimated ($126\pm 21^\circ$ and $95\pm 19^\circ$ simulated vs $150\pm 36^\circ$ and $114\pm 31^\circ$ postoperatively, $p<0.001$) while ER was systematically overestimated ($50\pm 33^\circ$ simulated vs $36\pm 21^\circ$ postoperatively, $p<0.001$). Simulated abduction and external rotation highlighted a significant difference between Inlay-155° and Onlay-145° ($p=0.01$ and $p<0.001$) and this was also retrieved clinically at last follow-up ($p=0.02$ and $p<0.001$).

Conclusions: This study is the first to evaluate the clinical relevancy of predicted ROM for RSA preoperative planning. Motion that involves scapulothoracic joint (AAE and abduction) are underestimated while ER is overestimated. However, preoperative planning provides clinically relevant ROM prediction, especially when comparing two different types of humeral implants (Inlay-155° and Onlay-145°) for abduction and ER. Thus, ROM simulation provides a valuable tool to optimize implant selection and to choose RSA implants to reach the optimal RoM.

FP.08.03

DO PATIENTS WITH POOR EARLY CLINICAL OUTCOMES AFTER ANATOMIC AND REVERSE TOTAL SHOULDER ARTHROPLASTY ULTIMATELY IMPROVE?

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Background: While most patients undergoing aTSA and rTSA have substantial improvement in pain and function at early follow-up, improvements occur more slowly during postoperative rehabilitation in some patients. We assessed a patient's risk of persistent shoulder dysfunction beyond the early postoperative period and identify risk factors for persistent poor function.

Methods: We identified 702 primary aTSAs for OA and 1,360 primary rTSAs for OA, CTA, RCT, between 2001-2022 with early (3- or 6-months) and 2-year follow-up from a multicenter database. Early poor performance was defined as a postoperative ASES score <20th percentile. Persistent poor performance was defined as failing to achieve the patient acceptable asymptomatic state (PASS) (aTSA=81.7, rTSA=77.3) at 2-year follow-up. We identified 144 aTSA and 292 rTSA early poor performers. Our primary outcome was the rate of persistent poor performance. Secondary, we identified risk factors for persistent poor performance.

Results: At 2-year follow-up, 74 aTSAs(51%) and 178 rTSAs(61%) had persistent poor performance. For aTSA, the rate of persistent poor performance did not differ based on whether patients were early poor performers at 3-month follow-up, 6-month follow-up, or both (50% vs. 49% vs. 56%, $P=0.795$). In contrast, 85% of rTSAs classified as early poor performers at both 3- and 6-months were persistent poor performers at 2-years versus 56% and 54% of poor performers at 3- or 6-month follow-up only (respectively; both $P<0.001$). For rTSA, early poor performers at both follow-up visits had a 29.8% [95%CI=18.6-41.0%] greater absolute risk and a 1.54 [95%CI=1.32-1.81] greater relative risk of persistent poor performance compared to rTSAs with poor performance at 3- or 6-month follow-up only (both $P<0.001$). On multivariable analysis, persistent poor performance was best predicted by a diagnosis of hypertension and diabetes for aTSA and prior shoulder surgery and poor preoperative ASES score for rTSA.

Conclusions: Half of aTSAs and nearly two-thirds of rTSAs with an ASES score <20th percentile at early follow-up will have persistent poor shoulder function at 2-years. Risk factors for persistent poor performance should be assessed in early poor performers to determine if there are implant-positioning errors that would benefit from revision or if continued targeted physical therapy should be pursued.

FP.08.04

CLINICAL OUTCOMES BASED ON FINAL BASEPLATE VERSION IN REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: While surgeons attempt to place the baseplate of a reverse total shoulder arthroplasty (rTSA) close to neutral version, outcomes based on the final version remain unknown. The purpose of this study is to determine the clinical and radiographic outcomes of rTSA based on the amount of retroversion the baseplate is placed in to determine if increasing retroversion affects the outcomes.

Methods: All primary rTSA patients in a multicentered international database with a 2-year minimum follow-up implanted with computer navigation so the final baseplate version is known were included. A single medialized glenoid/lateralized humerus rTSA implant system was used. Patients were stratified by their final version: $<0^\circ$ (anteversion), 0 to 5° of retroversion, $6-10^\circ$, and $>10^\circ$. Motion, outcome scores and radiographic outcomes were compared between groups using ANOVA with Tukey HSD post tests and chi square.

Results: Four hundred and fourteen patients (189 females/225 males) were identified, with a mean follow-up of 30 months. Demographics were similar between the 4 groups. The mean native version was 10.3° , and the mean postoperative version was 3.1° . Preoperatively, 46% were $>10^\circ$, 25% $6-10^\circ$, 18% $0-5^\circ$ and 11% anteverted. Postoperatively, 3% were $>10^\circ$, 23% $6-10^\circ$, 68% $0-5^\circ$ and 6% anteverted. Postoperatively, there were no significant differences between the 4 groups with regards to outcome scores or motion, except for abduction greater in the $>10^\circ$ retroversion group that exceeded the MCID. At follow-up, pain scores, patient satisfaction, notching and complications were similar between the groups.

Conclusions: This study demonstrated that computer navigation was highly efficacious, placing 97% of patient in 10° or less of retroversion or in anteversion. Except for abduction, there were no significant differences with regards to motion, pain relief, outcome scores, patient satisfaction or complications between the different groups based on the final implanted version. rTSA baseplates can be placed in anteversion or up to 10° of retroversion. The outcomes of patients left in 15° or greater retroversion could not be answered by this study since the use computer navigation left very few patients with postoperative retroversion $>10^\circ$.

FP.08.05

PYROCARBON HUMERAL HEADS FOR HEMI-SHOULDER ARTHROPLASTY MAINTAIN ADEQUATE GLENOID BONE STOCK AND CLINICAL OUTCOMES AT 5 TO 9 YEARS FOLLOW-UP

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Background: The purpose of this study was to evaluate the progression of glenoid erosion and clinical scores of HSA using pyrocarbon humeral heads from short- (2–4 years) to mid-term (5–9 years).

Methods: We retrieved records of 45 consecutive patients that underwent HSA with pyrocarbon humeral heads from 2013-2015. Patients were evaluated at a 'first' (2–4 years) and a 'second' follow-up (5–9 years). Glenoid morphology was assessed using computed tomography (CT) scans and glenoid erosion was assessed using plain radiographs. The Constant score, American Shoulder and Elbow Surgeons (ASES) and Subjective Shoulder Value (SSV) score were assessed by an independent observer.

Results: From the initial cohort of 45 patients, 2 underwent revision surgery (4.4%) and 6 were lost to follow-up (13.3%), leaving 37 for outcome assessment. At first follow-up of 2.2 ± 0.4 years, only 5 patients showed progression of glenoid erosion (13.5%) compared to immediate postoperative radiographs. The absolute CS was 76.7 ± 14.4 , ASES was 92.3 ± 15.0 , and SSV was 84.1 ± 15.2 . At second follow-up of 6.2 ± 1.2 years, 4 additional patients showed progression of glenoid erosion (10.8%) compared to first follow-up. The absolute CS was 80.8 ± 16.0 , ASES was 92.3 ± 15.0 , and SSV was 82.8 ± 18.3 . At final follow-up, glenoid erosion was moderate in 8 (21.6%) and severe in 2 (5.4%), but had only progressed in 8 shoulders (by 1 grade in each shoulder) compared to immediate postoperative radiographs.

Conclusions: At 5 to 9 years following HSA using pyrocarbon humeral heads, postoperative radiographs revealed progression of glenoid erosion in 21.6% compared to immediate postoperative radiographs, albeit by only 1 grade in all cases. The proportion of shoulders with moderate to severe glenoid erosion (27.0%, at 5-9 years) compares favourably with the literature for HSA using metallic heads (26%-50%, at 4-5 years). Furthermore, patients maintained satisfactory Constant scores and SSV at 5-9 years, and only 2 of the initial 45 patients required revision surgery (4.4%) at 5-9 years, which is considerably lower than those reported for HSA using metallic heads, where revisions range from 11% to 30% at 1-7 years and severe glenoid erosion ranges from 26% to 50% at 3.7-5.0 years.

FP.08.06

DISTAL PERIPHERAL NERVE TENSION AFTER REVERSE SHOULDER ARTHROPLASTY: A CADAVERIC STUDY

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Background: Peripheral nerve injury is a known complication after reverse shoulder arthroplasty (RSA) which has mainly been studied at the level of the proximal plexus branches. However, the effect of RSA on distal peripheral nerves and the influence of elbow and wrist position is not known. The aim of this cadaveric study was to analyse the influence of RSA implantation and upper limb position in the distal median and radial nerves. The hypothesis was that RSA significantly increases distal nerve tension, and that the latter was largely influenced by elbow and wrist position.

Methods: 12 fresh-frozen cadaveric upper limbs were involved in this study. Nerve tension was measured in the median nerve at the level of the proximal arm, elbow, and distal forearm, and in the radial nerve at the level of the elbow, using a customised three-point tensiometer. Nerve tension was measured before and after RSA implantation, using a mid-lay implant (Medacta, Castel San Pietro, Switzerland). Two different configurations were tested, using the smallest and largest implant sizes. 3 upper-limb key positions were analysed (plexus at risk, plexus relief, and neutral), from which the effect of elbow and wrist position was further tested.

Results: RSA implantation significantly increased nerve tension throughout the arm, and made the distal segments highly dependant on elbow and wrist position. There was no significant difference between the 2 tested implant configurations. The plexus at risk position induced the most nerve tension in all nerve segments, while the neutral position the least. Flexing the elbow was the most efficient way to decrease tension in all tested nerve segments and key positions. Wrist flexion significantly further decreased nerve tension in the median nerve, whereas wrist extension decreased tension in the radial nerve.

Conclusions: RSA significantly increases tension in the median and radial nerves, regardless of implant size, making it more vulnerable to wrist and elbow position. Elbow flexion is the most effective to decrease nerve tension, supporting the use of a protective postoperative sling, while elbow extension should be avoided when implanting the humeral component.

FP.08.07

THE IMPACT OF CORACOID MORPHOMETRY ON INTERNAL ROTATION OUTCOME IN PATIENTS WITH CUFF TEAR ARTHROPATHY TREATED WITH REVERSE SHOULDER ARTHROPLASTY

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Background: Functional internal rotation (fIR) motion remains a concern after reverse shoulder arthroplasty (RSA). The extreme variability of the coracoid morphometry together with the gain in tension of the conjoint tendon could impact IR after RSA. Our aim was to evaluate the relationship between postoperative internal rotation outcome and coracoid morphometry, evaluated as anteroposterior (AP) and mediolateral (ML) glenocoracoid distances in a 3D pre-op CT scans, in a consecutive series of patients undergoing the same RSA implant.

Methods: A retrospective analysis of a prospectively collected series of 40 patients [18M-22F; mean age (SD):73.4 (4.1)] submitted to RSA for cuff tear arthropathy, was performed.

Functional internal rotation function was measured as the highest midline segment of the back that can be reached and converted into 5 range segments of motion. Participants were divided into 2 groups according to the fIR (A ≤ 6; B: >6). Passive IR was also measured. The AP and ML glenocoracoid distances were measured, in millimeters, on the preop 3D CT scans. Statistics were performed.

Results: The mean follow-up was 29 months (range 24-39). The mean score for fIR was 6.45 (SD:1.81) while the mean score for passive IR was 6.84 (SD:1.75). No difference was found between fIR and passive IR ($p = 0.328$). No statistical difference was found between fIR and glenosphere size ($p = 0.562$) and fIR and size of the liner ($p = 0.429$). Significant statistical correlations have been found between AP and ML coracoid distances and the two groups (AP in Group A: 28.50 and B: 31.265, $p = 0.034$; ML in Group A: 23.053 and B: 14.27, $p < 0.001$).

Conclusions: Our study demonstrated that coracoid morphometry, evaluated as glenocoracoid distance, significantly impact IR outcomes in a 145° neck shaft angle RSA; in particular, a high mediolateral glenocoracoid distance (>23mm) was found to be determinant. This anatomical parameter should be considered in the preoperative planning of RSA and additional surgical strategies addressed in order to gain satisfactory fIR.

FP.08.08

EFFECT OF ADDITIONAL POLYETHYLENE THICKNESS ON SOFT TISSUE TENSION IN CADAVERIC REVERSE SHOULDER ARTHROPLASTY MODEL MODIFIED BY NOVEL DEVICE

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Background: Reverse shoulder arthroplasty has revolutionized the treatment of glenohumeral arthritis and accounts for an increasing percentage of the shoulder arthroplasty performed annually. Over time innovations have improved surgical execution but the intraoperative assessment of soft tissue tension is still a subjective, feeling-based process. The use of a novel, smart implant will provide real-time anatomical data as well as real-time patient specific adjustment with objective data on soft tissue tension and reveal the change in soft tissue tension with each additional millimeter of polyethylene thickness.

Methods: A single cadaveric implantation of a novel humeral reverse arthroplasty device (Statera Medical) was performed by fellowship trained surgeons using an inlay, 155° neck shaft angle prosthesis. The subscapularis was taken down via a peel technique in a standard deltopectoral approach. Data was gathered real-time from the device after taking the arm through a set ROM protocol with the arm in 40° of forward elevation. One millimeter of additional thickness was deployed via an adjustable screw mechanism, and the ROM protocol and measurements were started again. This was completed six times from 0 to 6mm of thickness and measurements of force in lbf and load distribution as well as arm position were taken without a subscapularis repair.

Results: The average increase in force measured across the glenohumeral joint was increased by 11.12% per millimeter of polyethylene thickness (range 6-16%). The largest percent increase in force (16%) was seen from when increasing the polyethylene thickness from 0-1mm. These forces ranged from 11.04 lbf to 22.61 lbf and increased with increasing forward elevation and internal rotation.

Conclusions: In a cadaveric Gramont design model, each millimeter of polyethylene increased the force across the glenohumeral joint by an average of 11.12%. This device represents a unique, novel implant that can both objectively assess glenohumeral forces and modify the soft tissue tension *en vivo* with an adjustment screw mechanism. Future testing with a lower neck shaft angle and subscapularis repair will be performed. Additional results of approximately six additional cadaveric specimens will be available by the time of the presentation in Rome.

FP.09.01

GLENOID RETROVERSION, HUMERAL SUBLUXATION AND WALCH CLASSIFICATION ARE NOT ASSOCIATED WITH A MUSCLE IMBALANCE BETWEEN ANTERIOR AND POSTERIOR CUFF

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Background: In 1999, Walch et al. described the type B glenoid characterized by posterior subluxation of the humeral head leading to asymmetric loading of the glenoid and posterior wear with secondary glenoid retroversion. Until now, the etiology of this pathology remains unknown and it has been hypothesized that horizontal muscle imbalance between the anterior and the posterior cuff could cause this condition. The objective of this study was to compare the ratio of anterior to posterior rotator cuff muscle volume depending on posterior humeral subluxation and retroversion analyzed as continuous variables and based on the Walch classification.

Methods: Two hundred and forty-seven CT scans of shoulders (with the entire scapula and rotator cuff) with primary glenohumeral osteoarthritis (92 type A and 155 type B) were included in this study. The scapula, proximal humerus, deltoid and rotator cuff muscles were all segmented automatically. For each muscle, the volume of muscle fibers without intra-muscular fat was then measured and the ratio between the volume of the subscapularis and the volume of the posterior cuff (infraspinatus + teres minor) was calculated (AP ratio). Statistical analyses were performed to determine whether a correlation could be found between this AP ratio and retroversion/posterior humeral subluxation/glenoid type in the Walch classification using a Spearman's correlation test and a Wilcoxon test respectively.

Results: No significant difference ($p=0.35$) was found between the AP ratio of type A and type B glenoids. No correlation was found between AP ratio and glenoid version ($\rho = 0.005$, $p=0.94$) nor between AP ratio and humeral subluxation ($\rho = -0.022$; $p=0.72$).

Conclusions: As opposed to previous two-dimensional CT-scan studies, we did not find any correlation between AP muscle volume ratio and glenoid parameters, especially retroversion, humeral subluxation and Walch type in our three-dimensional analysis. Therefore, muscle imbalance does not seem to be the etiology for the posterior humeral subluxation leading to posterior glenoid erosion and subsequent retroversion characteristic of Walch B glenoids.

FP.09.02

OUTCOMES OF ACUTE VERSUS DELAYED REVERSE SHOULDER ARTHROPLASTY FOR PROXIMAL HUMERUS FRACTURES IN THE ELDERLY - A SYSTEMATIC REVIEW AND META-ANALYSIS

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Background: Reverse shoulder arthroplasty (RSA) has become an increasingly popular treatment option for proximal humerus fractures (PHFs) in the elderly. There is however contradictory evidence on the impact of timing of RSA on patient outcomes. It remains unclear if poor results after initial non-surgical or surgical management can be improved with delayed RSA. The aim of this systematic review and meta-analysis is to compare the outcomes of acute RSA and delayed RSA for the treatment of PHFs in the elderly.

Methods: A systematic search was performed on four databases for studies that compared acute RSA with RSA used after prior non-operative or operative treatment. Studies with a mean cohort age <65 years old were excluded. Demographical data, clinical outcome scores, range of motion measurements, and post-operative complications were collected from included studies.

Results: Sixteen studies were included for data analysis. Compared with delayed RSA cohorts, acute RSA cohorts had higher forward flexion (124.3° vs 114.9°; $p=0.019$), external rotation (24.7° vs 20.2°; $p=0.041$), and abduction (113.2° vs 99.8°; $p=0.03$). Compared to RSA after conservative management, acute RSA had greater 21 external rotation (29.9° vs 21.4°; $p=0.043$). The acute RSA cohort had significantly higher ASES (76.4 vs 68.2; $p=0.025$) and Constant-Murley scores (65.6 vs 57.3; $p=0.002$) compared to the delayed RSA cohort. Subgroup analyses showed significantly greater Constant-Murley (64.9 vs 56.9; $p=0.020$) and SST scores (8.8 vs 6.8; $p=0.031$) with acute RSA compared to RSA after conservative treatment. ASES score was higher in the acute RSA cohort compared to RSA after open reduction internal fixation (ORIF) (77.9 vs 63.5; $p=0.008$). The overall complication rate per 100 patient-years was 11.7 for the acute RSA cohort, and 18.5 for the delayed RSA cohort (RR: 0.55; $p=0.015$).

Conclusions: Based on the current evidence, acute RSA presents better clinical outcome measures and range of motion measurements, with decreased complication rates than RSA performed after prior non-operative or operative treatment.

FP.09.03

OUTPATIENT VERSUS INPATIENT TOTAL SHOULDER ARTHROPLASTY: A MATCHED COHORT ANALYSIS OF POSTOPERATIVE COMPLICATIONS, SURGICAL OUTCOMES, AND REIMBURSEMENTS

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Background: There has been a trend toward performing arthroplasty in the ambulatory setting. The primary purpose of this study was to compare outpatient and inpatient total shoulder arthroplasty (TSA) in terms of postoperative medical complications, healthcare utilization outcomes, and surgical outcomes.

Methods: Patients who underwent outpatient TSA or inpatient TSA with minimum 5-year follow-up were identified in the PearlDiver Database. These cohorts were propensity-matched based on age, sex, Charlson Comorbidity Index, smoking status, and obesity (BMI>30). All outcomes were analyzed using Chi-square and T-tests where appropriate.

Results: After matching, a total of 4,831 patients were included in our final cohort. Of these patients, 1,613 (33.4%) underwent outpatient TSA and 3,218 (66.6%) underwent inpatient TSA. Outpatient TSA patients had significantly lower rates of various 90-day medical complications ($p<0.05$ for all). Outpatient TSA patients had lower risk of aseptic loosening (1.30% vs 2.24%, $p=0.026$) at 2-years post-operation and lower risk of PJI (2.23% vs. 3.42%, $p=0.023$) at 5-year post-operation relative to inpatient TSA patients. Outpatient TSA reimbursements were significantly lower than inpatient TSA reimbursements at the 30-day, 90-day, and 1-year postoperative intervals.

Conclusions: The present study found patients undergoing outpatient TSA to be at lower odds for both postoperative medical and surgical complications compared to those undergoing inpatient TSA. Despite increased risk for postoperative healthcare utilization in terms of readmissions and ED visits, outpatient TSA was significantly less expensive at every postoperative time point assessed.

FP.09.04

ROTATOR CUFF AND DELTOID MUSCLE CHANGES FOLLOWING REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: Reverse total shoulder arthroplasty (rTSA) is being performed in greater proportion for shoulders with an intact rotator cuff (RC). Little is known regarding in-vivo effects of rTSA implants on RC and deltoid musculature. This study quantifies changes in cross-sectional area (CSA) of the RC and deltoid following rTSA and assesses clinical impacts of these changes.

Methods: Twenty-five patients undergoing rTSA were included. Pre-operative and one-year post-operative computed tomography (CT) scans, range-of-motion, and functional scores were collected. Cross-sectional area (CSA) measurements of the supraspinatus (SS) and combined infraspinatus/teres minor (IS/Tm) were made at three points on parasagittal CT sections by two reviewers. Measurements of deltoid CSA were made at three points in a plane perpendicular to the humeral shaft. Scalar measurements in two orthogonal planes were used to assess lateralization and distalization.

Results: Compared to pre-operative measurements, the CSA of the SS and IS/Tm decreased in 72% (18/25; mean 13.4% decrease; SD, 19.8%; range, 61.8% decrease to 13.7% increase; $p=0.02$) and 64% (16/25; mean 8.7% decrease; SD, 13.5%; range, 35.3% decrease to 14.9% increase; $p=0.11$) of shoulders, respectively. Eighty-four percent of shoulders saw a decrease in their combined posterosuperior cuff complex area (21/25; mean 11.5% decrease; SD, 11.2%; range, 43.4% decrease to 5.4% increase; $p=0.035$). In contrast, deltoid CSA increased in 80% of patients (20/25; mean 7.9% increase; SD, 20.2%; range, 41.3% decrease to 67.8% increase; $p=0.43$). There were no significant differences in CSA changes between shoulders with cuff-intact glenohumeral osteoarthritis (GHOA) and rotator cuff tear arthropathy (RCTA) ($p=0.36$, $p=0.58$, $p=0.16$, $p=0.36$ for SS, IS/Tm, posterosuperior cuff and deltoid, respectively). In shoulders with GHOA, a smaller decrease in CSA of the SS was associated with a smaller increase in deltoid CSA ($R=-0.68$; $p=0.03$), and greater improvements in forward elevation ($R=0.66$; $p=0.04$).

Conclusions: In general, posterosuperior cuff CSA declines and deltoid CSA increases following rTSA with a minimally lateralized construct. In GHOA, changes in CSA of SS were inversely associated with deltoid CSA changes and positively associated with forward elevation improvements. For patients with intact RC undergoing rTSA, preservation of SS may optimize forward elevation and decrease deltoid muscle burden.

FP.09.05

CLINICAL OUTCOMES OF ANATOMIC VERSUS REVERSE TOTAL SHOULDER ARTHROPLASTY FOR PRIMARY OSTEOARTHRITIS WITH PREOPERATIVE FORWARD FLEXION STIFFNESS AND AN INTACT ROTATOR CUFF

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Background: Both anatomic and reverse total shoulder arthroplasty (aTSA and rTSA) provide functional and clinical improvements for patients with primary osteoarthritis. One purported benefit of aTSA over rTSA is comparatively better postoperative ROM; however, it is unclear whether aTSA provides superior ROM compared to rTSA in patients with preoperative stiffness.

Methods: A retrospective review of a single-institution prospectively-collected shoulder arthroplasty database was performed between 2007-2020. Patients were excluded for preoperative diagnosis of nerve injury, infection, or fracture. Analysis included 344 aTSAs and 163 rTSAs performed for primary cuff-intact osteoarthritis with 2-year minimum follow-up. Defining preoperative stiffness as passive FE $\leq 105^\circ$, three cohorts were matched 1:1: (1) stiff aTSAs (n=85) to non-stiff aTSAs, (2) stiff rTSAs (n=74) to non-stiff rTSAs, and (3) stiff rTSAs (n=64) to stiff aTSAs. We compared ROM, outcome scores, and complication and revision surgery rates at latest follow-up.

Results: Compared to non-stiff aTSAs, stiff aTSAs continued to have poorer postoperative active ER and passive FE postoperatively. While stiff rTSAs had poorer preoperative ROM and functional scores for all measures compared to non-stiff rTSAs, there were no differences between groups postoperatively. When comparing stiff aTSAs to stiff rTSAs, no significant differences in preoperative ROM or functional outcome scores were identified. However, stiff rTSAs had greater postoperative active FE (135 \pm 19 vs. 119 \pm 29, p=.001), passive FE (148 \pm 18 vs. 135 \pm 27, p=.004), and active abduction (127 \pm 23 vs. 109 \pm 29, p=.001) than stiff aTSAs. Postoperative outcome scores were more favorable in the stiff rTSA cohort for the SPADI, SST, ASES, UCLA, and Constant scores. When comparing the proportion of stiff aTSAs vs. stiff rTSAs that exceeded MCID and SCB for aTSA, stiff rTSAs demonstrated greater proportions in all measures except ER. The rate of complications did not significantly differ between stiff aTSA and stiff rTSA, but there was a higher rate of revision surgery in stiff aTSAs.

Conclusions: Preoperative FE stiffness leads to poorer postoperative ROM compared with non-stiff patients for aTSA, but not rTSA; however, functional score improvements are similar. Postoperative ROM and outcome scores favor rTSA when comparing stiff aTSA and stiff rTSA, indicating rTSA may have a role for patients with cuff-intact osteoarthritis and preoperative FE stiffness.

FP.09.06

REVERSE SHOULDER ARTHROPLASTY FOR PRIMARY OSTEOARTHRITIS IN PATIENTS UNDER 55 HAS LOWER REVISION RATE COMPARED TO TOTAL AND PARTIAL ANATOMIC REPLACEMENTS - ANALYSIS OF AUSTRALIAN JOINT REGISTRY

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Background: Reverse shoulder arthroplasty (RSA) has been increasingly used for primary osteoarthritis in the younger population with favourable functional results. Its survivorship in this highly active population, however, remains undefined. In this study, we conduct a review of the Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) to evaluate the revision rates of different types of shoulder arthroplasties in different age groups. Our hypothesis is that RSA has a higher survivorship than partial and total anatomic replacements in patients younger than 55.

Methods: Primary osteoarthritis as an indication was included for this study. 5-year Cumulative Percent Revision rate (CPR) was retrieved from AOANJRR 2020 dataset for humeral resurfacing (HR), hemiarthroplasty (HA), total anatomic shoulder arthroplasty (ATSA), and RSA, stratified according to the age groups: <55, 55-64, 65-74, and >75. The groups <55 and >75 were directly compared, with the group >75 chosen as a control for implant survivorship. Kaplan-Meier estimates of revision rates were graphed. Age- and gender- adjusted hazard ratios (<55 vs. >75) were calculated for each type of replacement. A hazard ratio with confidence interval that contains 1 was considered nonsignificant and inconclusive of hazard.

Results: 29658 joints were evaluated. The mean 5-year CPR was lowest for RSA compared to all other arthroplasties in all age groups. Younger age group was associated with a higher CPR for all arthroplasty types. However, the dispersion between groups is higher in HR, HA, and ATSA than in RSA. Comparing identical age groups among the four types of arthroplasties, the rate of annual increase in CPR is lowest in RSA. Hazard ratios for revision between the groups <55 and >75 are as follows: Humeral Resurfacing - 7.14 (2.44, 20.00), $p < 0.001$, Hemiarthroplasty - 7.78 (3.76, 16.09), $p < 0.001$, ATSA: 2.13 (1.64, 2.70), $p < 0.001$, and RSA-1.88 (0.96, 3.68), $p = 0.064$. Only the hazard ratio for reverse shoulder arthroplasty was considered statistically insignificant.

Conclusions: RSA may be a viable option in young patients with primary osteoarthritis, with midterm revision rates comparable to those of older patients and lower than the rates associated with anatomic prostheses.

FP.09.07

CLINICAL AND RADIOLOGICAL OUTCOMES OF THE TOURNIER ASCEND FLEX UNCEMENTED METAPHYSEAL BEARING STEM AT A MINIMUM 2-YEAR FOLLOW UP

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Background: The Ascend Flex is a short stem humeral implant with a proximal titanium plasma coating to help with osseous integration. It has been reported to have good early/mid-term clinical outcomes and low revision rates (0 - 13%). The reported rates of stress shielding for this implant varies greatly from 3% to 71% and the clinical implications of this are unknown. The aim of this study was to evaluate the early radiographic and clinical outcomes of patients who underwent primary shoulder arthroplasty with the uncemented Ascend Flex implant.

Methods: All consecutive patients who underwent shoulder arthroplasty with uncemented Ascend Flex implants with a minimum of 24 months follow up were included in this retrospective series. The outcomes of interest were revision rate, reoperation rate, radiographical loosening, subsidence, stress shielding, distalisation and lateralisation shoulder angles (DSA, LSA), adverse events, and preoperative and postoperative Oxford Shoulder Score (OSS).

Results: 151 shoulders (143 patients) were eligible for inclusion. 74 were anatomic total shoulder arthroplasty, 75 were reverse geometry, and 1 was a hemiarthroplasty. Mean age was 71.0 ± 8.2 years. 56% female. Mean follow up duration was 51.6 ± 17.2 months. No patients underwent humeral component revision, 1 patient (0.7%) required glenoid revision for integration failure within an adverse event rate of 11.9%. 3 cases (2.7%) met the criteria to be deemed radiologically loose. 6 cases (5.4%) demonstrated stress shielding. Mean DSA and LSA was $41.7^\circ \pm 30.8^\circ$ and $87.4^\circ \pm 13.1^\circ$ respectively. Mean subsidence was 3.16 ± 1.89 mm. Functional outcomes by way of OSS statistically improved from 13.8 ± 7.3 preoperatively to 32.9 ± 13.8 postoperatively ($p < 0.0001$).

Conclusions: The findings of this series demonstrate reassuring clinical and radiological outcomes for the Ascend Flex humeral implant in primary shoulder arthroplasty. Stress shielding was found to be low (5.4%) compared to the literature. Further investigation is required to document the mid to long-term outcomes for this relatively new humeral component.

FP.09.08

TWO-STAGE REVISION SHOULDER PROSTHESIS VS. PERMANENT PROSTALAC IN THE TREATMENT OF THE SEPTIC ARTHRITIS OF THE SHOULDER JOINT

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Background: The septic arthritis of the shoulder joint caused severe joint destruction and sequelae. We performed a retrospective case-control study to compare the clinical outcomes of 2-stage revision reverse total shoulder arthroplasty (RTSA) and permanent PROSTALAC (prosthesis with antibiotic-loaded acrylic cement) spacer in the septic arthritis of the shoulder joint.

Methods: Thirty one patients (32 shoulders) treated for the septic arthritis of the shoulder joint were retrospectively reviewed after a mean follow-up of 3 years (range 1, 1-5 years). Fifteen patients (15 shoulders) underwent permanent PROSTALAC spacer (Group I) and 16 patients (17 shoulders) performed 2-stage revision RTSA (Group II). We evaluated clinical outcomes including pain VAS, ASES, UCLA, SST and range of motion and radiological outcomes at the last follow-up.

Results: At the last follow-up, there were no clinical or radiographic signs of recent infection in the remaining patients, except for two re-infection cases in the RTSA group. Follow-up examination showed significant improvement of all variables compared to preoperative values ($p < 0.001$). Radiographs did not show progressive radiolucent lines or change in the position of the functional spacer. No statistically significant differences were reported between the two groups concerning VAS scores, ASES, UCLA and SST scores while average forward flexion and abduction were significantly higher in patients undergoing 2-stage revision RTSA surgery. In both groups, 2 and 4 complications were developed (2 glenoid severe erosion in PROSTALAC spacer group, 2 glenoid component loosening and 2 resection arthroplasty in 2-stage revision group).

Conclusions: Both surgical procedures provided infection eradication and satisfying subjective functional outcomes. Functional results were superior in patients treated with revision RTSA, although a higher rate of complication was reported in this cohort of patients, thus suggesting the use of permanent spacer in high-risk or low-demanding elderly patients.

FP.10.01

COMPARISON OF FUNCTIONAL BRACING OF HUMERAL SHAFT FRACTURES: THERMOPLASTIC CUSTOM BRACES AGAINST PRE-PREPARED COMMERCIAL BRACES

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Background: Functional humeral bracing of mid-shaft humeral fractures has been widely accepted as a gold standard for non-operative treatment. Despite reported high union rates, there is no proven superiority of any orthosis. Here we aim to compare the outcomes following use of custom-made thermoplastic versus commercial humeral brace with regards to time to union; non-union rates, types of non-union and conversion to surgery.

Methods: Patients with humeral fractures treated between 2018 and 2021 identified retrospectively by electronic records at two UK tertiary centres. Only diaphyseal humerus fractures (AO 12) were included in the study. Proximal (AO 11), distal (AO 13), open and pathological humeral fractures were excluded. Patients attending one centre received a custom made thermoplastic splint and the other centre, an off the shelf humeral brace applied. Radiological union was defined as healing of, at least 3 out of 4 cortices determined from follow up radiographs. Data calculations were made using chi-square test.

Results: 74 patients treated with a thermoplastic brace and 71 with a commercial brace were identified. There were 59 men and the cohort's mean age was 64 years (SD17). Both groups had similar gender and age distributions. More patients achieved union with a thermoplastic brace (72%) than a commercial brace (55%) which was statistically significant (χ^2 , $p=0.04$). Although time to union was similar in both groups (5 vs. 5.4 months), a hypertrophic non-union was twice as common in the commercial brace group (4 vs. 8 cases). Patients with a commercial brace converted to surgical treatment more frequently (11 vs. 14 cases).

Conclusions: Thermoplastic custom-made braces provide better fracture stability allowing for statistically significantly higher rates of fracture union during a similar treatment period time in comparison to commercially available splints. Patients wearing a commercial splint were significantly more likely to develop hypertrophic non-union requiring surgery.

FP.10.02

PEDICLED BONE TRANSFER OF THE FIRST RIB IN THE TREATMENT OF FAILED SURGICAL MANAGEMENT OF CLAVICULAR NON-UNION

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Background: Failed treatment of clavicular non-union by iliac bone grafting occurs in approximately 10% of cases. The working hypothesis of this study is that a local pedicled bone flap taken from the first rib could be proposed as an alternative.

Methods: An anatomical study from 67 first ribs from 67 skeletons allowed us to characterise the vascular feeder foramina and therefore specify the harvesting area for a pedicled bone graft. Then, from 4 donated bodies (8 procedures), injected arterially and venously, the operative technique was defined and the relationships with the elements of the subclavian vascular bundle and the brachial plexus were measured.

Results: 6 feeder foramina have been identified : 3 antero-superior and inferior, located 7, 15 and 8 mm respectively from the bony sternal edge of the first rib; this area corresponds to the insertion of the subclavius muscle on the first rib. The size of the sterno-costal articular cartilage measured 17mm on average. Technically, using a single approach, a mixed bone and muscle graft may be harvested with a sufficient arc of rotation to cover the entire clavicle (graft thickness between 8 and 20mm). However, control of the subclavian vessels requires posterior extension of the approach to the clavicle. In this situation, the vascular bundle remains at a distance from the transplant (on average 1 to 2cm with the arm alongside the).

Conclusions: This anatomical and cadaveric study confirmed that it is possible to transfer a bone graft from the first rib, pedicled onto the subclavius muscle, for the treatment of failed surgical management of clavicular non-union.

FP.10.03

CEMENTLESS REVERSE TOTAL SHOULDER REPLACEMENT FOR ACUTE PROXIMAL HUMERUS FRACTURES: RESULTS OF 2-8 YEARS FOLLOW UP.

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Background: Proximal humerus fractures (PHFx) are one of the most common fractures in the elderly and its incidence is expected to increase. Reverse TSA (rTSA) for treatment of acute fractures in the elderly shows good outcome yet traditionally it is performed with cemented implants due to concerns of bone quality and fixation. The purpose of this study was to prospectively evaluate the clinical and radiographic outcomes of a cementless rTSA in acute fractures.

Methods: Between 2007 to 2019, 50 patients underwent a cementless rTSA for acute proximal humerus fractures. All operations performed within 4 weeks from fracture with mean time to surgery of 2 weeks. Procedures were performed using the Neviaser - MacKenzie approach with a cementless rTSA, designed for fractures, incorporating bone graft impaction technique. Mean age 80.2 years (range 40-94). Thirty-five patients were available for long follow-up. Fifteen patients could not be evaluated: 8 died along the years (delighted with the shoulder in their last follow up) and 7 lost to follow up. Mean follow-up 44.4 months (range 24-106 months).

Results: The patients showed good outcome with 31/35 patients very satisfied with the results at the last follow-up. The mean Constant Score was 59.5 points (Age/Sex adjusted, 91.0) at the last follow up. Mean forward elevation was 125.4, abduction 120°, active internal rotation 70.2° and active external rotation 27.7°. Tuberosity healing was achieved in 82.9% of the cases (n=29). There were no complications in the study group. Radiographically, good fixation of the implants was observed with no signs of lucencies, loosening or implant subsidence.

Conclusions: Cementless rTSA for acute proximal humerus fractures demonstrates excellent clinical and radiographic results with high patient satisfaction. The use of a cementless rTSA with suitable stem design and incorporation bone graft impaction technique, provides good immediate and long-term implant fixation. The specific implant design with only proximal HA-Porous coating and a smooth distal stem, support metaphyseal fixation and reduce the risk of stress shielding. Use of cementless rTSA for acute proximal humerus fractures seems promising in the medium to long term (2-8y).

FP.10.04

COMPARATIVE OUTCOMES BETWEEN ISOLATED GREATER TUBEROSITY PROXIMAL HUMERUS FRACTURES VS GREATER TUBEROSITY SHOULDER FRACTURE DISLOCATIONS

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Background: The purpose of this study was to investigate the difference in clinical and radiological outcomes for isolated greater tuberosity fracture-dislocations compared to isolated greater tuberosity fractures of the proximal humerus.

Methods: A two centre, retrospective cohort study was performed on adults presenting with either a fracture dislocation of the greater tuberosity or an isolated fracture of the greater tuberosity of the shoulder. Clinical outcomes were assessed by Oxford Shoulder Score (OSS), QuickDASH, VAS for pain and Subjective Shoulder Value (SSV) with a minimum follow up time of 24 months. Radiological outcomes were described according to Mutch classification, degree of displacement and time to union. Complications and interventions were documented.

Results: 78 patients were included with a mean age of 58 years, 55% were female and 61% involved the dominant side with a mean follow up time of 5.1 years. 41 patients were included in the fracture dislocation (FD) group and 37 in the isolated fracture (IF) group. The IF group were significantly younger (51 vs 65, $p = 0.0004$) but the groups were otherwise homogenous. There was a statistically significantly higher rate of comminution ($p = .0001$) and delayed or nonunion ($p = .0013$) in the FD group. The FD group had a statically significant increased overall complication rate ($p = .000273$) and operation rate ($p = .038541$). 21% of the FD group had temporary nerve injuries with none in the IF group. There was no statistically significant difference in overall functional outcome scores between groups. A minimally clinically important difference (MCID) was observed in the mean OSS scores of the FD group compared to the IF group (39 vs 42). Subgroup analysis displayed a statistically significant (77 vs 86; $p = 0.047$) difference in the SSV of those patients who had a > 5 mm displacement of their fractures.

Conclusions: This study shows that >5 mm displacement of the GT is an independent poor prognostic factor for an inferior outcome in these injuries. FD is associated with a higher complication and operation rate. Despite this, the overall functional outcome score of both groups are comparable apart from a MCID in OSS score between the two groups.

FP.10.05

SURGICAL VERSUS NON-SURGICAL TREATMENT FOR DISPLACED PROXIMAL HUMERAL FRACTURES: KEY MESSAGES FROM AN UPDATED COCHRANE REVIEW

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Background: Fractures of the proximal humerus are common injuries, especially in older people. The indication for surgery remains a key treatment question for displaced fractures - surgical interventions are still used widely despite accumulating evidence that surgery may not result in a better outcome. We updated our Cochrane review to include the new evidence for non-pharmacological interventions for treating these fractures. We aimed to assess the benefits and harms of surgical versus non-surgical treatment for proximal humeral fractures.

Methods: A systematic review and meta-analysis. We conducted a comprehensive search in multiple bibliographical databases in November 2021. We considered all randomised and quasi-randomised controlled trials that compared non-pharmacological interventions for treating acute proximal humeral fractures in adults. Pairs of review independently selected studies, assessed risk of bias and extracted data. We pooled data where appropriate and used GRADE for assessing the certainty of evidence for each outcome. This presentation focuses on surgical versus non-surgical treatment comparison.

Results: We included 47 randomised trials (3,179 participants) that tested one of 26 comparisons. Ten trials, (717 participants) evaluated surgical versus non-surgical treatment for displaced fractures. We found high-certainty evidence of no clinically important difference between surgical and non-surgical treatment in patient-reported shoulder function at one year (SMD 0.10, 95% CI -0.07 to 0.27; 552 participants, 7 studies) and two years (SMD 0.06, 95% CI -0.13 to 0.25; 423 participants, 5 studies). We found high-certainty evidence of no clinically important between-group difference in quality of life at one year (EuroQol: MD 0.01, 95% CI -0.02 to 0.04; 502 participants, 6 studies). Low-certainty evidence of a higher risk of additional surgery in the surgery group was found (RR 2.06, 95% CI 1.21 to 3.51; 667 participants, 9 studies).

Conclusions: There is high-certainty evidence that compared with non-surgical treatment; surgery does not result in a better outcome at one and two years after injury. Surgery may increase the need for subsequent surgery.

FP.10.06

PROXIMAL HUMERUS FRACTURE SEQUELAE: ARE CORRECTIVE OSTEOTOMIES STILL A TABOO? ROLE OF THREE-DIMENSIONAL PREOPERATIVE PLANNING AND PATIENT SPECIFIC SURGICAL INSTRUMENTATION

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Background: Symptomatic proximal humeral fracture sequelae (PHFS) represent a surgical challenge due to the altered bone and soft tissue morphology. The purpose of this study was to report the outcome of Multiplanar Corrective Humeral Osteotomies (MCHOs) associated to reverse total shoulder arthroplasty (rTSA) performed following a three-dimensional (3D) pre-operative planning and using a 3D-printed patient-specific surgical instrumentation (PSI) in type 1C, 1D and 4 PHFS.

Methods: In this prospective monocentric study, we enrolled patients affected by symptomatic PHFS type 1C, 1D or 4, treated between 2018 and 2019 with rTSA associated to MCHO and followed-up at 12 and 24 months. The pre- and post-operative Constant score (CS), Visual Analogue Scale (VAS) and Disabilities of the Arm Shoulder Hand score (DASH) were recorded. All patients underwent a pre-operative computed tomography (CT), then a dedicated software (Mimics 22, Belgium) was used to run a segmentation algorithm on CT images. Four different PHFS subgroups (based on ten specific anatomical variables and on the type of osteotomy required) were identified. Metaphyseal bone cuts were virtually performed before surgery in all patients, and a 3D-printed PSI was used to reproduce the planned osteotomies in vivo.

Results: Twenty patients completed a 2-year follow-up. Preoperative and 2-year mean (\pm standard deviation) values for the CS, VAS and DASH were 24.3 (\pm 8.8), 6.5 (\pm 1.3), 60.7 (\pm 9.6), and 67.7 (\pm 11.4), 1.6 (\pm 0.8), 24.1 (\pm 13.1) points, respectively. The minimally clinical important difference for CS and DASH score was achieved in 95% of patients. No major complication was observed. One patient showed an unexplained worsening of clinical scores between the 12 and the 24-month follow-up, while in one patient bone resorption of the greater tuberosity was observed on radiographs at 2 years, with no clinical impact.

Conclusions: We demonstrated that the combination of pre-operative 3D planning and intra-operative 3D-printed PSI to perform MCHO associated to rTSA in the treatment of Boileau type 1C, 1D and 4 PHFS may lead to a satisfactory clinical outcome at 2 years of follow-up.

FP.10.07

ARTIFICIAL INTELLIGENCE-BASED CLASSIFICATION OF PROXIMAL HUMERAL FRACTURES IN PLAIN RADIOGRAPHS, PERFORMANCE OF A CONVOLUTIONAL NEURAL NETWORK CLASSIFIER

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Background: Classification of proximal humeral fractures (PHF) in plain radiographs is used to guide treatment, but agreement in classification can be difficult to achieve. Artificial intelligence (AI)-based networks, convolutional neural network (CNN) have shown potential in fracture classification. The AO Foundation/Orthopaedic Trauma Association (AO/OTA) classification of PHF lack of research on AI-assisted classification. Our aim was to train and evaluate the ability of a CNN in classification of PHF according to the AO/OTA classification.

Methods: 6 733 plain radiographic shoulder examinations were assessed and labeled and were used to train a CNN, and 560 radiographs to validate its performance in classification.

Results: 6 172 examinations were used in CNN training, divided as 463 type A (extraarticular, unifocal, 2-part fracture); 61 type B (extraarticular, bifocal, 3-part fracture); 47 type C, (articular or 4-part fracture) and 5 612 without PHF. The CNN exhibited excellent classification accuracy when evaluated by a unique dataset of 560 examinations. Classification performance for all PHF, presented as the mean Area Under the Curve (AUC) in ROC-curve analysis, mean, was 0.96 (95% CI 0.94–98). AUC for type A fractures was 0.95 (95% CI 0.93–0.97), type B 0.96 (95% CI 0.92–0.99) and type C 0.87 (95% CI 0.72–1.02), respectively.

Conclusions: AI-based classification of PHF in plain radiographs yielded high classification accuracy. These findings can be used in development of clinically applicable AI-based PHF classifiers. In extension, such systems could further solidify basis for diagnostics and treatments.

FP.10.08

FUNCTIONAL OUTCOMES IN PROXIMAL HUMERUS FRACTURES TREATED WITH PRIMARY VERSUS SALVAGE REVERSE SHOULDER ARTHROPLASTY

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Background: Reverse total shoulder arthroplasty (RSA) is an alternative for patients with complex fractures of the proximal humerus and a salvage option for osteosynthesis failures, fracture sequelae, and hemiarthroplasty (HA) revisions. The objective of this work is to evaluate the functional results of patients with proximal humerus fractures (PHF) treated with a primary RSA versus patients treated as a salvage measure for treatment failures of PHF.

Methods: Retrospective cohort of patients with PHF who were treated between 2015 and 2022 with RSA initially or as salvage secondary to failure of orthopedic treatment, osteosynthesis, or HA. Cases with ipsilateral upper extremity fracture, history of previous infection, shoulder surgeries prior to the fracture, or follow-up of less than 1 year were excluded. Demographic variables and radiological characteristics of the initial fracture were considered. Functional outcomes were assessed using range of motion (ROM), Constant-Murlay (CS) scales, subjective shoulder score (SSV), and pain (VAS). For the comparative statistical analysis, the T-test and Mann-Whitney tests were used.

Results: Ninety patients underwent RSA, forty patients met the inclusion and exclusion criteria. The average age was 64 years (47-80), 25 women and 15 men. Of which 23 were treated with primary RSA and 17 salvage RSA. 54% of all fractures were 4-part, 34% impacted in valgus and 32% in varus with an average follow-up of 15 months (12-80 months). Of the patients treated with salvage RSA, 11 were with osteosynthesis, 5 with HA and 2 orthopedic. The most frequent complication was avascular necrosis in 6 cases. The primary RSA group presented significantly less pain (VAS 0.5 +/-0.13 v/s 1.8 +/-0.40) (P=0.002) and better CS functional index (73.2 +/-1.6 v/s 65 +/-3.01) (P=0.01) at the end of follow-up. There were no differences between the two groups in ROM (active anterior elevation, external and internal rotation) and SSV.

Conclusions: In this series of patients, the ROMs are similar in patients treated primary RSA or as salvage with a reverse arthroplasty, however primary patients present significantly less pain and better functionality as evidenced by the CS index.

FP.11.01

ASSESSMENT OF PROGRESSION AND CLINICAL RELEVANCE OF STRESS-SHIELDING AROUND PRESS-FIT RADIAL HEAD ARTHROPLASTY: COMPARATIVE STUDY OF TWO IMPLANTS

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Background: Few studies analyzed proximal radial neck resorption (PRNR) after radial head arthroplasty (RHA). Stress-shielding has been assumed to explain this phenomenon. No data are available on the progression of stress-shielding and its clinical relevance in the mid-long term. The aims of this study are to analyze how PRNR starts and progresses radiographically in two types of press-fit RHAs and to investigate its clinical relevance.

Methods: Ninety-seven patients with RHA were analyzed: 56 received a bipolar RHA (Group 1) while 41 received an anatomical implant (Group 2). Radiographs were performed post-operatively and after 3, 6, 9 and 12 weeks, 6, 9, 12, 18 and 24 months, and annually thereafter. PRNR was measured in all radiographs in the 4 radial neck quadrants. At the last follow-up, the mean PRNR of the 4 quadrants was calculated and classified as mild (0-3mm), moderate (3-6mm) or severe (>6mm). MEPS, p-ASES-e and q-DASH were used for the clinical assessment. Radiographic signs of implant loosening were investigated.

Results: The mean follow-up was 6 years (2 to 14). PRNR started after a mean of 7.5 weeks and progressed significantly during the first two years, by the end of which the bone resorption stabilized. The final mean PRNR was 3.0 mm in Group 1 and 3.7 mm in Group 2. PRNR was absent, mild, moderate and severe in 18%, 25%, 50% and 7% of patients in Group 1 and in 12%, 32%, 39% and 17% in Group 2, respectively. The mean MEPS, q-DASH and p-ASES-e were 95.9, 4.4 and 94.8 in Group 1 and 92.2, 9.9 and 90.8 in Group 2, respectively. No significant differences were observed between groups in the clinical and radiographic outcomes. No correlations were found between PRNR and the clinical results.

Conclusions: PRNR after press-fit RHA is a common radiographic finding that develops in the first 24 months before stabilizing definitively. PRNR does not affect the clinical results or implant survival in the mid-term.

FP.11.02

THE INCIDENCE AND RISK FACTORS FOR REOPERATION AND REVISION FOLLOWING TOTAL ELBOW ARTHROPLASTY WITH AN ANATOMIC CONVERTIBLE PROSTHESIS

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Background: Despite frequent early failures, total elbow arthroplasty (TEA) remains a valuable tool in treating degenerative and traumatic elbow pathologies. This study aims to understand the incidence of and risk factors for re-operation following TEA at a high-volume center utilizing a single implant with convertible linkage and potential for anatomic reconstruction of the lateral column.

Methods: Following local institutional review board approval, all patients undergoing primary TEA at this single tertiary referral center by one of five fellowship-trained shoulder and elbow surgeons utilizing the Latitude prosthesis (Stryker, Kalamazoo, MI) between July, 2001 and May, 2020 were identified. Via retrospective chart review, patient characteristics, surgical indication, linking status, radial head treatment, and implant characteristics were obtained. In addition, indication and timing of any re-operation was identified from chart review.

Results: During the study period, 225 cases were performed in 210 patients with 57 (27.1%; 57/210) males, an average age of 62 years (range: 23-95), and a mean follow-up of 10.9 years (range: 2-21). In follow-up, 93 elbows required 192 re-operations at a median 8 months (range: 3 days – 15 years). 42 patients required revision of non-modular implants (19%) and 14 were definitively explanted (6%). The need for re-operation or revision following TEA for osteoarthritis (56 and 32%), inflammatory arthropathy (44 and 24%), and other (67 and 42%) was greater than that for acute fracture (28 and 6%) and trauma sequelae (39 and 14%; $p < 0.05$). In multivariate analysis, radial head replacement (OR: 3.3; $p = 0.007$) and surgical indications of osteoarthritis (OR: 5.7; $p = 0.02$) or other (OR: 8.0; $p = 0.02$) relative to fracture predicted the need for revision surgery. Alternatively, unlinked TEA was the sole independent predictor of need for any elbow re-operation (OR: 2.4; $p = 0.007$). No effects from age, gender, or stem length were noted.

Conclusions: Despite advancements in implant design and surgical techniques, TEA continues to suffer from a high rate of re-operation, revision, and ultimately explantation. This is especially true for patients undergoing TEA for non-traumatic indications. Further work is required to optimize long-term outcomes following TEA through improved understanding of appropriate surgical indications, techniques, and implant utilization.

FP.11.03

ANTERIOR RADIAL HEAD SUBLUXATION: A RADIOGRAPHIC SIGN FOR EARLY DETECTION OF PRIMARY ELBOW OSTEOARTHRITIS

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Background: The mainly used elbow OA grading radiographic systems at present do not take account of radiocapitellar joint or radial head subluxation. To investigate primary elbow osteoarthritis (OA) for the presence of radial head (RH) subluxation and to determine if RH subluxation severity correlates to elbow OA worsening.

Methods: Seventy-one patients with primary elbow OA were included and 45 with lateral epicondylitis were identified as non-arthritic elbow controls to evaluate RH subluxation between January 2012 and January 2020. Primary elbow OA was classified regarding Kwak's classification. The radiocapitellar ratio (RCR; the ratio of the displacement of the radial head about the diameter of the capitulum) was calculated using lateral views. These RCR values were compared between the OA and the control groups.

Results: Of the patients enrolled, 24, 22, and 25 were classified as stage I, II, and III OA. The control group was presented with a mean RHR of -1.2% (\pm 6.8). Patients with stage I/ II/III elbow OA were presented with mean RHR of 5.9% (\pm 7.5), 15.9% (\pm 10.8), and 18.5% (\pm 9.1). Significant increases were noted in the RCR of patients in all three OA groups compared with the control group cases [P (stage I/ II/III vs. Control) = 0.001/0.000/0.000] and of patients in stage II/III groups compared with the stage I group cases [P (stage II/III vs. I) = 0.000/0.000]. However, no difference was detected between the stage II and III groups (P = 0.145).

Conclusions: RH subluxation is a radiographic finding associated with primary elbow OA occurring mainly in the early stages of the osteoarthritic process of the elbow and stagnating as OA progresses.

FP.11.04

THE PRESENCE OF PERIPROSTHETIC OSTEOLYSIS DOES NOT AFFECT THE FUNCTIONAL OUTCOMES OF RADIAL HEAD ARTHROPLASTY IN ELBOW FRACTURE-DISLOCATION

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Background: Proximal radius is a major contributor to elbow and forearm stability, and its replacement is recommended in cases of complex elbow-fracture dislocation with irreparable radial head fractures. Radial head prosthesis (RHP) affords the ability to reestablish the stabilizing function of the radial head. Mono-block and modular options are available, as well as unfixed or fixed models. Unfixed stems, have smooth shafts, which allows stem motion to occur within the medullary canal. Each prosthesis presents complications inherent to its design. Radial neck osteolysis is known to occur after RHP, with prevalence varying between reports. Painful loosening is the primary reason for radial head fixation reoperation. The aim of this study was to evaluate the incidence of osteolysis and radiolucencies in primary RHP and correlate this with functional outcomes in patients of elbow fracture dislocation.

Methods: A single-center retrospective study included all patients undergoing RHP for acute radial head complex fracture-dislocation between 2012 and 2019. At a minimum 1-year follow-up, patients were assessed clinically on joint range of motion (ROM), Mayo Elbow Performance Score (MEPS) and Broberg and Morrey (B&M) rating system and radiologically on standard radiographs. All patients went to a non-anatomical smooth-stemmed metallic modular implant. A single trained elbow surgeon evaluated all radiographs, classifying the presence of osteolysis and lucencies according to the 7 Popovic zones around the radial component, and presence of heterotopic ossification (HO). The T- test was used for unpaired samples. A 95% confidence interval was used.

Results: A total of 47 cases were included, 85.1% were men. The mean age was 40.4 ± 11.7 years [range, 20.5 – 67.2 years]. A total of 95.7 % (45) had a full functional evaluation. The mean MEPS was 89.3 ± 1.6 . The mean BM was 87.7 ± 1.7 . The overall results for the presence of radiolucency, osteolysis, and HO were 70%, 38%, and 40%, respectively. The presence of radiolucency or osteolysis doesn't have an impact on MEPS or B&M (MEPS $p= 0.75$ / B&M $p= 0.85$) and (MEPS = 0.37/ B&M = 0.72) respectively.

Conclusions: The presence of osteolysis or radiolucency in a non-anatomical smooth-stemmed RHP doesn't have an impact on functional outcomes.

FP.11.05

ARTHROSCOPIC TRANSFOSSA APPROACH; MINIMAL INVASIVE MANAGEMENT OF ELBOW ARTHRITIS

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Background: The concept of “trans-fossa” has originally been used for “OK procedure” by eliminating fossa with bony spurs in olecranon and coronoid fossa. However, it is not recommendable to routinely excessive eliminating fossa in arthroscopic trans-fossa approach but only limited resection mainly for visualization purpose with saving bony column of distal humerus as much and then, resurfacing around connecting fossa which is the principle of OCA. Since the direction of visualization through the fossa gives more intuitive understanding of anterior pathology.

Methods: Patients treated with osteocapsular arthroplasty between January 2010 and December 2015 were divided into Conventional arthro (21 cases) and Transfossa arthro groups (15 cases), respectively. Clinical outcome was measured using range of motion (ROM) arc, functional score (Mayo Elbow Performance Score [MEPS]), and pain score (visual analog scale [VAS]). Conventional radiography was used for outcome analysis.

Results: Mean follow-up time was 36.6 ± 14.4 (24-89) and 35.4 ± 14.2 (24-83) months following Conventional and Transfossa, respectively. Average ages were 50.0 ± 7.0 (40-63) and 52.4 ± 10.4 (41-75) years in Conventional and Transfossa groups, respectively. Overall scores for ROM (preoperative to final follow-up: $65.5^\circ \pm 22.8$ to $112.0^\circ \pm 50.9$, $P < .01$), MEPS (42.9 ± 13.7 to 73.7 ± 16.6 , $P < .01$), and VAS (6.6 ± 1.3 to 4.0 ± 2.3 , $P < .01$) were improved. Preoperative ROM improved from $64.0^\circ \pm 23.3$ to $118.0^\circ \pm 17.8$ following Conventional and $66.5^\circ \pm 22.6$ to $108.0^\circ \pm 24.0$ following transfossa. Preoperative MEPS improved from 40.7 ± 15.6 to 73.6 ± 16.7 following Conventional and 44.3 ± 12.2 to 73.8 ± 16.7 following transfossa. Preoperative VAS improved from 6.9 ± 1.2 to 3.9 ± 2.6 following Conventional and 6.4 ± 1.3 to 4.1 ± 2.0 following Transfossa.

Conclusions: Arthroscopic osteocapsular arthroplasty using transfossa approach is comparable to the conventional procedure in managing primary osteoarthritis of the elbow; however, the Conventional procedure shows the better outcome in improvement of flexion limitation.

FP.11.06

THE COMPARATIVE PERFORMANCE OF RADIAL HEAD PROSTHESES IN PATIENTS YOUNGER THAN AND OLDER THAN 50 YEARS: A SYSTEMATIC REVIEW

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Background: Patient age may play a role in the surgeon's decision between RHA and ORIF in radial head fracture treatment. Though large sample reports have detailed outcomes of radial head replacement for a mean age younger than 50 years, the age ranges are widely distributed. Patient outcomes are not uniform across a broad age distribution. Therefore, treatment decisions should be evaluated within the confines of a narrower age bracket. We performed a systematic review comparing the clinical outcomes for radial head replacement in patients younger and older than 50 years of age. Further analysis compared outcomes between arthroplasty performed as a primary procedure and as a secondary procedure in patients younger and older than 50 years of age.

Methods: PubMed was queried for articles which delineated individual patient data for age, surgical treatment, and appropriate outcome metrics. Articles were grouped based on patient age of under 50 and over 50 years and within those age groups, based on the arthroplasty being performed as a primary or as a secondary procedure.

Results: There were no significant differences between the under 50 and the over 50 groups for MEPS ($p=0.79$) and for implant revision/removal ($p=0.32$). In the under 50 group, RHA done as a primary procedure had significantly higher ($p=0.001$) mean MEPS than RHA done as a secondary procedure. In the over 50 group, relative risk was 2.39 (95% CI 2.12 - 2.69) for implant revision/removal ($p=0.11$) when comparing primary and secondary procedures.

Conclusions: At a mean follow up of 48 months, radial head arthroplasty in patients under the age of 50 years had satisfactory outcomes which were comparable to outcomes in patients over the age of 50 years. Across both age groups, arthroplasty performed as a primary procedure demonstrated superior outcomes compared to arthroplasty performed as a secondary procedure. Our findings provide guidance to surgeons who face a multifaceted decision when encountering younger adult patients with radial head fracture patterns that may not be amenable to fixation. Awareness of the age-specific performance of radial head implants is an important component of the decision for surgical treatment.

FP.11.07

REVISION TOTAL ELBOW ARTHROPLASTY (RTEA) WITH THE SEMICONSTRAINED COONRAD/MORREY PROSTHESIS FOLLOW-UP TO 21 YEARS

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Background: Revision total elbow arthroplasty (TEA) has increased, especially in young patients with high functional expectations. The objective of this study was to evaluate the long-term results of revision TEA with a single semi constrained prosthesis.

Methods: Thirty-four revision TEAs were performed with a Coonrad/Morrey prosthesis in 32 patients; 2 patients had bilateral procedures. The mean patient age was 61 years (range, 22 to 76 years), and the revision TEA was performed at a mean time of 7.8 years (range, 1.6 to 21 years) after the primary TEA. Etiologies for revisions were humeral and ulnar aseptic loosening (n = 14), ulnar aseptic loosening (n = 8), humeral aseptic loosening (n = 6), septic arthritis (n = 4), and unstable unlinked prostheses (n = 2). Clinical and radiographic evaluations were performed with systematic preoperative infection workup and quantification of bone loss. The mean follow-up was 11.4 years (range, 2 to 21 years).

Results: The Mayo Elbow Performance Score (MEPS) at the last follow-up was excellent in 6 cases, good in 18 cases, fair in 8 cases, and poor in 2 cases, with a mean improvement (and standard deviation) between the preoperative values at 42.4 ± 16.1 points and the postoperative values at 81.8 ± 12 points ($p < 0.001$). The mean pain scores improved significantly from 6.7 ± 1.3 points preoperatively to 1.4 ± 1.4 points postoperatively ($p < 0.001$). The flexion-extension arc increased significantly ($p = 0.02$) from 74 ± 27 preoperatively to 100 ± 31 postoperatively. The total number of complications was 29 in 19 revision TEAs (56%). Twenty of the 29 complications simply required monitoring without surgical intervention. Six repeat surgical procedures were required, and 3 implant revisions (9%) were performed.

Conclusions: Revision TEA with a semiconstrained prosthesis can provide good clinical results that can be maintained during follow-up. The rate of complications is high. Proper evaluation of the risk-benefit ratio is essential for each revision TEA and should be discussed with the patient.

FP.11.08

SAFETY OF TOTAL ELBOW ARTHROPLASTY IN PATIENTS WITH RHEUMATOID ARTHRITIS AND PRIOR HIP OR KNEE PERIPROSTHETIC JOINT INFECTION

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Background: The volumes of both total elbow arthroplasty (TEA) and hip and knee arthroplasty are increasing. Periprosthetic joint infection (PJI) after TEA remains a substantial cause of morbidity, with certain studies reporting primary TEA PJI rates over 10%. The risk of PJI for primary TEA in patients with a history of lower extremity PJI is unknown. The purpose of this study was to compare the incidence of PJI after primary TEA in patients with a history of lower extremity PJI and matched controls.

Methods: Our institutional Joint Registry Database was queried to identify patients who underwent primary TEA and had previously undergone treatment for lower extremity PJI between 1974 and 2021. Twelve elbows (10 patients) with a mean follow up of 8.2 years were identified. There were 9 female elbows (75%) and 3 male elbows (25%) with a mean age of 63 years (range, 44-78 years) and mean mass index of 27 kg/m² (range, 23-35 kg/m²). All patients had a diagnosis of rheumatoid arthritis. This cohort was 1:7 matched to 84 elbows (83 patients) with no history of lower extremity PJI.

Results: None of the 12 TEA included in the study group developed PJI. The cumulative incidence of PJI in the matched cohort at 10 years was 6.4% (5 elbows). Regarding superficial infections, there was 1 in the study group (9.1%) and 5 (5.8%) in the matched cohort. In the study group, 2 elbows underwent revision (component loosening) and 4 underwent reoperation (2 for loosening, 1 for superficial infection, 1 for hematoma). Eight elbows in the matched cohort underwent revision and 23 underwent reoperation. The study cohort was associated with higher risk of revision (HR 1.75, p=0.4) and reoperation for any cause (HR 1.56, p=0.4).

Conclusions: In this relatively small cohort, there was no incidence of PJI in patients who underwent primary TEA for rheumatoid arthritis and had previously undergone treatment for lower extremity PJI. The cumulative incidence of PJI in the matched cohort at 10 years was 6.4%. Although underpowered to make a conclusion, this study did not reveal an association between infection after TEA and a history of lower extremity PJI.

FP.12.01

EFFECT OF POLYDEOXYRIBONUCLEOTIDE ON TENDON HEALING AND FATTY DEGENERATION IN ARTHROSCOPIC ROTATOR CUFF REPAIR: A RANDOMIZED CONTROLLED TRIAL

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Background: Polydeoxyribonucleotide (PDRN) has been recently used as a tissue regeneration activator. This study was performed to explore the effects of PDRN on tendon healing and reversal of fatty degeneration in arthroscopic rotator cuff repair.

Methods: Sixty patients with rotator cuff tears who had undergone arthroscopic rotator cuff repair were enrolled in this single center, double-blinded randomized controlled trial study. Thirty patients were randomly allocated to group 1 and received PDRN injection to the repair site during the surgery. The other 30 patients were allocated to group 2 and underwent saline injection. In out-patient department, all the patients in the two groups were injected with the same materials to the repair site under ultrasound guidance at 2 weeks after surgery. The Visual analog scale (VAS) for pain, American Shoulder and Elbow Surgeon's score (ASES), Constant score, range of motion and muscle power were checked at preoperatively and until postoperative 1 year. Follow-up MRI was checked at postoperative 6 month. The mean plasma levels of vascular endothelial growth factor (VEGF), fibroblast growth factor (FGF) and insulin-like growth factor (IGF) were checked until postoperative 6 months.

Results: In the two groups, the overall functional outcomes improved after surgery. Group 1 showed a significant decreased VAS score at 16 weeks after surgery compared with that in groups 2 ($P=0.014$). And group 1 showed a significant decreased fatty degeneration of supraspinatus and infraspinatus on follow-up MRI at 6 months after surgery ($P=0.028$ and $P=0.030$). On the follow-up MRI, group 2 showed higher retear rate than group 1, but this difference did not reach a statistical significance ($G1 : G2 = 4 : 8, P=0.333$). Group 1 showed a significantly higher mean plasma FGF level postoperative 1 hour and 6 weeks than group 2 ($15.5 > 11.1; P=0.008, 7.9 > 6.0; P=0.001$).

Conclusions: PDRN may have possibility to improve tendon healing and decrease fatty degeneration after arthroscopic repair of rotator cuff tear associated with growth factor.

FP.12.02

ARTHROSCOPIC ROTATOR CUFF REPAIR IN FIBROMYALGIA PATIENTS HAD COMPARABLE OUTCOMES TO A MATCHED CONTROL GROUP

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Background: Although fibromyalgia is associated with poor outcomes of orthopedic surgeries, several studies show some benefit for surgical intervention and nevertheless recommend operative treatment when indicated. There is sparse evidence of the effect of fibromyalgia on the outcomes of shoulder surgery. The purpose of this study was to investigate the effect of fibromyalgia on patient-reported outcomes of arthroscopic rotator cuff repair (ARCR).

Methods: All patients with a confirmed diagnosis of fibromyalgia who underwent ARCR in one institution between 2010-2021 were included. Data retrieved from medical records included demographics and preoperative and last follow-up (minimum 1 year) postoperative Disabilities of the Arm Shoulder and Hand (DASH) score, Subjective Shoulder Score (SSV), and Numeric Pain Rating Scale (NPRS). A matched controlled group of patients without fibromyalgia who had undergone ARCR was selected according to age, sex, and preoperative DASH, SSV and NPRS scores.

Results: There were no significant differences in demographic characteristics and preoperative scores between the study and control groups. The fibromyalgia patients' postoperative scores for all 3 measurements showed significant improvement: SSV by 32.1 (P = 0.004), DASH by 20.3 (P = 0.016), and NPRS by 2.33 (P = 0.017). There were no significant differences in the postoperative DASH, SSV, and NPRS between the fibromyalgia and control groups.

Conclusions: Fibromyalgia patients with rotator cuff tears who undergo ARCR do not have inferior patient-reported outcomes compared to non-fibromyalgia controls. Fibromyalgia should not be considered a contraindication for ARCR.

FP.12.03

RECOMBINANT HUMAN PARATHYROID HORMONE BIOCOMPOSITE PROMOTES BONE-TO-TENDON INTERFACE HEALING IN A RABBIT MODEL OF A CHRONIC ROTATOR CUFF TEAR

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Background: Local administration of rhPTH during the surgical repair might enhance the bone-to-tendon interface (BTI) healing, however, optimal local application method is not still established. To investigate the optimal local application method for rhPTH to promote BTI healing after repair of chronic rotator cuff tear (RCT) in the rabbit model.

Methods: Three types of nanofiber sheets were compared with negative control group using normal saline (group A). Nanofiber sheet alone, created using PCL was utilized as positive control (group B). For group C, ready-made nanofiber sheet was soaked in rhPTH solution, and for group D, rhPTH was permeated into the nanofiber of PCL by coaxial electrospinning method during manufacturing process (rhPTH biocomposite). Pharmacokinetic feature of rhPTH release were examined in vitro for 6 weeks to evaluate its possibility to be locally applied in the surgical field. In vivo, 64 rabbits were randomly assigned into 4 groups as described above. Nanofiber sheets (group B and C) or rhPTH biocomposite (group D) were implanted on the surface of repair site in 6 weeks after the creation of chronic RCTs, followed by genetic and histological analyses after 4 weeks of surgery. Furthermore, serologic, genetic, histological, and biomechanical analyses were performed in another 12 weeks of surgery.

Results: The rhPTH biocomposite (group D) exhibited a better sustained and controlled release feature of rhPTH. In vivo, the PINP and ALP levels of serum were more increased in group D than did the other groups (all $P < 0.001$). For the genetic evaluation, group D showed higher collagen type Ia1, collagen type IIIa1, and bone morphogenetic protein 2 expression levels than did the other groups at 4 weeks. For the histologic evaluation, group D showed greater collagen fiber continuity, orientation, density and more mature tendon-to-bone junction than did the other groups at 12 weeks. For the biomechanical evaluation, group D showed a higher load-to-failure rate than did the other groups with higher bone and tissue mineral density and bone volume/total volume rate at 12 weeks.

Conclusions: This rhPTH biocomposite which can be applied at the surgical field effectively accelerated BTI healing in chronic rotator cuff tear model of rabbits.

FP.12.04

DOES ANYONE NEED A BONE MARROW STIMULATION IN ARTHROSCOPIC ROTATOR CUFF REPAIR FOR SMALL TO LARGE ROTATOR CUFF TEAR?

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Background: The purpose of this study was to investigate the effect of bone marrow stimulation on the clinical and structural outcomes of arthroscopic rotator cuff repair.

Methods: A total of 204 patients with small, medium, and large-sized full-thickness rotator cuff tears were included in this study. 103 patients who underwent bone marrow stimulation and arthroscopic rotator cuff repair were assigned to the bone marrow stimulation (BMS) group, and 101 patients who underwent only arthroscopic rotator cuff repair were assigned to the control group. Clinical and functional outcomes were evaluated before surgery, at 3 months, 6 months, 1 year, and 2 years after surgery, and the range of motion, commonly used functional scores such as ASES and constant score, and commonly used clinical scores such as VAS were evaluated. In addition, postoperative tendon integrity was evaluated using ultrasound at 6 months and 2 years after surgery.

Results: The range of motion and functional scores such as ASES and constant score and clinical score such as VAS did not differ significantly between the two groups during 2 years after surgery (all $p > 0.05$). Also, there was no significant difference in the rotator cuff tear rate between the 2 groups in the results of confirming the tendon integrity using ultrasound for 2 years after surgery. (all $p > 0.05$).

Conclusions: : In patients with small, medium, and large-sized rotator cuff tears, the presence or absence of bone marrow stimulation is not expected to affect the postoperative outcome in arthroscopic rotator cuff repair.

FP.12.05

SUPRASCAPULAR ARTERY IS HELPFUL IN EVALUATING FATTY INFILTRATION OF ATROPHIC SUPRASPINATUS ON MAGNETIC RESONANCE IMAGING

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Background: Evaluating fatty infiltration of atrophic supraspinatus on magnetic resonance imaging (MRI) could be unreliable, because of the difficulty in determining the border of supraspinatus. This study proposed and validated a suprascapular artery method for evaluating fatty infiltration of supraspinatus.

Methods: A retrospective study was performed. Imaging evaluation including fatty infiltration (using supraspinous fossa method and suprascapular artery method separately) and the tangent sign of supraspinatus was performed using MRI. The American Shoulder and Elbow Surgeons (ASES) scores, pain visual analog scale (VAS) scores, and range of motion of the affected shoulder were assessed.

Results: A total of 121 shoulders with large to massive rotator cuff tears were included. The branches of suprascapular artery were confirmed to surround and outline the supraspinatus on the Y-view and adjacent sections in almost all cases. In cases with positive tangent sign, the mean grading of Goutallier classification was significantly lower when using suprascapular artery method.

Conclusions: The suprascapular artery could be helpful in evaluating fatty infiltration of atrophic supraspinatus on MRI. The supraspinous fossa method might overestimate fatty infiltration of supraspinatus with positive tangent sign.

FP.12.06

ARTHROSCOPIC REPAIR OF RETRACTED LARGE AND MASSIVE ROTATOR CUFF TEARS WITH AND WITHOUT COLLAGEN PATCH AUGMENTATION: EARLY OUTCOMES AND TENDON INTEGRITY

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Background: Consistently successful and durable repair of massive rotator cuff tears (mRCTs) remains elusive because of multiple biological and biomechanical challenges. Recently, increased tendon thickness and improved outcomes have been observed following arthroscopic treatment of partial articular-sided RCTs by applying a reconstituted bovine collagen scaffold patch to the bursal tendon surface. The objective of this study was to compare the early clinical and imaging results following repair of retracted mRCTs, including revision repair, with and without patch augmentation.

Methods: The study group comprised 24 patients (17 males, 60.8 years) with mRCTs, involving 2 or 3 tendons and exceeding 4 cm in length, undergoing arthroscopic tendon to bone repair followed by on-lay patch augmentation. The control group comprised 24 patients (19 males, 61.5 years) matched by tear size undergoing repair one year earlier without patch augmentation. Repairs were carried out similarly using single or double row techniques, depending on footprint coverage following releases (mean 4.7 vs. 4.8 suture anchors). Most tears were atraumatic, but 8 study and 6 control patients had acute on chronic tears. Additionally, 8 study and 9 control patients had undergone previous repair. Non-contrast high-field MRI was obtained in 20/24 study patients and 17/24 control patients at minimum 6 months.

Results: Significant but similar improvements were noted in study and control groups. Active elevation improved from 110° to 149° and from 130° to 153° in study and control groups, respectively ($p < 0.01$); ASES, SANE, SST, and VAS-pain improved from 36 to 86, 35 to 88, 3.8 to 9.3, 5.8 to 0.9 in the study group and from 41 to 88, 39 to 84, 4.3 to 9.8, and 5.7 to 1.0 in the control group ($p < 0.001$ for all). All control patients and 90% of study patients exceeded MCID for ASES and VAS-pain. Postoperative MRI revealed intact repairs in 11/20 patients in the study group (55%) and 9/17 (53%) in the control group.

Conclusions: Arthroscopic mRCT repair with and without collagen patch augmentation achieves excellent clinical outcomes. However, postoperative MRI reveals structural failure in 40%, underscoring the need for better patient and tear selection as well as additional biological adjuncts.

FP.12.07

SUPEROXIDE INDUCED OXIDATIVE STRESS IS ASSOCIATED WITH RECURRENT TEAR AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR

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Background: Re-tears after arthroscopic rotator cuff repair (ARCR) remain a significant clinical problem. Oxidative stress contributes to the degeneration of the rotator cuff, and a degenerative rotator cuff can lead to re-tear after ARCR. However, the correlation between oxidative stress and re-tear after ARCR is unclear. Purpose of this study was to investigate the correlation between superoxide induced oxidative stress and re-tear after ARCR.

Methods: A total of 68 patients who underwent ARCR using a suture-bridge technique participated in this study. Specimens were collected from the edge of the torn tendon during surgery. The modified Bonar score was used to evaluate degeneration of the rotator cuff on histological specimens, and fluorescence intensity on dihydroethidium (DHE) staining was used to detect oxidative stress. Superoxide dismutase (SOD) enzyme activity was also measured. The following were used for clinical evaluation: age, tear size on magnetic resonance imaging (MRI) before surgery, Goutallier classification on MRI before surgery, and Japanese Orthopaedic Association score before and 6 months after surgery. After the repaired rotator cuffs were evaluated on MRI at 6 months after surgery, the patients were divided into groups: those with a healed rotator cuff (healed group; n = 46) and those with a recurrent tear (retear group; n = 22). The significant differences between the groups were determined with regard to clinical evaluation, modified Bonar score, DHE intensity, and SOD activity. In addition, multivariate logistic regression analysis was performed to investigate risk factors for recurrent tear.

Results: Age, tear size, Goutallier classification, modified Bonar score, DHE intensity, and SOD activity were significantly greater in the retear group than in the healed group, although the Japanese Orthopaedic Association score was not significantly different. Multiple logistic regression analysis demonstrated that age, tear size, and SOD activity were significantly correlated with re-tear.

Conclusions: In addition to tear size and age, superoxide induced oxidative stress was an exacerbating factor for re-tear after ARCR. Controlling the superoxide induced oxidative stress may prevent re-tear after ARCR.

FP.12.08

PREVIOUS ROTATOR CUFF REPAIR INCREASES THE RISK OF REVISION SURGERY FOR PERIPROSTHETIC JOINT INFECTION AFTER REVERSE SHOULDER ARTHROPLASTY

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Background: Previous studies have indicated an increased risk of periprosthetic joint infection in patients treated with reverse shoulder arthroplasty compared with patients treated with anatomical total shoulder arthroplasty. The reason for this is unclear but may be related to a high prevalence of previous rotator cuff repair in patients who are treated with reverse shoulder arthroplasty. The purpose of this study was to determine previous non-arthroplasty surgery as a risk factor for revision due to periprosthetic joint infection after reverse shoulder arthroplasty for cuff tear arthropathy, massive irreparable rotator cuff tears or osteoarthritis.

Methods: Data was retrieved from the Danish Shoulder Arthroplasty Registry and medical records. We included 2,217 patients who had reverse shoulder arthroplasty for cuff tear arthropathy, massive irreparable rotator cuff tears or osteoarthritis between 2006 and 2019. periprosthetic joint infection was defined as at least 3 out of 5 tissue samples positive for the same bacteria or as definite or probable periprosthetic joint infection evaluated from the International Consensus Meeting. The Kaplan-Meier method was used to illustrate the unadjusted 14-year cumulative rates of revision. The Cox regression model was used to report hazard for revision due to periprosthetic joint infection. Results were adjusted for previous non-arthroplasty surgery, gender, diagnosis, and age.

Results: Revision was performed in 88 (4.0%) shoulders of which 40 (1.8%) were due to periprosthetic joint infection. There were 272 (12.3%) patients who had previous rotator cuff repair of which 11 (4.0%) were revised due to periprosthetic joint infection. The 14-year cumulative rate of revision due to periprosthetic joint infection for patients with previous rotator cuff repair was 14.1% and for patients without previous surgery it was 2.7%. The adjusted hazard ratio for revision due to periprosthetic joint infection for patients with previous rotator cuff repair was 2.2 (95% CI 1.04 to 4.60) compared to patients without previous surgery.

Conclusions: There is an increased risk of revision due to periprosthetic joint infection after reverse shoulder arthroplasty for patients with previous rotator cuff repair. We recommend that patients with previous rotator cuff repair to be regarded as high-risk patients when considering reverse shoulder arthroplasty.

FP.12.09

FACTORS RELATED TO CLINICAL OUTCOMES IN WELL-HEALED REPAIRED ROTATOR CUFF

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Background: Arthroscopic rotator cuff repair is a well-developed procedure that produces acceptable postoperative outcomes. However, clinical outcomes are not always satisfactory, even though repaired tendon is well healed. The purpose of this study was to analyze the factor related to clinical outcomes in well-healed rotator cuff tendons after arthroscopic rotator cuff repair.

Methods: From 2017 to 2019, among patients who underwent arthroscopic rotator cuff repair at our clinic, we included patients who completed a physical examination, several outcome scales under study and an magnetic resonance imaging(MRI) to evaluate structural integrity postoperatively at 6 months. Finally, 80 patients were enrolled in this study. The preoperative demographic data, history of prior shoulder surgery, preoperative shoulder ROM, a global fatty degeneration index(GFDI), preoperative pain score, tear depth and size which were evaluated intraoperatively, biceps tenotomy, subscapularis tendon repair and repair techniques were analyzed as independent variables. Clinical outcomes of patients were evaluated through ASES score at postoperative 6 months and 1 year. ASES score were classified; 90 or more as Excellent and 89 or less as Non-excellent. By univariate logistic regression analysis we found out factors associated with clinical outcomes. A cutoff value of $p < 0.3$ from the univariate analysis was used as a threshold to decide factors which were used in the multiple analysis.

Results: At postoperative 6 months, preoperative external rotation level, tear depth, dominant shoulder and preoperative pain score were found out in initial univariate logistic regression analysis. Next, tear depth (OR = 3.957, $p = 0.023$) and preoperative pain score (OR = 1.110, $p = 0.025$) were associated with postoperative clinical outcomes in multiple logistic regression analysis. At postoperative 1 year, tear size, repair technique, preoperative pain score and GFDI were found out at initial univariate analysis. Finally, GFDI (OR = 2.739, $p = 0.032$) were associated with postoperative ASES scores in multiple logistic analysis.

Conclusions: In patients without re-tear after arthroscopic rotator cuff repair, tear depth and preoperative pain score were the important factor for worse clinical outcomes at postoperative 6 months. At postoperative 1 year, GFDI were significant factors associated with poor clinical outcomes.

FP.13.01

ENHANCEMENT OF ROTATOR CUFF HEALING BY SARTANS TO INHIBIT TRANSFORMING GROWTH FACTOR-BETA: A CASE CONTROL MATCHED COHORT STUDY

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Background: Fibrosis of the torn tendons and muscle tendon units following rotator cuff repair may lead to poor healing. Transforming growth factor-beta 1 (TGF- beta1) plays an important role in the cascade in the development of fibrosis. Sartans (antihypertensive drugs) have been shown to block TGF- beta1. The purpose of this study was to compare the clinical outcomes and tendon integrity of patients after rotator cuff repair with and without sartans medication.

Methods: Patients who underwent arthroscopic rotator cuff repair (ARCR), had sartans in their medication and were at least 2 years postoperative were included, and matched with patients who underwent ARCR without having sartans (No-sartan group) by age, sex, involved tendon, and tear size. Patient-reported outcome (PRO) scores were collected at final follow-up including the Constant Murrey Score (CMS), Western Ontario Rotator Cuff Score (WORC), Simple Shoulder Test (SST), and visual analog scale (VAS). Tendon integrity (maintained continuity: yes/no) was assessed by ultrasound examination at final follow-up.

Results: 26 patients (versus 26 matched-controls) were available for follow-up. There were 6 female (23%) and 20 male (77 %) patients with a mean age of 63.7 years (range, 40-74.8 years). No patient underwent revision surgery. Differences in mean PRO scores between sartan and No-sartan groups, respectively, were seen at final evaluation as follow: CMS: 81 (range, 54 – 100) versus 82 (range, 63 – 99) (P = .457); WORC: 38 (range, 0 – 156) versus 23 (range, 0 – 92) (P = .071); SST: 9.8 (range, 6 – 12) versus 10 (range, 6 – 12) (P = .187); and VAS: 1.8 (range, 0 – 8) versus 0.4 (range, 0 – 5) (P = .012*). Intact tendon insertion was observed in 100% (26/26) for sartans and 88% (23/26) for No-sartans groups, respectively (P = .041*).

Conclusions: Patients with torn rotator cuff tendons benefited similarly from ARCR concerning clinical presentation. An increased rate of tendon integrity was observed in patients with sartans in their medication, however, less pain in patients without sartans.

FP.13.02

BICEPS EXTENSION SUPINATION TEST (BEST) A PREDICTIVE CLINICAL SIGN OF BICEPS MEDIAL INSTABILITY

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Background: There are no dynamic physical examination tests that reproduce long head biceps (LHB) medial instability. We describe a provocative physical examination test that can reproduce medial biceps instability: The Biceps Extension Supination Test (BEST). Purpose: To assess the relative value of the Biceps Extension Supination Test (BEST) for the diagnosis of LHB medial instability (subluxation or dislocation).

Methods: We performed a prospective study of 50 consecutive painful shoulders with or without rotator cuff tears. We excluded patients with stiff shoulder or elbow, neurological deficits, and previous surgery in the shoulder. Patients who subsequently underwent preoperative imaging (MRI, ArthroCT or Ultrasound) were included. The BEST Test is made with shoulder in 90° of forward flexion, elbow extension at 0° and forearm supination, and is considered positive when there is pain (anterior shoulder) or asymmetry in active elbow extension or forearm supination compared to the contralateral side. Statistical analysis included sensitivity, specificity, negative predictive value, positive predictive value. Associated lesions were described.

Results: The mean ages were 59 years (24-76), there were 92% of patients with positive BEST Test, 100% of this cases presented anterior shoulder pain and 89% presented difference in supination compared to contralateral side, the difference in supination compared to the contralateral side was: less than 10° in 42%, between 11 and 20° in 33%, and more than 20° in 14% of the cases. The patients imaging were MRI 79%, ArthroCT 18% and ultrasound 3%, we identified medial biceps dislocation in 19% and medial biceps subluxation in 81% of the patients. Our study showed that BEST has a sensitivity of 85%, specificity of 70%, positive predictive value of 76%, negative predictive value of 67%, and accuracy of 80.0%.

Conclusions: The BEST is a valuable preoperative clinical test to predict biceps medial instability (subluxation / dislocation). This test reproduces the patient's shoulder pain and unmasks the deficit of elbow extension (caused by medial subluxation of the biceps tendon over the medial rim of the groove) and the deficit of forearm supination (caused by medial subluxation of the biceps tendon inside the cleavage of the subscapularis tendon).

FP.13.03

ISOLATED SUPRASPINATUS TENDON TEAR CAN INDUCE THE SUBSCAPULARIS MUSCLE ATROPHY WITHOUT SUBSCAPULARIS TEAR

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Background: This study aimed to (1) propose a new quantitative subscapularis atrophy measuring method using magnetic resonance imaging (MRI) and (2) describe and measure the subscapularis muscle atrophy without subscapularis tear in the case of isolated supraspinatus tear.

Methods: From 2020 to 2022, 153 patients who underwent arthroscopic repair of small or medium size single supraspinatus tear without subscapularis tear (group S) were analyzed. Age, sex, and MRI findings [supraspinatus tear size (mm), Goutallier classification, and occupation ratio; subscapularis Goutallier classification, upper CSA to supraspinatus fossa (UCSF) ratio] were recorded. The incidence and the related factors of subscapularis atrophy were analyzed. For normal control of subscapularis measurements, 50 young (20–40 years, group Y) and old (over 40 years, group O) shoulders without rotator cuff tears were established. The correlation between subscapularis Goutallier classification and UCSF ratio was analyzed.

Results: Group S (n=153) had 58.1 ± 10.2 years with 69 females. Group O (sex- and age-matched) and group Y (sex-matched) had 57.5 ± 8.1 and 29.8 ± 5.8 years with 24 females each. In group S, subscapularis Goutallier grades 1 and 2 were observed in 77 (50.3%) and 36 (23.5%) patients without subscapularis tear. The UCSF ratio was significantly different across the groups (group S, O, and Y; 0.80 ± 0.20 , 0.93 ± 0.16 , and 1.06 ± 0.20 , all $P < 0.001$). Female sex [odds ratio (OR) 3.06, $P = 0.034$] and advanced supraspinatus Goutallier grade (OR 4.70, $P < 0.001$) were independent factors for subscapularis Goutallier grade 2. Female sex (estimate -0.09, $P = 0.011$) and low supraspinatus occupation ratio (estimate 0.47, $P = 0.004$) were independent factors for subscapularis atrophy by UCSF ratio. A relatively high correlation was observed between subscapularis Goutallier grade and UCSF ratio ($r = -0.45$, $P < 0.001$).

Conclusions: With isolated supraspinatus tear, subscapularis muscle atrophy without tendon tear can be observed, which is affected by advanced supraspinatus atrophy and female sex. Subscapularis tear predicted by subscapularis atrophy in Y-view in sagittal oblique MRI can be mispredicted in the case of supraspinatus tear with advanced atrophy. The UCSF ratio can be used for the quantitative measurement of subscapularis atrophy.

FP.13.04

HANDHELD ULTRASOUND CANNOT REPLACE MRI FOR DIAGNOSIS OF ROTATOR CUFF TEARS

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Background: Due to innovations in US systems handheld ultrasound (HHUS) devices are available. Pilot studies on the use of HHUS for musculoskeletal pathologies showed promising results regarding their diagnostic accuracy. No previous studies have been performed to evaluate the reliability and validity of HHUS for the assessment of rotator cuff pathology. The purpose of this study was to examine the reliability and validity of the handheld ultrasound (HHUS) compared to conventional ultrasound (US) and the gold standard, MRI or CT, for diagnosis of rotator cuff tears and fatty infiltration.

Methods: Sixty-four adult patients with shoulder complaints were included in this study. HHUS of the shoulder was performed twice by an orthopedic surgeon and once by a radiologist. Rotator cuff tears, tear width, retraction and fatty infiltration were measured. Inter- and intrarater reliability of the HHUS was calculated using a Cohen's kappa coefficient. Furthermore, HHUS was compared to conventional US and MRI. Criterion and concurrent validity were calculated using a Spearman's correlation coefficient.

Results: Intrarater agreement of HHUS for assessment of rotator cuff tears ($K=0.914$, supraspinatus) and fatty infiltration ($K=0.844$, supraspinatus) was moderate-to-strong. Interrater agreement was none-to-minimal for the diagnosis of rotator cuff tears ($K=0.465$, supraspinatus) and fatty infiltration ($K=0.346$, supraspinatus). Concurrent validity of HHUS compared to MRI was fair for diagnosis of rotator cuff tears ($r=0.377$, supraspinatus) and fair-to-moderate for fatty infiltration ($r=0.608$, supraspinatus). HHUS shows a sensitivity of 81.1% and specificity of 62.5% for diagnosis of supraspinatus tears, 60% and 93.1 % for subscapularis tears, 55.6% and 88.9% for infraspinatus tears. the diagnostic accuracy of HHUS was moderate for diagnosing RCTs in non-obese patients ($r=0.709$) and poor for diagnosing RCTs in obese patients ($r=-.272$) compared to MRI.

Conclusions: Based on the findings in this study HHUS is a moderately valid diagnostic tool to diagnose RCTs compared to MRI. HHUS has high specificity for the diagnosis of RCTs which highlights its potential use as a screening tool in the outpatient clinic. However, HHUS appears to have limited accuracy in obese patients. As such, HHUS cannot be recommended as a sole alternative to more expensive and time-consuming MRI scans.

FP.13.05

ARTHROSCOPIC SUPERIOR CAPSULAR RECONSTRUCTION WITH MESH AUGMENTATION FOR THE TREATMENT OF IRREPARABLE ROTATOR CUFF TEARS: A COMPARATIVE STUDY OF SURGICAL OUTCOMES

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Background: Arthroscopic superior capsular reconstruction (ASCR) is an alternative to open surgery for irreparable chronic rotator cuff tears. This approach can provide static restraint while avoiding upward migration of the humeral head. However, graft tears and their impact on clinical outcomes following ASCR remain a debated topic. This study aimed to evaluate the clinical outcomes of ASCR with mesh augmentation for the treatment of irreparable rotator cuff tears (IRCTs).

Methods: From 2013 to 2018, the data of 72 patients with IRCTs who underwent ASCR were retrospectively evaluated. Among them, 64 patients who met the inclusion and exclusion criteria were enrolled in this study. Fascia lata grafts augmented with a polypropylene mesh were used for 30 patients (group M) and grafts without mesh augmentation were used for 34 patients (group C). Clinical outcomes were evaluated using range of motion, the ASES questionnaire, and Visual Analog Scale for pain. Radiological outcomes were evaluated with based on acromiohumeral distance (AHD) and stage of rotator cuff arthropathy. The status of fatty infiltration and graft was evaluated using MR. Outcomes were assessed preoperatively and at the final follow-up.

Results: Both groups showed improvement in clinical and radiological outcomes at the final follow-up. Group M demonstrated a higher improvement in ASES score (29.1 ± 15.8) than group C (18.1 ± 15.9 , $p = 0.006$). Forward flexion and external rotation improved in group M (40 ± 26 and 11 ± 5 , respectively) and group C (28 ± 23 and 6 ± 3 , respectively; $p = 0.003$ and 0.004 , respectively). Graft healing rate was significantly higher in group M (83.3%) than in group C (58.8%, $p = 0.039$) and AHD was significantly higher in group M (9.1 ± 2.4 mm) than in group C (6.3 ± 1.8 mm) at the final follow-up ($p = 0.001$). Subgroup analysis revealed that patients with graft failure generally showed progression of fatty infiltration without improvement in the stage of rotator cuff arthropathy. Patients with intact grafts demonstrated a more substantial improvement in functional outcomes (ASES score and forward flexion motion).

Conclusions: ASCR with mesh augmentation reduces graft failure rate as to restore superior shoulder joint stability.

FP.13.06

ARTHROSCOPIC ATELOCOLLAGEN INSERTION IN HIGH-GRADE PASTA LESIONS: A RETROSPECTIVE COHORT STUDY WITH PROPENSITY SCORE MATCHING

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Background: The purpose of this study was to evaluate the effect of atelocollagen insertion to the bone-tendon interface of the repaired tendon after transtendon suture bridge repair for high-grade partial articular supraspinatus tendon avulsion (PASTA) lesions. Clinical and radiological outcomes of atelocollagen inserted rotator cuff repair with atelocollagen non-inserted rotator cuff repair in the high-grade PASTA lesions were compared.

Methods: From January 2017 to June 2020, the data of 301 consecutive patients who underwent arthroscopic transtendon suture bridge repair of PASTA lesions by a single surgeon were retrospectively reviewed. Among 301 patients, 268 patients available for minimum 2- year follow-up were included. These patients were divided into two groups: 200 patients treated with atelocollagen non-inserted transtendon suture bridge repair (Group I) and 68 patients with atelocollagen inserted transtendon suture bridge repair (Group II). Patients in Group II were matched to patients in Group I using propensity score matching. Clinical scores and range of motion were compared between two groups. Also, repaired tendon integrity and thickness was compared at immediate, postoperative 6-month and 1-year in MR images as the vertical distance from mid-point footprint of the greater tuberosity.

Results: Regardless of atelocollagen insertion, transtendon suture bridge repair of high-grade PASTA lesions showed significant improvements of the clinical scores and radiological outcomes. For most comparisons, there were no significant differences in clinical scores and range of motion between groups. However, forward flexion of 1-year and last follow up and abduction of last follow up were significantly higher in the experimental group. Also, group II showed significant larger tendon thickness of the repaired tendon at immediate postoperative, 6-month and 1-year MRI ($p < 0.05$). Furthermore, less residual pain at the last follow-up was found in Group II ($p = 0.043$).

Conclusions: Regardless of atelocollagen insertion, transtendon suture bridge repair of high-grade PASTA lesions showed significant clinical and radiological improvements at the last follow-up. Especially, atelocollagen inserted rotator cuff repair group showed larger tendon thickness and less residual pain at the last follow-up.

FP.13.07

DOES BELLY PRESS ANGLE PREDICT SEVERITY OF SUBSCAPULARIS TEAR?

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Background: Although there are controversies on the indication of surgical repair of SSC tears, some surgeons advocate that repair of partial subscapularis tears. However, detecting partial-thickness subscapularis tears preoperatively are more difficult than full-thickness tears. To prevent neglected partial subscapularis tears, meticulous preoperative evaluation via physical examination and imaging is essential. This study aimed to analyze the relationship between the baseline characteristics and the severity of the subscapularis tear, and to provide diagnostic clues for patients requiring subscapularis repair.

Methods: This retrospective study included 286 patients who underwent arthroscopic rotator cuff repair between 2020 to 2022. Baseline characteristics, including range-of-motion, functional scores, muscle strength ratio, modified belly press test (measuring belly press angle), and bear hug test, were collected. Types of subscapularis tear (by Yoo and Rhee subscapularis tear classification), supraspinatus tear, and biceps lesion were recorded during arthroscopic surgery. The relationship between the severity of the subscapularis tear and the biceps lesion, muscle strength ratio, belly press angle, and bear hug test was analyzed, and diagnostic performance was further analyzed using the area under the curve (AUC)/receiver operating characteristics (ROC).

Results: Among 286 patients, 189 (66.1%) had subscapularis tears (IIA or severe). There was a significant difference in biceps lesion ($p < 0.01$), muscle strength ratio of belly press test ($p = 0.03$), belly press angle ($p < 0.01$), and bear hug test ($p < 0.01$) between type IIA and IIB. With 15° of belly press angle as a new cut-off value, the modified belly press test showed 67.6% sensitivity, 73.9% specificity, 20.0% positive predictive value, 40.3% negative predictive value, 69.6% accuracy, and 0.758 AUC/ROC in detecting type IIB or higher subscapularis tear which indicating surgical indication.

Conclusions: Type IIA and IIB subscapularis tears (by Yoo and Rhee classification) showed differences in biceps lesion, belly press strength ratio, belly press angle, and bear hug test. The cut-off value of the 15° belly press angle showed an accuracy of 69.6% in detecting patients with type IIB or higher subscapularis tears requiring subscapularis repair.

FP.13.08

LONG TERM OUTCOMES OF NONOPERATIVE TREATMENT OF ATRAUMATIC, SYMPTOMATIC FULL THICKNESS ROTATOR CUFF TEARS. TEN YEAR OUTCOMES OF THE MOON SHOULDER COHORT

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Background: The MOON Shoulder multicenter prospective cohort study enrolled 452 patients with symptomatic atraumatic full thickness rotator cuff tears from January 17, 2007- September 23, 2010 to determine the effectiveness of physical therapy as a treatment, and to identify the features predicting the decision for surgery. We are reporting the 10-year follow up of this cohort.

Methods: Patients performed a standard evidence based physical therapy protocol for 6-12 weeks. After the initial 6-12 weeks of therapy, we contacted patients at 1, 2, 5, 7, and 10 years and collected data on whether they had surgery and the details of that surgery.

Results: Of the 452 patients in original cohort, 31 patients withdrew before 10-years leaving 421 available for analysis. Thirty-seven patients (9.1%) died before 10 years, and 40 others (9.0%) were lost to follow up. 115 patients (27%) were known to have had surgery over the 10-year follow-up period. Of this group, details regarding surgery were available for 105 patients. Rotator cuff repair was performed in 103 patients (98%) (one partial repair and one augmented with graft). One patient (0.2%) had a reverse total shoulder arthroplasty. Of those that had surgery, most (56.5%) had surgery within 6 months of enrollment. Patient expectations regarding the effectiveness of nonoperative treatment was the strongest predictor for surgery in this group. For those that had surgery after 6 months of enrollment, workers compensation status and shoulder activity were more important than patient expectations in predicting the need for surgery. Patient reported outcome measures (PROMs) (WORC, ASES, SANE, and VAS for Pain) improved beyond the MCID after treatment with physical therapy. These improvements in PROMs were stable and did not decline over the 10-year follow-up.

Conclusions: Physical therapy is effective treatment for >70% of patients with atraumatic rotator cuff tears, and patient reported outcomes do not decline over 10 years. Of those that had surgery, low expectations regarding therapy predicted early surgery and activity level and workers compensation became important for later surgery. The risk of death in this cohort of older individual was 9.1% over 10 years, whereas the risk of needing a reverse arthroplasty was 0.2%.

FP.13.09

INJECTION OF MONOCYTES PREPARED WITH SELECTIVE FILTRATION SYSTEM OF PERIPHERAL BLOOD DO NOT IMPROVE HEALING IN ROTATOR CUFF REPAIR

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Background: The aim of this study is to compare, at 6-months follow-up, the clinical outcomes and the rotator cuff healing evaluated with ultrasonography, with or without the addition of activated autologous monocytes over the tendon-bone interface at the end of the arthroscopic rotator cuff repair.

Methods: 75 patients were recruited in the study, and randomly divided into 2 groups (monocytes = 34; control = 41). They have been evaluated pre-op and at least 6 months after the arthroscopic procedure. The clinical evaluation was carried out through: Visual Analogue Scale, Constant-Murley Score, American Shoulder and Elbow Surgeons score. Musculoskeletal ultrasonography has been used to classified the cuff integrity through the adapted Sugaya score.

Results: Patients have been recalled after a minimum follow-up of 6 months. In terms of pain, there were better results in the control group where the VAS score increased of 5.5 ± 1.9 . In the group of monocytes the Constant rating system showed a significant improvement from a preoperative average of 41 ± 11 to an average of 81 ± 13 postoperatively; in the study group also, we detected an improvement of 37 ± 15 points between pre and postoperative evaluation. According to ASES scores, the average total score improved from 40 ± 16 to 78 ± 19 in the study group and from 38 ± 17 to 79 ± 9 in the control group. Ultrasonography revealed no meaningful differences between the two groups, in fact better Sugaya values have been observed in the study group than in the control group.

Conclusions: The clinical outcomes and ultrasonography results at 6-months follow-up show similar results between the 2 groups. Further studies and an extended follow-up are needed to get to more reliable conclusions regarding a potential advantage in the use of activated monocyte infiltrations after an arthroscopic rotator cuff repair.

FP.14.01

**CAN MAKING SKIN INCISION WITH ELECTROCAUTERY ELIMINATE CUTIBACTERIUM ACNES FROM SURGICAL WOUND DURING SHOULDER ARTHROPLASTY?
A PROSPECTIVE RANDOMIZED CLINICAL TRIAL**

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Background: Cutibacterium acnes remains the most commonly detected organism in shoulder arthroplasty. C. acnes infection is thought to occur during shoulder arthroplasty through contamination of the surgical field with C. acnes from the incised dermal edges. The purpose of this study was to examine if using electrocautery for making skin incisions would result in decreased C. acnes contamination during shoulder arthroplasty compared to using scalpels.

Methods: Patients undergoing primary shoulder arthroplasty were randomized into 2 groups, Electrocautery vs. Scalpel incision group. All patients received a standard preoperative antiseptic preparation including chlorhexidine gluconate showers, intravenous antibiotic administration, and topical application of hydrogen peroxide, povidone iodine, isopropyl alcohol, and DuraPrep®. Cultures were obtained from the incised dermal edge immediately after skin incision and from surgeon's gloves and forceps immediately prior to humeral component implantation. The primary outcome was positive C. acnes culture rates compared between the groups.

Results: A total of 64 patients (32 in each group) were enrolled. There were 24 males in each group. Regarding dermis cultures, 10 patients (31%) in the Scalpel group were positive with 8 of them positive for C. acnes, whereas no patients in the Electrocautery group were positive ($p < 0.001$). Regarding glove cultures, the Electrocautery groups had 7 positive patients (22%), and the Scalpel group had 10 (31%). Regarding forceps cultures, the Electrocautery group had 5 (16%), and the Scalpel group had 8 positive patients (25%). All positive cultures were exclusively from male patients. There were no wound complications, infection, or inferior cosmesis of incision healing in the Electrocautery group while the Scalpel group had one acute postoperative infection.

Conclusions: Making skin incisions using electrocautery resulted in zero C. acnes culture at the incised dermis, suggesting its potential effect against C. acnes. However, this initial antibacterial effect did not prevent later appearance of C. acnes in the surgical field. All positive cultures were exclusively from male patients, suggesting that the source of C. acnes was specifically related to the male. Future studies are to investigate potential synergistic effects of combining with other anti-bacterial strategies to achieve a successful elimination of C. acnes.

FP.14.02

METHYLPREDNISOLONE TAPER IS AN EFFECTIVE ADDITION TO MULTIMODAL PAIN REGIMENS AFTER TOTAL SHOULDER ARTHROPLASTY: RESULTS OF A RANDOMIZED CONTROLLED TRIAL

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Background: Perioperative corticosteroids have shown promise as a non-opioid analgesic adjunct for various orthopaedic pathologies. However, there is a paucity of studies investigating the role of corticosteroids in the postoperative setting after total shoulder arthroplasty (TSA). Thus, the purpose of this study is to assess the impact of a methylprednisolone taper on a multimodal pain regimen after TSA.

Methods: This study is a randomized control trial, clinicaltrials.gov (NCT03661645), of a group of opioid naïve patients undergoing TSA. Patients were randomly assigned at the time of surgery to receive intraoperative dexamethasone only (control group) or intraoperative dexamethasone followed by a 6-day oral methylprednisolone (Medrol) taper course (treatment group). All patients received the same standardized perioperative pain management protocol. A pain journal was used to record visual analog pain scores (VAS-pain), VAS-nausea, and number of opioid tablets consumed during the first 7 post-operative days (POD). Patients were seen at 2-weeks, 6-weeks, and 12-weeks post-operatively for clinical evaluation and collection of patient-reported outcomes.

Results: Overall, there were 67 patients enrolled in the study, including 32 in the control group and 35 in the treatment group. There was a reduction in the mean VAS pain scores and in cumulative oxycodone tablet consumption (control group = mean of 18 pills vs. treatment group = 4.2 pills) in the first postoperative week. Patients also had less opioid-related side effects, including nausea, within this first postoperative week. Although there was an improvement in VAS pain score in the treatment group at 2 weeks postoperatively, there were no differences at 6 weeks, 12 weeks, or at final follow-up. There were no differences in EQOL, shoulder SANE, or ASES scores at 2 weeks, 6 weeks, or 12 weeks postoperatively, or at final follow-up, between the groups. At a follow-up of 23.4 (12-39) months in the control group and 19.4 (12-37) months in the treatment group, there was 1 infection in the control group and 1 postoperative cubital tunnel in the treatment group.

Conclusions: A methylprednisolone taper course shows promise in reducing acute pain and opioid consumption as part of a multimodal regimen following TSA.

FP.14.03

COMPARING REPAIRED SUBSCAPULARIS TENDON INTEGRITY USING ULTRASONOGRAPHY IN ONLAY VERSUS INLAY REVERSE SHOULDER ARTHROPLASTY

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Background: The role of subscapularis tendon in a Reverse Shoulder Arthroplasty(RSA) has been much debated lately. However, recent studies have shown that a healed subscapularis tendon yields a better functional outcome. In our study, we are comparing the healing of subscapularis tendon between an Inlay Reverse Shoulder arthroplasty with an Onlay Reverse Shoulder Arthroplasty.

Methods: This is a retrospective review of patients that have undergone RSA in a single center by a single surgeon from January 2014 till December 2021. We included the patients that had subscapularis tenotomy repaired and had ultrasonography(USG) of the tendon at 6 months postoperatively. We divided the patients into an onlay group and inlay group respectively. Based on the USG finding, we used the Sugaya classification to determine whether the tendon is healed or not healed and classify the patient as having a healed subscapularis tendon if the USG demonstrates Sugaya type I-III tendon integrity and not healed when its Sugaya type IV and V tendon integrity.

Results: 189 patients were evaluated in this study with a total of 91 patients undergoing an inlay type of RSA and 98 patients having onlay type of RSA. The healing rate of repaired subscapularis tendon in the inlay group is about 55% and the onlay group recorded a 73.5%.

Conclusion: The outcome of this study shows that healing of the repaired subscapularis tendon in RSA patients is better in the Onlay type. This can be largely attributed to the preservation of the intramedullary vascular system and also the near normal tendon excursion that can be achieved from the Onlay type RSA.

FP.14.04

EVALUATION OF THE EFFECT OF THE AUGMENTED GLENOID BASEPLATE ON THE IMPROVEMENT OF CLINICAL AND RADIOLOGIC OUTCOMES IN RTSA

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Background: Glenoid deformity is commonly encountered in reverse total shoulder arthroplasty (RTSA) and challenges for shoulder surgeon. Augmented baseplates have recently been used to address glenoid deformity. The purpose of this study was to evaluate the clinical and radiologic outcomes of an augmented baseplate during RTSA in patients with glenoid deformity.

Methods: Forty-eight patients with RTSA were included in this study. RTSA with the augmented baseplate were performed in 24 patients (group A), whereas age/sex matched 24 patients with glenoid wear who underwent RTSA with the standard baseplate (group S). Clinical scores (PVAS, FVAS, ASES, Constant, KSS, SST score) and ROM were checked preoperatively and at 6 months, 1 year and over 2 years postoperatively. We measured glenoid inclination, retroversion, and lateral humeral offset (LHO) in Preoperative radiographs for determining glenoid morphology and deformity. Postoperative radiographs were used to evaluate for correction of deformity and complications.

Results: There were no significant differences in the demographic characteristics, mean follow-up duration (20.5 vs 21.1 months) and preoperative glenoid wear types and degree. Both groups showed significant improvement of clinical scores and some ROM measures (FE, ABD) compared to preoperative. Group A were divided into 2 subgroups (Superior augmentation 15, Posterior augmentation 9). Glenoid inclination was significantly improved in the superior augmentation group, while retroversion was significantly improved in the posterior augmentation group. Nevertheless, there were no significant differences between pre- and postoperative LHO in group A. Also In group S, the posterior wear subgroup was significantly corrected for retroversion compared to preoperative retroversion, but there was no significant correction in glenoid inclination in the superior wear subgroup. Furthermore, unlike group A, postoperative LHO was significantly decreased in group S. Two acromial stress fractures (8.3%) occurred in group A, whereas 1 scapular notching (4.2%) occurred in group S.

Conclusions: RTSA with augmented baseplate results in excellent clinical outcomes and significant correction of deformity. However, there was no difference in clinical outcomes between augmented group and standard group at a mean follow-up of 20.8 months. Standard baseplate showed LHO being decreased compared to augment glenoid, so when we are implanting for humeral or glenoid lateralization this should be consider.

FP.14.05

COMPARISON OF SHORT-TERM CLINICAL OUTCOMES AND RADIOGRAPHIC CHANGES IN GRAMMONT REVERSE SHOULDER ARTHROPLASTY BETWEEN THE FRENCH AND JAPANESE POPULATIONS: A PROPENSITY SCORE-MATCHED ANALYSIS

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Background: Although Grammont-style reverse total shoulder arthroplasty (RSA) showed excellent clinical results in Europe, its utility for Asian populations remains unclear. This study aimed to compare the French and Japanese populations in terms of range of motion (ROM), functional outcomes, and scapular notching rates in patients who underwent standard Grammont-style RSA. We hypothesized that RSA for the Japanese population may not provide as good ROM and functional results at the final follow-up as that for the French population.

Methods: A total of 25 Japanese patients undergoing RSA were propensity score matched to 25 French patients undergoing RSA. The patients were matched for four different covariates using a propensity score analysis. The minimum follow-up period was 2 years. We investigated differences between the populations with respect to size and shoulder joint ROM and Constant score (CS) measured preoperatively and at the final follow-up. Scapular notching was examined using radiographs at the final follow-up.

Results: The average height and weight of the French and Japanese patients were 164 cm and 70 kg and 152 cm and 56 kg, respectively. Anterior elevation (AE), external rotation (ER) at the side, internal rotation (IR), and CS total changed from 101 to 145, 17 to 15, 4.5 points to 5.5 points, and 36 points to 72 points, respectively, in the French population and from 63 to 119, 8.5 to 13, 4.6 points to 4 points, and 28 points to 58 points, respectively, in the Japanese population. AE improved in both the groups; ER and IR remained unchanged before and after surgery. The frequency of scapular notching (>grade 1) was higher in the Japanese population (56%) than in the French population (20%).

Conclusions: Grammont-style RSA improved AE and CS in both the populations, but AE and CS were significantly higher in the French population than in the Japanese population at the final follow-up. Scapular notching frequently occurs in the Japanese population.

FP.14.06

BIOMECHANICAL CHARACTERISTICS OF GLENOSPHERE ORIENTATION BASED ON TILTING ANGLE AND OVERHANG CHANGES IN REVERSE SHOULDER ARTHROPLASTY / GLENOSPHERE ORIENTATION AND COR IN RSA

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Background: Glenoid position and inclination are important factors in protecting against scapular notching, which is the most common complication, and which directly affects the longevity of reverse shoulder arthroplasty (RSA). This study aimed to investigate the biomechanical characteristics of glenosphere orientation, comparing neutral tilt, inferior overhang with an eccentric glenosphere at the same placement of baseplate, and inferior tilt after 10° inferior reaming in the lower part of the glenoid in RSA.

Methods: Nine cadaveric shoulders were tested with five combinations of customized glenoid components: a centric glenosphere was combined with a standard baseplate (group A); a centric glenosphere was combined with a wedge-shaped baseplate tilted inferiorly by 10° with the same position (group B); an eccentric glenosphere with a 4-mm inferior overhang was combined with a standard baseplate (group C); an eccentric glenosphere with a 4-mm inferior overhang was attached to a wedge-shaped baseplate (group D); and 10° inferior reaming was performed on the lower part of the glenoid to apply 10° inferior tilt, with a centric glenosphere secured to the standard baseplate for simulation of clinical tilt (group E). Impingement free angles for adduction, abduction, forward flexion, external rotation, and internal rotation were measured. The capability of the deltoid moment arm for abduction and forward flexion, deltoid length, geometric analysis for adduction engagement were evaluated.

Results: Compared with neutral tilt, inferior tilt at the same position showed no significant difference in impingement-free angle, moment arm capability, deltoid length. However, group D resulted in better biomechanical properties than a central position, regardless of inferior tilt. Group E demonstrated a greater range of adduction, internal and external rotation, and higher abduction and forward flexion capability with distalization, compared to corresponding parameters for inferior tilt with a customized wedge-shaped baseplate.

Conclusions: A 10° inferior tilt of the glenosphere, without changing the position of baseplate, had no benefit on impingement free angle and deltoid moment arm. However, a 4-mm inferior overhang with an eccentric glenosphere had a significant advantage, regardless of inferior tilt. Inferior tilt through 10° inferior reaming showed better biomechanical results than neutral tilt, due to the distalization effect.

FP.14.07

RSA INSTABILITY: A RETROSPECTIVE REVIEW OF 32 INSTABILITY CASES

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Background: RTSA instability is a devastating complication that may result in revision surgeries, unfavorable functional outcome and in some cases severe functional impairment. The purpose of this study was to retrospectively analyze RTSA instability cases for their etiology, treatment and final functional outcome.

Methods: A retrospective study of 32 patients (mean age 69 years; range 42-85) treated for RTSA instability in two different institution between 2004 and 2019 (mean follow-up 47.71 months; range 12-158). Standard X-ray were routinely performed, while Computed Tomography scans and contralateral radiographs were obtained in case the etiology for instability was not evident. Clinical outcome measures included range of motion, SSV, VAS, SST, and Constant-Murley scores and recurrence of instability.

Results: Etiologies for RTSA instability included: soft tissue insufficient tension (12 patients); glenoid loosening (7); component impingement (5); mechanical failure (4); component malposition (3); no explanation (1) and multiple etiologies. Successful orthopaedic reduction was registered in two cases. Component revision included: higher humeral stem position (6 patients); larger spacer (5); larger glenosphere (5); complete humeral and glenoid replacement with bone graft (6). At final follow-up all 32 RTSA were reported to be stable with a mean VAS of 0.96; SSV 55.62%; constant score 50; constant ponderate 71.3%; SST 8/12. Reported mean range of motion included: forward elevation 109 degrees; external rotation 1st position 20.6 degree; external rotation 2nd position 32.5 degrees; abduction 99.5 degrees; internal rotation 4.4 (constant score).

Conclusions: The management of unstable RTSA represent a challenge to the shoulder surgeon. The most frequently encountered etiology for instability was soft tissue tension followed by component loosening, impingement, mechanical failure and malpositioning. Orthopaedic reduction was rarely successful and frequently revision surgeries with component exchange were required for the restoration of soft tissue tension and correct positioning of components.

FP.14.08

PREDICTING PAIN AND FUNCTION WITH THE NEUTROPHIL-TO-LYMPHOCYTE RATIO IN PATIENTS FOLLOWING PRIMARY REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: The prevalence of glenohumeral joint osteoarthritis is estimated to be between 16-20% in the middle-aged and elderly population. Total shoulder arthroplasty is a common treatment for shoulder arthritis with the incidence of the reverse shoulder arthroplasty increasing sharply over the last 10 years. Chronic pain persists in 22% of patients undergoing shoulder arthroplasty according to a patient survey. Currently, there is no reliable way to predict patients who will have persistent pain and functional limitations after surgery. The Neutrophil-to-Lymphocyte ratio (NLR) has been widely studied as a measure of immune-inflammatory reaction and neuro-endocrine stress. Therefore, the purpose of this study was to investigate the predictive ability of an NLR > 2.5 to identify patients with elevated pain and functional limitations at 6 and 12 months following primary reverse total shoulder arthroplasty.

Methods: This study was a retrospective cohort design utilizing a patient registry from a single fellowship trained shoulder surgeon. Patient data was collected retrospectively between 2019 and 2020. Neutrophil-to-Lymphocyte ratio (NLR) was obtained from preoperative complete-blood-count differential (CBC). Primary outcomes measures assessed were ASES pain and function sub-scores, Pittsburgh Sleep Quality Index (PSQI), and Single Assessment Numeric Evaluation (SANE) score.

Results: At 6-months, patients with an NLR >2.5 scored significantly worse on the ASES Pain ($p=0.0047$), ASES ADL ($p=0.0066$), and PSQI ($p=0.0345$). Differences in SANE scores were not significant ($p=0.3236$). At 12-months, only the PSQI scores remained statistically significant ($p=0.0137$). There were no significant associations between age, gender, or BMI.

Conclusions: Management of patients with chronic pain continues to be challenging with limited high-value interventions. Early identification of patients likely to develop persistent pain following reverse shoulder arthroplasty would allow for a multidisciplinary treatment approach sooner in the post-operative recovery phase. Based on our results, a pre-operative Neutrophil-to-Lymphocyte Ratio greater than 2.5 is a significant risk factor for having increased pain, functional limitations, and poor sleep quality compared to patients with a pre-operative NLR less than 2.5. A complete-blood-count (CBC) panel is quick, inexpensive, and currently a standard test ordered as part of pre-surgical planning.

FP.14.09

SPONTANEOUS DELTOID TEAR IN CUFF TEAR ARTHROPATHY AND ITS EFFECT ON THE OUTCOME OF REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: Deltoid function critically influences the results of reverse total shoulder arthroplasty (RTSA), and spontaneous deltoid attrition tears are frequently detected in cuff tear arthropathy (CTA) patients, but the clinical impacts of these tears on RTSA outcomes are undetermined.

Methods: Seventy-two patients that received RTSA for cuff tear arthropathy with preoperative MRIs and a minimum clinical follow-up of 1 year (mean 32 months) were retrospectively included in the study. Patients with a history of previous shoulder surgery or injury were excluded. The presence and location of deltoid attrition tears were determined in preoperative MRI. Propensity score matching (1-to-1) was performed to construct tear and no tear groups. Finally, 21 patients, matched with respect to age, sex, hand dominance, symptom duration, medical comorbidity (obesity, diabetes mellitus, coronary artery disease), Hamada grade, and implant type were assigned to each group. Clinical outcomes (functional scores, isometric power, and range of motion) in the two groups were compared.

Results: Deltoid attrition tear was detected in 21 (29 %) of the 72 enrolled cases. Anterolateral deltoid was the most frequent location and no tear was detected in the posterior deltoid. The tear rate increased with disease severity (Hamada G2, 8.3%; G3 22.7%; >G4 65.2%). No pre- or postoperative clinical variable differed significantly in the tear and no tear groups.

Conclusions: Deltoid attrition tear was detected in 29% of CTA patients that underwent RTSA. The most common site was the anterolateral region and tear prevalence tended to increase with CTA progression. However, RTSA was found to provide satisfactory outcomes regardless of the presence of deltoid attrition tear.

FP.15.01

A CORONOID-CENTRIC CLASSIFICATION SYSTEM OF PROXIMAL TRANS-ULNAR FRACTURE DISLOCATIONS HAS ALMOST PERFECT INTRAOBSERVER AND INTEROBSERVER AGREEMENT

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Background: Fracture-dislocations of the elbow, particularly those that involve a fracture through the proximal ulna, are complex and can be difficult to manage. However, current classification systems oftentimes cannot discriminate between Monteggia-variant injury patterns and trans-olecranon fracture-dislocations, particularly when the fracture involves the coronoid. The Mayo classification of proximal trans-ulnar fracture-dislocations unifies the trans-ulnar classification systems and categorizes these fractures in three types according to what the coronoid remains attached to: Trans-olecranon fracture-dislocations (the olecranon is fractured but the coronoid remains attached to the ulnar metaphysis); Monteggia variant fracture-dislocations (the ulnar metaphysis is fractured but the coronoid is still attached to the olecranon); and Basal coronoid trans-ulnar fracture-dislocations (the coronoid is not attached to either the olecranon or the ulnar metaphysis). The purpose of this study was to evaluate the intraobserver and interobserver agreement of the Mayo classification system when assessing elbow fracture-dislocations involving the proximal ulna, based on radiographs (XR) and computed tomography (CT).

Methods: Three fellowship-trained Shoulder and Elbow surgeons and 2 fellowship-trained Orthopedic Trauma surgeons blindly and independently evaluated the XR's and CT's of 90 consecutive proximal trans-ulnar fracture-dislocations treated at a level I trauma center. Inclusion criteria included a subluxation or dislocation of the elbow and/or radio-ulnar joints with a complete fracture through the proximal ulna. Each surgeon classified all fractures according to the Mayo classification, which is based upon what the coronoid remains attached to (ulnar metaphysis, olecranon or neither). Kappa values were calculated for both intraobserver and interobserver reliabilities.

Results: The average intraobserver agreement was 0.87 (almost perfect, range 0.76-0.91). Interobserver agreement was 0.80 (substantial agreement; range 0.70-0.90) for the first reading session and 0.89 (almost perfect; range 0.85-0.93) for the second reading session. The overall average interobserver agreement was 0.85 (almost perfect; range 0.79-0.91).

Conclusions: Classifying proximal trans-ulnar fracture-dislocations based upon what the coronoid remains attached to (the olecranon, the ulnar metaphysis, or neither) was associated with almost perfect intraobserver and interobserver agreement, regardless of trauma or shoulder/elbow fellowship training.

FP.15.02

MIXED REALITY GUIDANCE IN HUMERAL OSTEOTOMY PROVIDES SUPERIOR PRECISION AND ACCURACY: VALIDATION AND COMPARATIVE STUDY

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Background: Humeral deformities of both post-traumatic and developmental nature can lead to abnormal glenohumeral joint alignment and dysfunction. Traditionally, tools such as protractors, metal wedges, and patient specific instrumentation have been used intraoperatively to guide the osteotomies. Despite being useful, the issues of cost, ease of use, and the timing of ordering custom guides have to be considered. Development of new systems based on mixed reality allow for placement and manipulation of virtual objects with no lead time or physical disposables during the case. The purpose of this study is to perform validation study comparing 3 methods of osteotomy control: visual (eyeballing-EB), printed wedge (PW) and holographic wedge (HW).

Methods: 30deg closed wedge osteotomy was performed using adult porcine femur with oscillating saw. 3 methods of osteotomy were applied with 18 specimens for each group. Group EB- by best visual estimate by experienced surgeon, group PW using printed 30deg. wedge and group HW using mixed reality viewing system (RSQ HOLO, RSQ Technologies, Poznan, Poland). A holographic wedge tool corresponding with the 30deg. angle of correction was created and adjusted virtually by the surgeon to fit bone. Osteotomy was performed along converging surfaces of the virtual wedge. Angle of removed bone wedge and bone alignment after osteotomy (AP and lateral) were measured.

Results: Results of osteotomized bone wedge, long axis of the bone (AP and lateral alignment) represented by mean, standard and average deviations are presented below:

-wedge angle: EB 31(2,7; 2,3), PW 32,1(3,8;3), HW 29 (2,7;1,8); ANOVA-30EB vs 30H p=0,05; 30H vs 30W p<0,004

-AP bone angle: EB 150,5 (6,8; 5,4), PW 149,1(5,5; 4,6), HW 155,1(5,2; 3,9); ANOVA-30EB vs 30W p=0,02; 30H vs 30W p=0,003

-Lateral bone angle: 170,5 (6,5;5,2), PW 169,8(4,4;3,2), HW 175,3(5,1;4); ANOVA-30EB vs 30W p=0,01, 30H vs 30W p=0,003
HP showed lowest and closest to the planned values with lowest variability comparing to EB and PW. Interestingly lateral alignment was best controlled with holographic support, with others techniques loosing over 5 degrees of undesired effect.

Conclusions: Augmented reality provides superior precision and accuracy comparing to both visual control and printed wedge guides in osteotomy of long bones.

FP.15.03

TRANSOLECRANON FRACTURE-DISLOCATION AND TRANSOLECRANON BASAL CORONOID FRACTURE-DISLOCATION; RESULTS OF STANDARDIZED TREATMENT IN A RETROSPECTIVE COHORT

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Background: Our understanding of transolecranon fracture dislocation (TOFD) has increased. Classically, instability was considered of bone origin; therefore, correct osteosynthesis of the olecranon should be sufficient. Currently it is known that the associated lesions (ligaments, coronoid, radial head) have an impact on stability, so they should be included in surgical planning. Similarly, understanding of coronoid fracture patterns has progressed. As described by O'Driscoll et al., basal () subtype 2 coronoid fracture (BC2) correspond to a TOFD, but with a fracture passing through the base of the coronoid. In the scientific literature, there is no clear differentiation between pure-TOFD and BC2-TOFD. The main objective of this study is to evaluate the functional results and complications of TOFD using a standardized surgical technique. The secondary objectives are to describe the associated injuries, and to compare the results between pure-TOFD and BC2-TOFD.

Methods: This retrospective study included all patients with a TOFD treated with a standardized surgical procedure and rehabilitation protocol between 2013 and 2018 in a single center. Demographic data, and associated bone and ligament injuries were reviewed. Clinical outcomes (range of motion (ROM), Mayo elbow performance (MEPS) and Broberg and Morrey (B&M) scores) were evaluated at the final follow-up. Complications and reoperations were assessed.

Results: 24 patients were included, 75% were men. The average follow-up was $57,9 \pm 22$ months. The mean age was 42 ± 15 years. 19 (79,2%) were BC2-TOFD and 5(20.8%) were pure-TOFD. Ligament injuries requiring repair and radial head fracture were present in 8 (33.3%), and 11 (45,8%) respectively. The average ROM were flexion $119^\circ \pm 17$, extension deficit $20,4^\circ \pm 13^\circ$, pronation $69^\circ \pm 20^\circ$, supination $63.1^\circ \pm 27^\circ$. MEPS and B&M mean scores were 82.3 ± 16 and 82 ± 16 respectively. Reoperation rate was 33,3%. No significant differences were found between pure-TOFD and BC2-TOFD. A significant difference was found in MEPS ($P=.001$), B&M ($P=.002$), range of flexion ($P=.011$) and extension deficit($P=.005$); between patients who had reintervention and those who did not.

Conclusions: A standardized protocol for TOFD allows good to excellent functional results. There are no significant differences between pure-TOFD and BC2-TOFD. A third underwent reintervention. Patients with reintervention presented worse outcomes.

FP.15.04

PROXIMAL ULNA FRACTURES: INFLUENCE OF ASSOCIATED CORONOID FRACTURE. CASE-CONTROL STUDY

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Background: Proximal ulna fractures account for approximately 1% of upper extremity fractures and 10% of elbow fractures. The objective of this work was to evaluate the influence of a coronoid fracture with or without dislocation in the outcome of proximal ulna fractures.

Methods: We reviewed 65 patients operated on for proximal ulna fracture with plates between 2004 and 2019 with a minimum of 6 months (6 - 180) of follow-up. Twenty-three patients with coronoid fractures were compared with 42 isolated ulnar fractures. Coronoid fractures were classified according to the Regan and Morey classification. Retrospective evaluation included measurement of range of motion, MEPS and QDash scores, and occurrence of complications, osteoarthritis and ossification).

Results: In the group of 42 isolated ulna fractures the MEPS reached 85 (80- 100), the QDASH 11.4 (0-36.4), the flexion extension wheel 122 ° (110-140). There was 38% post-traumatic osteoarthritis, 12% pseudoarthrosis, 15% post-traumatic stiffness, 27% ossifications and 41% material removal. In the group with associated coronoid fracture, the MEPS reached 70 (60-95), the QDASH 36.4 (15.3- 52.3), the flexion extension wheel 85° (65-120). There was 87% post-traumatic osteoarthritis, 18% pseudoarthrosis, 62% post-traumatic stiffness, 64% ossifications and 27% material removal.

Conclusions: Associated coronoid fracture in proximal ulna fractures is associated with worse functional outcomes and the development of numerous complications. Coronoid fractures are serious fractures that require careful and precise reduction whenever possible.

FP.15.05

THE YIELD OF SUBSEQUENT RADIOGRAPHS DURING NONOPERATIVE TREATMENT OF RADIAL HEAD AND NECK FRACTURES

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Background: Isolated fractures of the radial head are usually treated nonoperatively. Recent literature has suggested that serial radiographs may not be necessary after the initial diagnostic radiograph in nondisplaced or minimally displaced radial head or neck fractures (Mason type 1 or 2) without additional injury to the affected limb. In this study, we aimed to determine (1) how often subsequent radiographs were obtained after the initial diagnosis of a non- or minimally displaced radial head/neck fracture at our institution, and (2) if subsequent radiographs changed initial management. We hypothesized that subsequent radiographs would not change initial management.

Methods: We identified 767 patients with nonoperative treatment for isolated Broberg and Morrey modified Mason type 1 or 2 fractures at a large urban hospital system during years 2019 and 2022. Patient demographics, provider characteristics, and treatment details were obtained from a hospital database. Additionally, the number of elbow radiographs obtained was collected. Nonparametric bivariate analysis was performed, and a p-value <0.05 was used to indicate statistical significance.

Results: A total of 767 patients were identified (459 males and 308 females), with a mean age of 40.8 years (SD 18.8). Thirty-eight percent (n=292) of patients had subsequent radiographs. Twelve of the 292 patients that had subsequent radiographs (4.1%) were offered surgery but declined. None of the patients with subsequent radiographs had an alteration of their weight-bearing status. In bivariate analysis, there was no association between patients' BMI, sex, race, marital status, or insurance and whether they obtained subsequent radiographs. However, patients who had subsequent radiographs performed were significantly more likely to be older (P-value = 0.028).

Conclusions: Radiographs subsequent to diagnosis do not alter treatment of nondisplaced or minimally displaced radial head or neck fractures (Mason type 1 or 2) without additional injury to the affected limb. The decreased utility of subsequent radiographs highlights a potential focus for quality improvement and decreased health resource utilization.

FP.15.06

PRELIMINARY RESULTS OF INTERNAL JOINT STABILIZER COVERED BY AN ANCONEUS FLAP FOR ELBOW INSTABILITY

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Background: The management of residual elbow instability is a challenge in either acute and chronic injuries. Hinged external fixators have been used but they are clumsy and associated to high rate of pin track complications. Moreover, troubles for recreation of the axis of rotation and flexibility of the external frame can result in up to 30% of recurrent instability. An internal joint stabilizer (IJS) was developed achieving similar range of motion with less complications and recurrent instability. However, a subcutaneous frame may provide local tenderness and patients 'complains. The present study evaluates the feasibility and the benefit of an IJS covered by an anconeus flap. Short term results, patients' satisfaction, adverse events and consequences on device removal were compared with a traditional technique with the device implanted above the anconeus.

Methods: As a preliminary analysis of a multicenter study started in January 2022, a retrospective study was performed focusing on influence that an anconeus flap position in relation to the IJS can have on short term results, local adverse events, patients 'satisfaction and device removal. The patients selected were divided in two groups: (group A) "IJS under anconeus"; (group B) "IJS above anconeus".

Results: The selection criteria resulted in a group of 10 patients for group A and 15 patients for group B. At an average follow-up of 3.5 months (range, 2-11 months), there was no significant difference between two groups in terms of all parameters analyzed. However, a trend for better tolerability and satisfaction in patients with the IJS covered by the anconeus flap can be noticed. Despite of a slightly longer removal procedure, no additional significant damage on muscle belly has been observed at the time of implant removal, which is pulled out from the base plate.

Conclusions: The IJS represents an effective and reliable option as a temporary stabilization for residual elbow instability. When performing a lateral approach with an anconeus flap, the internal device can be covered by the muscle belly at the end of the procedure. The preliminary results suggest at least similar tolerance and patient 'satisfaction without any relevant increase in complication rare at time of removal surgery.

FP.15.07

FACTORS FOR ELBOW STIFFNESS AFTER SURGICALLY TREATED DISPLACED RADIAL HEAD FRACTURES - COMPARISON OF IMMOBILIZATION PERIODS AND SOFT TISSUE INJURY PATTERNS-

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Background: Severely fragmented radial head fractures are not easy to fix, and failure can be expected even if fixation is performed firmly. It is well known that additional long-term immobilization can allow healing of the comminuted fracture after surgery. However, more than four weeks of immobilization for some elbow fractures are the cause of elbow stiffness; however, the relationship between long-term immobilization and stiffness after surgery for radial head fractures is not documented yet. Hence, this study aims to investigate how the immobilization period and which part of the injury can influence the development of stiffness after displaced radial head fracture surgery.

Methods: Forty-nine elbows of surgically treated displaced radial head fractures were assessed retrospectively. There were 25 male patients, and the mean age was 42.2 (range 18~75). All elbows were checked for elbow scores (Quick-DASH and MEPS), and a 3D-CT scan and MRI were taken less than 6 days before surgery. Immobilization of less than two weeks was defined as group A, and more than 4 weeks were defined as group B.

Results: There was no significant difference in Quick-DASH and MEPS for groups A and B ($p=0.857, 0.444$). No significance was detected in the range of motion between groups A and B (flexion, $p=0.103$; extension, $p=0.381$; flexion arc, $p=0.155$). The range of motion was significantly different by the tears of anterior capsular tear (ACT) (extension, $p=0.007$; flexion-arc, $p=0.01$) and ulnar collateral ligament tear (UCL) (flexion, $p=0.036$; flexion arc, $p=0.025$).

Conclusions: More than four weeks of immobilization after displaced radial head fracture surgery did not affect elbow stiffness. However, ACT and UCL rupture affected the development of elbow stiffness. Therefore, if there are no ACT or UCL injuries in MRI, long-term immobilization may not influence the development of elbow stiffness after displaced radial head fracture surgery.

FP.15.08

IS FORMAL HAND THERAPY NECESSARY FOR IMPROVED OUTCOMES FOLLOWING SURGICAL MANAGEMENT OF TERRIBLE TRIAD INJURIES?

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Background: No standardized physical therapy (PT) protocol exists for the management of terrible triad injuries. Upper extremity surgeons have emphasized the importance of specialized hand therapy (CHT). However, patient access to PT may be influenced by socioeconomic barriers. This study is the first to compare outpatient PT, home exercises, and CHT for terrible triad injuries. The purpose of this study was to examine the role of formal PT and CHT in the outcome of terrible triad injuries.

Methods: A retrospective single-surgeon study was conducted of patients who underwent treatment of terrible triad injuries. Postoperatively, patients were referred to CHT, PT, or guided to performed home exercises alone based on insurance and socioeconomic factors. Patients who were unable to access CHT were instructed on an overhead protocol for the first 6 weeks and had more frequent follow-up to monitor progress. Outcomes included range of motion, QuickDash, and Mayo Elbow scores and were compared based on whether patients completed CHT, whether they completed >50 PT sessions, or whether they had completed >3 months of PT.

Results: 13 patients met inclusion criteria. The mean age of the cohort was 47 years. Average follow up was 14 months. The average number of PT visits was 60.8. Nine (69%) patients completed CHT, 6 (46%) patients completed >50 PT session, and 5 patients (38%) completed >3 months. The average postoperative elbow ROM for the cohort was 14° extension, 128° flexion, 75° pronation, 65° supination. The average QuickDash score was 36.8 and the average Mayo Elbow score was 76.7. There was no residual instability. There was no difference in ROM or outcome scores for patients based on patient therapy protocol.

Conclusions: Access to post-operative therapy may be influenced by various socioeconomic factors. In the present study, no difference was found in outcomes of terrible triad injuries based on the amount of therapy or if guided by a hand therapist versus a physical therapist. The results of this study suggest that surgeon driven rehab guidance in the clinic in compliant patients may be equivalent to supervised hand therapy.

FP.16.01

EFFICACY OF PREGABALIN FOR PERI-OPERATIVE PAIN RELIEF IN ARTHROSCOPIC SHOULDER SURGERY: RESULTS FROM ESSPRS (EPWORTH SHOULDER PREGAB STUDY) RCT

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Background: Importance: Shoulder surgery is typically associated with high analgesic requirements and severe post-operative pain. Pregabalin is a neuropathic pain medication and non-narcotic analgesic that may be a useful adjunct medication in shoulder surgery. Objective: To assess the efficacy of pregabalin in pain management after arthroscopic rotator cuff repair and subacromial decompression.

Methods: Design: Double-blind randomized controlled trial from 17 August 2015 until 1 May 2020. Setting: Multicentre study by one of two orthopaedic surgeons within the one hospital network in Melbourne, Australia. Participants: 90 adult Participants with MRI confirmed rotator cuff tears or subacromial impingement undergoing arthroscopic rotator cuff repair or subacromial decompression surgery were enrolled in the study. Interventions: Participants were randomized into two groups of 45, receiving either pregabalin or placebo. Participants took 1 tablet twice daily of either Pregabalin (75 mg) or placebo from 5 days before their operation, until 15 days post-operation. The total follow-up period was 12 weeks. Participants completed a study diary including Visual Analogue Scale (VAS) pain scores, Oxford Shoulder scores, PainDETECT questionnaires and Range of Motion testing.

Main Outcomes and Measures: The primary outcome was Visual Analogue Scale (VAS) pain score at 2 weeks post operation. The secondary outcomes were overall/average VAS, functional outcome and neuropathic pain scores, and total opiate intake.

Results: Of the 90 participants, there were 65 Males and 25 Females, ranging between 24 and 81 years of age. There was a reduction in overall mean resting pain significantly decreased across the entire study period for the pregabalin group compared to placebo (mean 30.3 (95% CI: 24.41-36.17) vs 40.0 (95% CI: 33.15-46.90), respectively, $p=0.034$) as well as reduction in mean maximum pain scores (mean max pain 60 vs 73, respectively, $p=0.012$). There was no statistically significant difference between groups for Oxford Shoulder Scores, PainDETECT Scores, Range of motion testing or total opiate intake.

Conclusions: Pregabalin is a useful adjunct analgesic medication in shoulder surgery with minimal adverse effects. There was a reduction in overall pain over a 6 week period but no difference between groups for total opiate intake or functional outcome scores.

FP.16.02

IS LATARJET PROCEDURE EFFECTIVE IN PATIENTS WITH CHRONIC LOCKED ANTERIOR SHOULDER DISLOCATION? A RETROSPECTIVE STUDY

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Background: The chronic locked anterior shoulder dislocation (CLASD) is a difficult clinical problem for both patients and surgeons. Prior studies propose a variety of surgical techniques to address this problem, however, the failure rate is high. No studies on the clinical outcome of Latarjet procedure for the management of CLASD was published before.

Methods: From January 2005 to January 2019, 51 patients with chronic locked anterior shoulder dislocation were treated surgically in our institution. Open Latarjet procedures were carried out in 35 patients. A subscapularis tenotomy or split was chosen based upon the ability to achieve open reduction. Outcome was assessed pre- and postoperative with the American Shoulder and Elbow Surgeons (ASES) score, visual analog scale (VAS) for pain, and UCLA shoulder rating scale and Constant-Murley rating scale. A comparison of the clinical outcome between subscapularis (SSC) tenotomy & repair, SSC-splitting technique and combined humeral head replacement (HHR) was performed.

Results: Twenty-seven shoulders of 27 patients were available for a mean follow-up of 31.6 months. At the final follow up, the range of motion and the shoulder functional evaluations (VAS, ASES, Constant score and UCLA) were significantly improved at the final follow up. The overall redislocation or subluxation rate was 48% (12/25): 0% (0/5) for SSC-splitting group, 53.3% (8/15) for SSC tenotomy & repair group and 80% (4/5) for HHR group. The ASES score, UCLA score, Constant and the external rotation were significant better and less worsened glenohumeral osteoarthritis were identified in patients with SSC-splitting compared with SSC tenotomy & repair.

Conclusions: The Latarjet procedure for the treatment of chronic locked anterior shoulder dislocation (CLASD) can be successful if the shoulder can be reduced without requiring a subscapularis tenotomy. If this is reduction is not possible then other surgical reconstruction should be considered.

FP.16.03

ARTHROSCOPIC DOUBLE-BUNDLE CORACOCALVICULAR LIGAMENT RECONSTRUCTION USING CORTICAL FIXATION BUTTONS PROVIDES SUPERIOR STABILITY THAN SINGLE-BUNDLE TECHNIQUE FOR ACUTE ACROMIOCLAVICULAR DISLOCATION

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Background: Arthroscopic-assisted CC ligament reconstruction using single-bundle technique provided satisfactory clinical outcomes to treat acute AC joint dislocation. However, single-bundle technique does not contribute to the AP stability of the AC joint, that could lead to fixation failure of CC interval. This study aimed to compare clinical and radiological outcomes between single- and double-bundle arthroscopic-assisted CC ligament reconstruction using cortical fixation buttons with suture tapes for acute AC joint dislocation.

Methods: Patients who underwent arthroscopic-assisted CC ligament reconstruction using cortical fixation buttons with suture tapes for acute AC joint dislocation from July 2014 to March 2019 were identified. This study included patients treated for acute AC joint dislocation within two weeks after an injury, with Rockwood classification III or V and at least two years of follow-up. Patients were divided into two groups based on the reconstruction technique; group I (single-bundle technique) and group II (double-bundle technique). The clinical outcomes were compared using ASES score, Constant score, and VAS for pain score between the two groups. On the plain radiograph, the CC interval ratio (CCIR) was measured to evaluate maintenance of CC interval fixation. Postoperative complications, including reduction failure, were also documented.

Results: Fifty-eight patients (26 in group I, 32 in group II) were enrolled. There were no significant differences in CCIR between the two groups preoperatively and three months postoperatively. However, the CCIR of group I were significantly greater than that of group II six months postoperatively (group I: $160.5 \pm 48.5\%$, group II: $125.4 \pm 38.9\%$ six months postoperative, $P=0.01$; group I: $164.0 \pm 57.3\%$, group II: $123.2 \pm 35.9\%$ at the last visit, $P=0.01$). Despite radiologic differences, the clinical outcomes demonstrated no significant differences between the two groups (ASES score: 93.5 ± 5.2 in group I, 94.4 ± 4.5 in group II, $P=0.54$; Constant score: 92.9 ± 5.3 in group I, 94.8 ± 4.3 in group II, $P=0.16$). Reduction failure occurred in four patients (15.3%) in group I, and one patient (3.2%) in group II ($P=0.16$).

Conclusions: Arthroscopic-assisted double-bundle CC ligament reconstruction using cortical fixation buttons with suture tapes provided superior vertical stability than the single-bundle technique.

FP.16.04

VALIDATION OF A NEW OUTCOMES MEASURE FOR TOTAL SHOULDER ARTHROPLASTY: THE SPOT- SUBJECTIVE PATIENT OUTCOME TRACKER

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Background: The novel SPOT- Shoulder Subjective Patient Outcome Tracker® (SPOT) assesses 10 functional domains on a 0-100% scale, allowing an N/A response if the domain does not pertain to the patient. The domains are satisfaction with: comfort at rest, comfort with activity, ability to sleep, mobility, stability, strength, regular chores, regular work, regular exercise, and worry/frustration with the shoulder. The purpose of this study was to validate the SPOT for total shoulder arthroplasty.

Methods: The SPOT, ASES and SANE were administered preoperatively and at 2 years postoperative to patients undergoing shoulder arthroplasty between January 2017 and June 2018. Subjects were included in the analysis if they completed preoperative and 2-year postoperative questionnaires. Test/retest reliability of the SPOT was assessed in a cohort of 12 patients with a diagnosis of shoulder osteoarthritis. Construct validity was assessed by correlation testing, Bland-Altman plots were constructed to assess agreement, and effect size (Cohen's D) was calculated to assess the sensitivity to change from preoperative to 2 years postoperative.

Results: 139 patients met inclusion criteria (anatomic TSA (aTSA) = 73, RSA = 66). Preoperative measures demonstrated moderate correlation in both the aTSA and RSA cohorts (aTSA: SPOT/AESS $r=0.47$, SPOT/SANE $r=0.66$; RSA: SPOT/AES $r=0.50$, SPOT/SANE $r=0.50$). 2-year postoperative measures demonstrated strong correlation in both cohorts (aTSA: SPOT/AESS $r=0.77$, SPOT/SANE $r=0.85$; RSA: SPOT/AES $r=0.85$, SPOT/SANE $r=0.72$). Bland-Altman plots demonstrated good agreement between the SPOT and the ASES in both cohorts, good agreement between SPOT and SANE in the aTSA cohort and slightly weaker agreement between SPOT and SANE in the RSA cohort. Effect size of the SPOT was large for both aTSA and RSA indicating a strong sensitivity to change. Test/rest assessment demonstrated a strong correlation between tests ($r=0.85$, average 91 days between tests).

Conclusions: The SPOT is a valid outcomes measure to assess outcome after TSA or RSA and it demonstrated strong correlation to the ASES and SANE. The SPOT provides more specific information to the clinician regarding a patient's perceived deficit(s) before and after shoulder arthroplasty. The retrospective design and small sample sizes are limits of this study.

FP.16.05

OPIOID CONSUMPTION FOLLOWING ORTHOPEDIC SHOULDER SURGERY: A RANDOMIZED CLINICAL TRIAL

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Background: Opioid mismanagement has been on the rise since the beginning of the 21st century, with orthopaedic surgeons being the third biggest opioid prescribers. In response to the opioid crisis, the American Association of Orthopaedic Surgery has put a decreased emphasis on opioids and an increased focus on multimodal management. The purpose of this study was to assess how the number of initial postoperative opioid prescriptions alter the frequency of prescription refills following shoulder surgery. We hypothesized that the initial number of postoperative opioid prescriptions would not affect the frequency of refill requests.

Methods: A randomized clinical trial was performed on patients who underwent shoulder arthroplasty, rotator cuff surgery, and other arthroscopic shoulder surgery from a single shoulder/elbow fellowship-trained surgeon. Patients were randomized before shoulder surgery to receive either 7, 15, or 23 oxycodone (5 mg) tablets as their initial postoperative opioid prescription. An unblinded member of the study team recorded data related to any refill requests made by patients, including administrative office contacts between the day of surgery and the first postoperative visit. Demographics, surgery characteristics, and incidence of refill requests for the sample were summarized and analyzed.

Results: A total of 90 patients were included in our analysis. The average age was 58.7 ± 17.4 years and 60% were male. Other arthroscopic shoulder surgery was the most frequent surgery ($n = 34$), followed by arthroplasty ($n = 28$) and rotator cuff repair ($n = 28$). A total of 10 patients requested an additional prescription for opioid pain management (11%; $n = 10$): two patients with an initial postoperative opioid prescription of 7 pills (8.7%), three patients with an initial prescription of 15 pills (11.1%), and five patients with an initial prescription of 23 pills (12.5%). There was no difference in the number of patients that requested additional opioid medication between groups ($p = 0.916$).

Conclusions: Our study showed refill requests did not change with respect to the initial amount of prescribed opioids following shoulder surgery. We recommend initially prescribing no more than 7 tablets of 5-mg oxycodone in the postoperative period following shoulder surgery.

FP.16.06

ORAL TRANEXAMIC ACID DOES NOT IMPROVE VISION CLARITY IN SHOULDER ARTHROSCOPY

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Background: In shoulder arthroscopy, it is essential to maintain good visibility, for this purpose different methods have been described such as the use of a mechanical irrigation pump, induced anesthetic hypotension, epinephrine in solution, and the use of intravenous tranexamic acid with reported good results. The objective of this study is to evaluate visibility with the use of oral tranexamic acid during arthroscopic rotator cuff repair, as well as the relationship between changing variables of the anesthetic procedure with visual clarity.

Methods: Prospective double-blind, single randomized study performed in patients treated by arthroscopic rotator cuff repair in the shoulder institute by IQAEO group between 2020-2022. The sample was divided into group A with 29 patients (administration of oral tranexamic acid 1300mg, 30 min before the procedure), and 30 patients in group B (without tranexamic acid). We compared visual clarity in both groups using a 3-level graded scale during different surgical moments, as well as the relationship of cerebral O₂, mean blood pressure, and irrigation pump.

Results: Group A obtained 48 moments (55.17%) with grade III visibility, 39 moments (44.82%) with grade II visibility, and no moments with grade I visibility. Group B obtained 49 moments (54.5%) with grade III visibility, 37 moments (41.1%) with grade II visibility, and 4 moments (4.4%) with grade I visibility. The comparison of the frequencies between both groups did not show a statistically significant difference. On the other hand, the mean TAM at times 2 and 3 with grade I visibility was 82.5mm/hg and 79mm/hg respectively, so it seems that TAM control is more important to control visibility during shoulder arthroscopy.

Conclusions: In arthroscopic rotator cuff repair, oral tranexamic acid does not improve visual clarity. On the other hand, due to the results found in this study, it is considered that the anesthetic procedure with induced hypotension controlled with cerebral oxygenation measurement allows better visibility during the procedure with a lower risk of cerebral hypoperfusion.

FP.16.07

ANALGESIC EFFECT OF MAGNESIUM SULPHATE PRIOR TO OPEN LATARJET SURGERY

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Background: Single shot interscalene anaesthesia (ISA) is frequently used in open shoulder surgery for the management of early post-operative pain. On block resolution some patients may experience distressing rebound pain, and so technique is controversial. The use of multi-modal analgesia before and during ISA resolution is a common approach for attenuating such rebound discomfort. Whilst opioids and NSAIDs form the mainstay of analgesic therapy, other therapies may be considered. It has been suggested that pre-operative administration of magnesium may decrease pain and opioid consumption in the first 24 hours following surgery. We prospectively studied the effect of intravenous magnesium on rebound pain during ISA resolution following open shoulder surgery.

Methods: Twenty patients having Latarjet reconstructions by a single surgeon were randomised to receive either normal saline (S, n=10) or intravenous magnesium sulphate 50mg/kg (M, n=10) prior to induction. All patients received ISA (30ml 0.75% ropivacaine, dexamethasone 50mcg/ml) followed by general anaesthesia. Pre-emptive multimodal analgesia, VAS scores were recorded regularly to 24 hours post-operatively, and the duration of block recorded.

Results: In PACU all patients had a VAS score of 0 with effective block. ISA duration was 16.7hr (S) and 17.8 hr (M), p=0.49. Rebound VAS was significantly less in the magnesium group, 4.0 (0.6) versus 6.2 (0.8), p=0.03. There was no difference in opioid requirement for breakthrough pain (S 8.5mg, M 9.0mg, p=0.92). At 24 hours VAS scores were similar, S 4.7, M 3.3, p=0.16. Patient satisfaction was high in both the Saline and Magnesium groups.

Conclusions: Patients receiving intravenous magnesium sulphate prior to induction experience less pain on ISA resolution, with opioid requirement similar to control over 24 hours. High patient satisfaction indicates single-shot ISA is an acceptable technique for open shoulder surgery.

FP.16.08

A HIGHER MASS INDEX INCREASES THE RISK OF SHOULDER ADHESIVE CAPSULITIS IN YOUNG ADULTS: A NATIONWIDE COHORT STUDY

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Background: The effect of being overweight on the incidence of shoulder adhesive capsulitis (AC) is unclear. This study aimed to investigate the association between overweight and shoulder AC by age using a large nationwide population-based cohort in the Republic of Korea.

Methods: We analyzed clinical data for 3,517,066 individuals older than 20 years who had National Health Insurance Service health checkups in 2009. Patients who visited a hospital or private clinic to treat shoulder pain at least three times in one year and were assigned a diagnostic code for AC (ICD-10 code M750) were identified using claims data during a mean follow-up duration of 8.3 years. Hazard ratios (HRs) and 95% confidence intervals (CIs) for AC were calculated using a Cox proportional hazards model.

Results: The adjusted HR for AC in the <40 age group started to increase in the overweight and was associated with the severity of obesity [BMI <18.5, 0.654 (0.613-0.697); BMI <23, 1; BMI <25; 1.272 (1.231-1.315), BMI <30; 1.322 (1.281-1.364), BMI over 30; 1.332 (1.253-1.416)]. However, in the 40-64 and over 65 age groups, there was no significant increase in HR for AC according to BMI. In a subgroup analysis based on a BMI of 23 and the presence of comorbidities, the adjusted HR for AC was highest for overweight and the comorbidities diabetes [1.528 (1.508-1.549)] and dyslipidemia [1.212 (1.199-1.226)].

Conclusions: In people between 20 and 40 years old, a higher BMI increased the HR for AC. Overweight along with diabetes or dyslipidemia significantly increased the risk of AC.

FP.16.09

IS MUSCLE CRAMPING A FUNCTIONAL LIMITATION AFTER EITHER BICEPS TENODESIS OR TENOTOMY

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Background: The most effective treatment for long head of biceps remains unsettled. Studies have used outcome scores, including shoulder pain, to show tenodesis and tenotomy are comparable. Little attention has been directed at the functional limitations of biceps muscle cramping. The purpose of this report is to compare the functional effects of cramping following tenodesis and tenotomy.

Methods: Two hundred and two patients were reviewed (mean follow up of 14.2 years, range 5 to 20). There were 105 patients in the tenodesis group and 97 in the tenotomy group (75 with surgical tenotomy, 22 with spontaneous rupture). None had a full thickness or a high grade partial thickness rotator cuff tear. Each filled out the ASES Outcome Score pre-operatively (except the spontaneous rupture group) and post operatively. Each was told that we were asking about the biceps muscle, not the shoulder. These anatomic areas were specifically identified. Evaluation focused on pain and cramping in the biceps muscle with resisted flexion/supination and a special VAS scale (Functional Limitation Score) was created. All surgical procedures were identical except for tenodesis or tenotomy.

Results: For rupture patients, only the final ASES scores were calculated. For the tenodesis patients, the pre-operative scores were total 51, pain 7.2, and ADL 16. Post-operative scores were 87/1.2/23. The tenotomy patients pre-operative ASES scores were 53/ 7.1/17. Post-operatively, scores improved to 85/1.6/22..

The final scores for the rupture patients were 75/6.7/17. Comparison of post-operative scores showed no statistically significant difference among the three groups.

Mean post-operative VAS scale for functional impairment while doing activities requiring forceful supination/flexion were 1.6 for the tenodesis group. 5.8 for the tenotomy group, and 6.7 for the rupture group. Comparing tenodesis to tenotomy scores, there was a statistically significant difference ($P < 0.01$). The difference between the tenodesis and rupture patients was also significant ($P < 0.01$). The difference between the tenotomy and rupture groups was not statistically significant.

Conclusions: Despite shoulder outcome scores showing no difference between biceps tenodesis and tenotomy, when specifically queried about functional limitation of biceps cramping, a significant difference between the two exists in longterm follow-up.

FP.17.01

MID-TERM OUTCOMES OF PYROCARBON HUMERAL RESURFACING HEMIARTHROPLASTY COMPARED TO METAL HUMERAL RESURFACING AND METAL STEMMED HEMIARTHROPLASTY FOR OSTEOARTHRITIS IN YOUNG PATIENTS: ANALYSIS FROM THE AU

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Background: Humeral resurfacing hemiarthroplasty is a surgical option to treat shoulder arthritis. Potential benefits include the preservation of proximal humerus bone stock and avoidance of loosening or wear of the glenoid components implanted in total shoulder arthroplasty. Despite these potential benefits, improvement in survivorship has not been demonstrated from joint registry or other studies at mid-term follow-up. This is due predominantly to glenoid erosion and pain that occurs when the metal resurfaced head articulates with the native glenoid. The use of pyrocarbon as a resurfacing material has been proposed as an alternative bearing surface thought to reduce glenoid erosion due to marked reduction in wear rates in vitro. This study aims to compare the survivorship of shoulder hemi resurfacing utilising pyrolytic carbon to shoulder hemi resurfacing and stemmed hemiarthroplasty using metallic heads.

Methods: Data from the Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) were analysed for all patients aged <55 years who had undergone a primary shoulder replacement for osteoarthritis from 16 April 2004 to 31 December 2019. The outcome of shoulder procedures using pyrocarbon hemi resurfacing were compared to procedures using metal hemi resurfacing and metal hemi stemmed arthroplasty. Reason for revision of each arthroplasty class was analysed. The analyses were undertaken using Kaplan-Meier estimates of survivorship and hazard ratios (HR) from Cox proportional hazards models.

Results: There were 393 primary shoulder procedures of which 163 were pyrocarbon hemi resurfacing, 163 were metal hemi resurfacing and 67 metal stemmed hemiarthroplasties.

The CPR at 6 years was 8.9% for pyrocarbon hemi resurfacing 17.1% for metal hemi resurfacing and 17.5% for metal hemi stemmed. Pyrocarbon hemi resurfacing had a statistically lower revision rate compared to other hemi resurfacing prostheses (HR=0.41 (95% CI 0.18, 0.93), p=0.032). Pain, prosthesis fracture and infection were the key reasons for revision. In male patient, pyrocarbon humeral resurfacing had a lower cumulative percent revision compared to metal stemmed hemiarthroplasty (HR=0.32 (95% CI 0.11, 0.93), p=0.037).

Conclusions: Pyrocarbon humeral resurfacing arthroplasty had statistically lower revision rates at mid-term follow-up in patients aged <55 years compared to other hemi resurfacing.

FP.17.02

REVISION OF LONG STEM TSA WITH STEMLESS-METAPHYSEAL IMPLANT - MID TO LONG TERM RESULTS

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Background: Traditionally, revision of stemmed arthroplasty necessitated the use of longer stem. In young patients, preservation of bone stock is crucial for possible further future operations. The aim of the study was to assess the mid to long term (2-12 years) clinical and radiological results of revisions of long stems Total shoulder arthroplasty (TSA) with stemless-metaphyseal reverse TSA (rTSA).

Methods: Between 2010 and 2020, 10 patients (6M;4F) underwent revision arthroplasty from stemmed to stemless rTSA due to pain and dysfunction. The mean age at surgery was 66.6 ± 12.2 years. The stemmed implants revised were from different design and manufacturers (Biomet, Lima and Exactech). Patients were assessed clinically with the Constant score (CS), Subjective Shoulder Value (SSV), Satisfaction and Radiologic assessment.

Results: Impaction with bone graft substitute was used in all cases to fill the void on the humeral side together with antibiotic impregnated Calcium sulphate (Stimulan) beads, in suspicion of low-grade infection. The mean follow-up was 64 months (24-144). Mean Constant score (CS) improved from 16.2 (4-35) to 72.1 (67-85), Age/sex adjusted CS from 20.4 to 98.5 ($p < 0.005$). The mean SSV increased from 0.5/10 preoperatively to 9/10 in the last follow-up. All the patients showed improvements in pain Range of motion and function.

The stemless implants showed solid fixation in the humerus without any lucent lines, loosening, subsidence or evidence of stress shielding, with good new bone formation and filling of the intramedullary canal. In two patients, perforation of the lateral cortex and implant tilt occurred in the first few weeks post operatively due to weak cortical bone. The implant settled and remained stable in its new tilted position with conservative treatment, new bone was formed around the implants with solid fixation.

Conclusions: Revision of a long-stemmed prosthesis with a stemless-metaphyseal one is feasible and a better option, if the metaphyseal cortical envelope is preserved on removal of the stemmed implant. Good outcome is achieved with good fixation of the stemless-Metaphyseal implant and preservation of bone stock.

FP.17.03

THE EFFECTS OF MENTAL HEALTH AND PAIN CATASTROPHIZING ON OPIOID UTILIZATION AND PAIN CONTROL FOLLOWING TOTAL SHOULDER ARTHROPLASTY

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Background: Prolonged opioid use is associated with higher complications and worse patient-reported outcomes following total shoulder arthroplasty (TSA). Identified risk factors for prolonged postoperative use are limited to several medical comorbidities, gender, and preoperative opioid use. In this study, we hypothesized that patient-reported mental health characteristics can help to identify patients at risk of worse postoperative pain control, worse sleep, and higher opioid utilization following TSA.

Methods: Ninety-three consecutive patients were asked to fill out two mental health questionnaires prior to undergoing TSA. Following surgery, patients filled out a daily pain diary to track their daily pain, pain medication use, and quality and duration of their sleep for 30-days. Preoperative opioid use and postoperative refill were determined by the New York Prescription Monitoring Program (NYS-PMP). Mixed-model linear regressions were conducted. Significance was defined as $p < 0.05$.

Results: Postoperative opioid refill was associated with female gender, preoperative opioid therapy, higher inpatient opioid use, and all mental health measures. Number of days using opioids postoperatively was associated with worse pain catastrophizing (PCS) and somatization scores (PHQ-15). Preoperative opioid therapy was associated with worse somatizations scores, whereas no opioids used after surgery was associated with more favorable somatization scores. Worse sleep quality and duration was associated with less favorable PCS scores.

Conclusions: Greater mental health burden is associated with worse postoperative pain control and higher opioid utilization. This is especially evident in the pain catastrophizing and somatization domains.

FP.17.04

TRENDS IN TOTAL SHOULDER ARTHROPLASTY DURING THE COVID-19 PANDEMIC

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Background: The novel coronavirus (COVID-19) pandemic had a significant impact on surgical volume of total shoulder arthroplasty (TSA) with a 55% decline during the second quarter of 2020. As restrictions eased, TSA volume recovered back to its pre-pandemic baseline by Q3/Q4. The purpose of this study was (1) to compare the postoperative length of stay (LOS), discharge disposition (DD), complications, ED utilization, hospital readmissions, and reoperations within 90 days following TSA before and during the pandemic era and (2) to evaluate surgical trends of TSA induced by the pressures of the global pandemic.

Methods: All patients undergoing either primary anatomic or reverse TSA between January 2018 and December 2021 were included. Procedures performed before March 11, 2020, were considered the "PRE" cohort while those after were considered the "POST" cohort. The outcome measures included postoperative LOS, DD, complications, ED utilization, hospital readmissions, and reoperations within 90-days following TSA. $P < 0.05$ was considered statistically significant.

Results: There were 227 and 96 patients in the PRE and POST groups, respectively. There were no differences in age ($p=0.6$), gender ($p=0.06$), BMI ($p=0.33$), Elixhauser Comorbidity Index ($p=0.8$), TSA indication ($p=0.65$) or arthroplasty type ($p=0.61$) between PRE and POST cohorts. During the pandemic, TSA was associated with more frequent same-day discharge (72% vs. 56%, $p=0.002$), and 38% of PRE patients had a LOS between 1-2 days as compared to 19% in the POST group. Ultimately, there were no differences between PRE and POST cohorts in any complication or frequency of 30- or 90-day ED encounters, readmissions, or reoperations ($p>0.05$ for all).

Conclusions: TSA during the pandemic was associated with more frequent same-day discharge without increasing the risk for postoperative complications, ED encounters, readmissions, or reoperations up to 90-days. Though the COVID-19 pandemic was the catalyst, these results were true between cohorts with similar medical comorbidities. Our results suggest that TSA, a procedure historically associated with an inpatient stay, can safely be performed expeditiously in an outpatient setting without increasing patient morbidity or mortality. Future studies should focus on developing predictive models for patient risk profiling to determine the appropriate setting of TSA.

FP.17.05

EFFECT OF HUMERAL TRAY OFFSET ON CLINICAL OUTCOMES AND COMPUTED TOMOGRAPHY PARAMETER IN REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: Despite the evolution of reverse total shoulder arthroplasty (RTSA), limitations in range of motion and strength leading to limited increases in functional scores have been reported. This study was undertaken to determine the effects of humeral tray lateralization.

Methods: A retrospective clinical study was performed on 35 patients who underwent RTSA with a single implant (Aequalis Ascend™ Flex short stem (Tornier SAS-Wright Medical Inc®, Bloomington, MN, USA)) and a humeral tray offset of 1.5 mm from July 2016 to November 2020 by a single surgeon. Patients were classified into two groups: an inferiorly positioned humeral tray group resulting in humeral lateralization (the inferior group (n = 22)) and a superiorly positioned humeral tray group resulting in distalization (the superior group (n = 13)). Constant-Murley score, University of California-Los Angeles shoulder scale, Simple Shoulder test, Activity scale, American Shoulder and Elbow Surgeon Shoulder score, and pain visual analogue score were evaluated. Range of motion (ROM) for forward flexion and abduction was measured. Strengths of forward flexion, internal rotation at 90° abduction, and external rotation at side (ER) were measured. Computed tomography (CT) was performed postoperatively to measure the amount of humeral lateralization.

Results: Postoperative ER power was greater in the inferior group ($32.39 \text{ N} \pm 12.08 \text{ N}$) than in the superior group ($23.77 \text{ N} \pm 10.96 \text{ N}$; $P = 0.043$). Postoperative abduction ROM was also greater in the inferior group ($158.18^\circ \pm 18.36^\circ$ vs. $128.08^\circ \pm 34.97^\circ$; $P = 0.011$), and humeral tray center to greater tubercle distance was larger in this group ($54.68 \text{ mm} \pm 5.31 \text{ mm}$ vs. $50.76 \text{ mm} \pm 3.65 \text{ mm}$; $P = 0.025$).

Conclusions: Lateralization by inferior humeral tray positioning provided better results than distalization by superior humeral tray positioning in RTSA in terms of ER strength and abduction ROM. RTSA with humeral lateralization appears to result in better functional outcomes.

FP.17.06

HUMERAL MEDIAL CALCAR RESORPTION: AN ANALYSIS OF THREE DIFFERENT TOTAL SHOULDER ARTHROPLASTY IMPLANT DESIGNS AT 1 YEAR

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Background: There is evidence that longer humeral stems in uncemented total shoulder arthroplasty (TSA) are associated with high rates of stress shielding, as well as other radiographic changes. Severe loss of the calcar can be caused by many pathologic processes, including stress shielding, debris-induced osteolysis, and undiagnosed infection. As such, a reduction in the bony support of the implant, regardless of the cause, can increase the risk of aseptic loosening and periprosthetic fractures. The purpose of this study is to determine whether implant length will affect 1) the severity of medial calcar resorption and 2) the rate of medial calcar resorption.

Methods: A retrospective review was performed on TSA patients evaluating three different-sized humeral implants (stemless, short, and standard) with a minimum of 1-year follow-up. Patients were matched based on both gender and age (± 4 years), resulting in 40 patients per cohort. Change in medial calcar resorption was evaluated and graded on a 4-point scale, from the initial postoperative radiographs to those at 3 months, 6 months, and 12 months.

Results: The presence of medial calcar resorption demonstrated an overall rate of 73.3% at one year. At 3 months, the stemless design saw presence of resorption in 20% of patients, while the short and standard designs showed resorption in 55% and 52.5%, respectively ($p = 0.002$). At 12 months, the stemless design demonstrated a rate of 65%, while both the short and standard designs had a 77.5% rate of resorption ($p = 0.345$). The standard design demonstrated a difference in severity of calcar resorption compared to the stemless design only at 3 months ($p = 0.009$), while the stemless design demonstrated lower grades of resorption compared to the short design at all time points: 3, 6, and 12 months ($p = 0.004$, $p = 0.003$, $p = 0.004$).

Conclusions: Stemless implants have significantly lower early instances of medial calcar resorption. While resorption rates progressed over time for all implants, rate of resorption for stemless implants remained slightly lower than the stemmed implants at 1-year. Additionally, short stem designs show increased severity of resorption at 3-months, 6-months, and 12 months when compared to stemless designs.

FP.17.07

3D PRE-OPERATIVE PLANNING SOFTWARE FOR SHOULDER ARTHROPLASTY: NOT AS PRECISE AS WE WOULD LIKE

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Background: Glenoid-component position is crucial for anatomic and reverse total-shoulder-arthroplasty outcomes. Mal-positioning in either version or inclination may impact component fixation and stability. Three-dimensional computed tomography (3D-CT) has supplanted axillary radiographs and standard 2-dimensional axial tomography images on pre-operative planning. Software (BluePrint™, Stryker) automatically measure version and inclination of glenoid, and reproduce pre-operative plan using patient-specific-instrumentation. Although this software has shown good reproducibility in accuracy studies, it has not yet been validated on fresh-frozen cadaveric model considered gold-standard for imaging research.

Methods: Transversal-observational study investigated accuracy of a 3D-CTscan-based pre-operative planning software (BluePrint™) on measurements of glenoid version and inclination in fresh frozen cadavers. We hypothesized software measurements for glenoid version and inclination were over-estimated when compared to anatomic measurements. Six matched-pairs-cadaveric-shoulders were CT-scanned according to specifications. Software automatically segmented axial-CTscan-images, and determined glenoid version, inclination, and glenoid-best-fit-sphere-curvature-radius. After scanned cadaveric-shoulders were dissected, analyzed for the presence of glenohumeral arthritis, and manually measured using a 3D-digitizer (MicroScribe) with 0.3mm-accuracy to access glenoid version and inclination. Scapular-plane based on two different techniques: three-points-plane (glenoid center point, trigonum, and inferior angle of scapula), and best-fit-plane according to software specifications. Glenoid plane based on two different techniques: three-point-plane (one point anterior and two posterior), and best-fit-sphere. Outcomes: glenoid version, inclination, Walsh-classification, and best-fit-sphere-radius. Conditions: software (BluePrint™), 3-D manual measurement (best-fit-scapula-planes/best-fit glenoid-sphere), and 2-D manual measurement (three-point-scapula-plane and three-point-glenoid-plane). Statistics: one-way-repeated-measures-ANOVA with $p < 0.05$.

Results: Mean glenoid-retroversion measured by software ($9.2 \pm 2.4^\circ$) was 58% higher than 2D-manual-measurement ($5.8 \pm 2.3^\circ$; $p = 0.006$). Software compared to 3D-manual-measurement ($8.2 \pm 2.3^\circ$) didn't presented significant different. Superior-inclination on software and 2D-manual-measurement were similar ($8.6 \pm 1.6^\circ$ vs $7.5 \pm 0.9^\circ$). Best-fit-sphere-radius-of-curvature on software ($30.8 \pm 1.2\text{mm}$) was similar to the 3D-manual-measurement ($33.8 \pm 1.5\text{mm}$). Walch B2/B3 specimens presented increased version ($16.2 \pm 4.3^\circ$) than Walch A ($5.6 \pm 2.0^\circ$; $p = 0.025$).

Conclusions: This study validated BluePrint™ planning-software measurements of glenoid version, inclination and best-fit sphere-radius in an accurate real-time cadaveric model. The software presented tendency to overestimate retroversion in Walch B2/B3 glenoids.

FP.17.08

PREDICTION OF POSTOPERATIVE LATERALIZATION AND DISTALIZATION AFTER REVERSE SHOULDER ARTHROPLASTY

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Background: The original concept of reverse shoulder arthroplasty (RSA) was to function the deltoid muscles efficiently by moving the humerus inferiorly and medially. Although the humeral position will change after RSA, the appropriate values of lateralization and distalization remained unclear. Excessive medialization is known to be detrimental to a limited range of rotation and scapular notch formation, while too much lateralization and distalization may result in overstuffing. The purpose of this study was to investigate the changes in the humeral position associated with RSA.

Methods: We prospectively included 200 shoulders from 100 healthy adults aged from 30 to 60 years (mean age 41.0 years) in this study. Computed tomography (CT) imaging of both shoulders was taken in the standing position using a newly developed upright CT scanner. The obtained image data were analyzed on MyShoulder software (Medacta Corporate) to simulate RSA. The distance of medialization and distalization compared with the anatomical position was measured when various glenosphere options would be placed. Correlation and regression analysis between their height and predicted humeral position was assessed.

Results: With a simulation of RSA using a 36-mm glenosphere, the humerus moved 3.0 ± 2.4 mm medially and 28.4 ± 2.8 mm distally compared to the original position. Their respective height was positively correlated both with postoperative medialization ($R=0.478$, $P<0.001$) and distalization ($R=0.396$, $P<0.001$). The predictive equation for postoperative medialization (mm) was "[0.116 x height (cm)] + 16.11" and that for postoperative distalization (mm) was "[0.111 x height (cm)] + 10.22". When 39-mm and 42-mm glenosphere was selected, the humeral position was significantly lateralized and distalized compared with the 36-mm glenosphere. In small-stature volunteers, the humerus will be more lateralized than their original position, which might cause overstuffing (10% with the 36-mm sphere, 20% with the 39-mm sphere, and 34% with the 42-mm sphere).

Conclusions: The present study indicated that the humeral position after RSA can be predicted by patients' height. With the concept of global lateralization, we can calculate the values of postoperative lateralization of different RSA implants. We believe that an appropriate selection of implants and size variations would be helpful for good clinical results and for preventing complications after RSA.

FP.18.01

BIOMECHANICAL AND HISTOLOGICAL COMPARISON OF INTRATUNNEL REPAIR AND ANATOMICAL PRIMARY REPAIR RESULTS IN CHRONIC ROTATOR CUFF TEARS: ANIMAL MODEL

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Background: Primary repair in chronic full-thickness rotator cuff tears is still an established and advanced technique as treatment of choice. However, according to the size of the tear, re-rupture rates reach 90%. In the classical primary repair of rotator cuff tears, there is no healing in the bone and there is a poor healing potential on the foot-print surface. Re-ruptures mostly occur in the tendon-bone junction area.

Methods: 72 shoulder joints of 36 New Zealand rabbits were used. 72 shoulder was dissected from the surrounding tissue to tendon attachment site and subscapularis tendon was cut in full thickness. It was waited for 2 months by wrapping the tendon with a penrose drain in order to prevent the tendon stump from sticking to the surrounding tissues. After 2 months, left shoulders were primarily repaired to anatomic insertion with 2.0 PDS sutures. Right shoulders was repaired with 2.0 PDS sutures inside the bone tunnel to the tuberculum minus. 12 rabbits (left shoulders: Group I, right shoulders: Group II) were sacrificed in each group at 4., 8. and 12. weeks. 6 rabbits had used for biomechanically and 6 rabbits had used for histologically at every sacrifice.

Results: Failure Load (Newton) was 133(95-142) in Group-1, 123(93-137) in Group-2 at 4 weeks, 106(91-122) in Group-1, 98(84-118) in Group-2 at 8 weeks, 100(64-130) in Group-1, 112(93-121) in Group-2 at 12th week. No significant difference was found between the groups in failure load. In histological examination, tendon maturity score was recorded 17 (12-23) at week 4, 19 (16-21) at week 8, and 25 (24-27) at week 12 in Group-I. In Group-II, it was recorded as 18 (18-21) in the 4th week, 18 (17-20) in the 8th week, 21 (16-22) in the 12th week. In the 12th week sacrifice group, the tendon maturity score in Group-I was found to be significantly higher than in Group-II (p=0.004).

Conclusions: There was no difference between the primary anatomic repair and intratunnel repair in terms of strength and durability of the tendon. Both groups showed healing in the tendons in the 4th week, therefore no biomechanical superiority was detected at the 8th and 12th weeks.

FP.18.02

DYSFUNCTIONAL SUBSCAPULARIS REDUCES THE POSTERIOR GLENOHUMERAL JOINT STABILITY

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Background: Conventional shoulder arthroplasty via deltopectoral approach caused subscapularis dysfunctions in up to 67% of patients. Dysfunctional subscapularis disrupts the glenohumeral joint force couple and was associated with posterior instability based on the abnormally smaller muscle cross-sectional area. However, a better understanding of the biomechanics would corroborate the need for a more appropriate surgical planning that avoids violating the rotator cuff, such as the rotator interval approach and the internervous posterior approach. Therefore, this study aimed to evaluate the joint stability in a subscapularis-deficient shoulder by assessing the joint forces for selected activities of daily living.

Methods: A musculoskeletal shoulder model was used to compute the muscle forces and the glenohumeral joint forces of a male subject (33-year-old, 68.5kg, 1.8m) during combing, eating, and washing the opposite axilla. The subscapularis dysfunction was simulated by removing the muscle from the model to represent the worst-case scenario. The normal and pathological biomechanics were compared.

Results: Washing produced the highest subscapularis force of 173N (vs 59N combing and 23N eating) in the normal shoulder. When simulating a subscapularis-deficient shoulder, washing accordingly resulted in the greatest force changes in the other 25 muscles to compensate for the loss of the subscapularis, whereas combing and eating had smaller to negligible changes. The loss of the subscapularis dramatically increased the maximum posterior shear force for washing by 90% while combing and eating had negligible changes. The subscapularis-deficient shoulder increased the posterior shear-to-compressive force ratio for only washing by 39% and increased the superior force ratio for only combing by 9%. The increased shear-to-compressive force ratio shifted the net glenohumeral joint force further from the glenoid centre and towards the rim, adversely reducing the joint stability. Thus, a larger and more eccentric posterior joint translation would be expected.

Conclusions: Our findings suggest that a dysfunctional subscapularis can induce posterior glenohumeral joint instability, particularly for activities initiated by the subscapularis. Careful considerations are needed during shoulder arthroplasty that would minimise or avoid violating the subscapularis to maintain long-term joint stability. Further investigations on simulating more internally rotating activities can provide a strong basis for the importance of subscapularis on joint stability.

FP.18.03

SUPERIOR CAPSULAR RECONSTRUCTION AND LOWER TRAPEZIUS TRANSFER BOTH PROVIDE GOOD OUTCOMES IN PROPERLY SELECTED PATIENTS WITH IRREPARABLE ROTATOR CUFF TEARS

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Background: Superior capsular reconstruction (SCR) and lower trapezius tendon transfer (LTT) have been proposed as effective treatment options for irreparable rotator cuff tears (IRCT) with limited comparative data. The purpose of this study was to assess the clinical, radiographic, and postoperative outcomes of SCR and LTT for posterosuperior IRCTs.

Methods: Over a 6-year period (2015 – 2021), 32 SCRs and 72 LTTs performed for IRCTs at a single institution were identified. Exclusions consisted of patients with an irreparable subscapularis tear, hamada grade greater than or equal to 4, and neurologic pathology of the shoulder. Outcomes collected included the visual analog scale (VAS), range of motion (ROM), American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES), Single Assessment Numerical Evaluation (SANE), and Quick Disabilities of the Arm, Shoulder, and Hand (QuickDASH) scores.

Results: Preoperatively, the LTT group had a worse teres minor fatty infiltration (0.3 vs. 1.1; $P = .009$), global fatty infiltration index (1.5 vs. 1.9; $P = .035$), and more common presence of an external rotation (ER) lag sign (15.6% vs. 48.6%; $P < .001$). At a mean follow-up of 2.9 ± 1.3 years no cohort differences were observed in ASES ($P = .513$), SANE ($P = .732$) or QuickDASH scores ($P = .407$). Postoperatively, the SCR group had a lower VAS (0.3 vs. 1.1; $P = .017$), higher forward elevation (FE) (156° vs. 143° ; $P = .004$), FE strength (4.8 vs. 4.5; $P = .005$), and a greater magnitude of improvement in VAS (6.8 vs. 5.1; $P = .009$), FE (56° vs. 31° ; $P = .004$), and FE strength (1.0 vs. 0.4; $P < .001$). The LTT cohort had a better improvement in ER (17° vs. 29° ; $P = .026$). There were no statistical differences in complications (9.4% vs. 12.5%; $P = .645$), reoperations (3.1% vs. 10%; $P = .231$), or survivorship free of reoperation ($P = .240$), between SCRs and LTTs.

Conclusions: With adequate selection criteria, both SCR and LTT provided satisfactory clinical outcomes for posterosuperior IRCTs at 3 years.

FP.18.04

ULTRASOUND-GUIDED SUPRASCAPULAR NERVE BLOCK FOR POSTOPERATIVE PAIN CONTROL OF ROTATOR CUFF REPAIR: PROXIMAL VS DISTAL APPROACH

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Background: The proximal approach of ultrasound-guided suprascapular nerve block has been recently introduced in treating shoulder pain and is known to improve nerve visualization and injection accuracy, compared with the conventional distal approach. The purpose of this study was to evaluate the effectiveness of US-guided SSNB using proximal approach compared to those of distal approach in postoperative pain control after arthroscopic rotator cuff repair.

Methods: This was a prospective randomized controlled trial of 54 patients who underwent arthroscopic rotator cuff repair. Patients were randomly assigned to either US-guided SSNB using proximal approach (N=27, proximal group) or distal approach (N=27, distal group). Outcome measures included visual analogue scale (VAS) for pain, and opioid consumption measured by morphine milligram equivalent (MME) at different time points (postoperative day 0, 1 and 2).

Results: There were no difference in demographic data, preoperative clinical scores and surgical procedures between groups. Postoperatively, there was no significant difference in VAS at each postoperative time point between groups (all $p > 0.05$). Pain VAS trends across day 0, 1 and 2 were also similar between groups. However, the opioid consumption at day 1 was significantly lower in proximal group than in distal group (43.2 ± 26.4 versus 64.3 ± 16.7 , MME, $p = 0.001$). The repeated-measures of analysis of variance test also showed significantly lower level of MME trends over time between groups ($p = 0.011$).

Conclusions: The proximal approach of US-guided SSNB provided effective postoperative pain control, comparable to the distal approach, while reducing opioid consumption after arthroscopic rotator cuff repair.

FP.18.05

MISSED STATIN THERAPY AND 10-YEAR ATHEROSCLEROTIC CARDIOVASCULAR DISEASE RISK SCORE ARE RELATED TO A HIGH RISK OF RETEAR AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR

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Background: There is no practical consensus on managing cholesterol in patients with rotator cuff repair despite hyperlipidemia and statin therapy being well-known factors in rotator cuff healing. The 10-year atherosclerotic cardiovascular disease (ASCVD) risk score is a commonly used guideline to determine statin administration for hyperlipidemia. The purpose of this study is to compare clinical and structural outcomes among patients who do not need statin therapy, who are on statin therapy, and who did not adhere to statin therapy and to identify the association between 10-year ASCVD risk score and rotator cuff re-tear.

Methods: This study enrolled 182 consecutive patients with a full-thickness rotator cuff tear who underwent arthroscopic repair. Based on the patients' statin administration history, patients were divided into three groups: those who do not need statin therapy (group I), those taking statins (group II), and those who have not adhered to statin therapy (group III). An MRI was performed to evaluate cuff integrity six months postoperatively. Radiographic and intraoperative factors related to cuff healing were analyzed.

Results: There were 78 patients included in group I, 66 patients in group II, and 38 patients in group III. The 10-year ASCVD risk score was significantly lower in group I than in the other two groups (group I, 7.5%±4.8%; group II, 14.6%±8.6%; and group III, 17.8%±8.2%; P<0.001). Shoulder pain and function were significantly improved in all 3 groups postoperatively. However, re-tears occurred significantly more frequently in group III than in the other two groups (group I, 12.8%; group II, 13.6%; and group III, 36.8%; P=0.003). In the logistic regression analysis, missed statin therapy, 10-year ASCVD risk score, and fatty infiltration of infraspinatus were the independent factors related to re-tear. The cut-off value for 10-year ASCVD risk score was 11.85%, with a sensitivity of 0.75 and a specificity of 0.62, respectively.

Conclusions: Patients who missed statin therapy showed a higher re-tear rate than patients taking a statin or who did not need statin therapy. Missed statin therapy, 10-year ASCVD risk score, and fatty infiltration of infraspinatus were the independent factors associated with re-tear.

FP.18.06

UNSUPERVISED MACHINE LEARNING TO IDENTIFY CLINICALLY MEANINGFUL SUBGROUPS IN PATIENTS UNDERGOING ARTHROSCOPIC ROTATOR CUFF REPAIR

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Background: Rotator cuff tears are estimated to affect 20.7% of the population, with the prevalence increasing with age. Clinically significant outcomes (CSOs) of arthroscopic rotator cuff repair (ARCR) can be measured in part with patient reported outcomes. This study aims to determine predictors of achieving CSO thresholds following elective ARCR by utilizing machine learning (UML).

Methods: A retrospective case-cohort analysis of a prospectively collected database was performed to identify patients who underwent elective ARCR from 2017-2018. Tear dimensions were measured on MRI utilizing a validated technique. CSO achievements on three validated standardized assessments (ASES, SANE, CMS) at 2-years follow-up were calculated. An unsupervised forest algorithm was utilized to partition patients into optimal and suboptimal CSO achievement subgroups and subsequently internally validate partitioning. This data, along with a total of 30 demographic, clinical, and preoperative PROs were assessed for prognostic value through a stepwise multivariable logistic regression.

Results: A total of 346 patients were eligible for inclusion and followed for an average of 3.8 (range: 2.0 – 6.2) years. The random forest algorithm arrived at an optimal partition with 176 patients and 157 patients in the optimal and suboptimal achievement subgroups, respectively. The two subgroups differed significantly ($P \leq 0.004$) in the likelihood of achievement of all CSOs. Stepwise multivariable logistic regression identified an increase of 1 mm in tear size in the sagittal dimension to predict a 10% increase in the probability of suboptimal achievement. Additional, additive risk factors for suboptimal CSO achievement included increased preoperative CMS score (OR: 1.11, 95% CI: 1.04-1.18, $P < 0.001$), increasing number of tendons involved (OR: 14.07, 95% CI: 4.5-44.02, $P < 0.001$) and subscapularis involvement (OR: 8.67, 95% CI: 2.45-30.71, $P = 0.01$). Protective factors included performance of a subpectoral biceps tenodesis compared to biceps tenotomy (OR: 0.26, 95% CI: 0.05-0.92, $P = 0.03$).

Conclusions: Clinically meaningful subgroups were uncovered using machine learning in patients undergoing ARCR. Tear size, number of tendons involved, and subscapularis involvement were highly significant and additive predictors of suboptimal CSO achievement. Treatment of concurrent biceps pathology with tenodesis confers 74% increased likelihood of CSO achievement vs. tenotomy.

FP.18.08

SOCIAL DETERMINANTS OF HEALTH INFLUENCE CLINICAL OUTCOMES OF PATIENTS UNDERGOING ROTATOR CUFF REPAIR: A SYSTEMATIC REVIEW

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Background: Social determinants of health (SDOH) are the collection of environmental, institutional and intrinsic conditions that may bias access to, and utilization of, healthcare across an individual's lifetime. The effects of SDOH are associated with disparities in outcomes after hip and knee arthroplasty, but its impact on rotator cuff repair (RCR) is poorly understood. This study aimed to investigate the influences SDOH have on accessing appropriate orthopaedic treatment, as well as its effects on outcomes following RCR.

Methods: This systematic review was performed in adherence to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses and the Cochrane Collaboration. A search of PubMed, Cochrane Library, and Embase from inception until March 2022 was conducted to identify studies reporting at least one SDOH and its effect on healthcare access, clinical outcomes, or patient-reported outcomes following RCR. The search term was created with reference to the PROGRESS-Plus framework. Methodological quality of included studies was appraised using the Newcastle-Ottawa Scale for non-randomized studies, and the Cochrane Risk of Bias Tool for randomized studies.

Results: Thirty-two studies (level I-IV evidence) from 18 journals across 7 countries, published between 1999 and 2022, met inclusion criteria, including 102,372 patients, 669 physical therapy (PT) clinics, and 71 orthopaedic surgery practices. Multivariate analysis revealed female gender, labor-intensive occupation and workers' compensation claims, comorbidities, tobacco use, federally-subsidized insurance, lower education level, racial/ethnic minority status, low-income place of residence and low-volume surgery regions, unemployment, and preoperative narcotic use contribute to delays in access to healthcare and/or more severe disease state upon presentation. Patients with federally-subsidized insurance and black race patients had significantly worse postoperative clinical and patient-reported outcomes; black patients also experienced more pain following RCR. Additionally, a lower education level was shown to be an independent predictor of poor surgical and patient-reported outcomes.

Conclusions: The impediments created by SDOH lead to worse clinical and patient-reported outcomes following RCR including increased risk of postoperative complications, failed repair, higher rates of revision surgery, and decreased ability to return to work. Orthopaedic surgeons, policy makers, and insurers should be aware of the aforementioned SDOH as markers for characteristics that may predispose to inferior outcomes following RCR.

FP18:09

IMPACT OF FATTY INFILTRATION OF THE INFRASPINATUS ON THE OUTCOMES AND GRAFT FAILURE AFTER ARTHROSCOPIC SUPERIOR CAPSULE RECONSTRUCTION FOR IRREPARABLE POSTEROSUPERIOR ROTATOR CUFF TEARS

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Background: Superior capsule reconstruction (SCR) was developed as an alternative treatment for irreparable rotator cuff tears to restore superior stability of the glenohumeral joint. Although fatty infiltration (FI) of the rotator cuff muscle, especially the infraspinatus (IST), has been implicated as a predictor of the outcome and repair integrity after rotator cuff repair surgery, it has not been fully investigated in cases of SCR. This study to evaluate the impact of FI of the IST on the clinical and radiological outcomes after SCR.

Methods: Fifty-five consecutive patients with irreparable posterosuperior rotator cuff tears who underwent SCR between January 2013 and August 2020 were included retrospectively. Preoperative and postoperative clinical and radiological findings (median follow-up more than 2 years), including magnetic resonance imaging (MRI) results, were thoroughly reviewed. The patients were divided into two groups: group 1 with mild FI of the IST (Goutallier grades 0–2) and group 2 with severe FI of the IST (Goutallier grades 3, 4). The American Shoulder and Elbow Surgeons Score, Constant score, visual analog scale score for pain, and range of motion were evaluated. Acromiohumeral distance and rotator cuff tear arthropathy using Hamada classification were assessed on plain radiographs. Postoperative graft integrity was evaluated by MRI. Graft failure was defined by complete discontinuity. Univariate and multivariable logistic regression analyses were performed to evaluate clinical and radiological findings that might be associated with successful SCR.

Results: Clinical and radiological outcomes significantly improved after SCR. Graft failure was noted in 15 (27.3%) patients and was more frequent in group 2 than in group 1 (14.3% vs. 50%; $P=0.004$). Univariate analysis indicated a significant association with graft failure after SCR for group 2 (odds ratio [OR], 6.00; 95% confidence interval [CI], 1.65–21.80; $P=0.006$). Multivariable analysis indicated that FI of the IST was the only factor associated with graft failure (OR, 6.37; 95% CI, 1.62–24.90; $P=0.008$).

Conclusions: Severe FI of the IST is a factor indicating a poor prognosis for graft integrity after SCR. Preoperative evaluation of fatty infiltration in the rotator cuff can predict postoperative outcomes and may help guide therapeutic options.

FP.19.01

DEVELOPMENT OF A CORE OUTCOME SET FOR LATERAL ELBOW TENDINOPATHY USING BEST AVAILABLE EVIDENCE AND AN INTERNATIONAL CONSENSUS PROCESS.

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Background: Core Outcome Sets (COSs) are recommended for research and clinical practice to facilitate comparison and meta-analysis of results. Whilst there is agreement on the core domains that should be assessed in studies related to tendinopathy, there is no agreed COS for Lateral Elbow Tendinopathy (LET). We aimed to develop a COS for LET (COS-LET) and to provide guidance for outcome evaluation in future research and clinical practice.

Methods: We implemented a multi-stage mixed-methods design combining two systematic reviews, domain-mapping of outcome measurement instruments to the core domains of tendinopathy, psychometric analysis of the instruments identified using the EMPRO scoring system, two patient focus groups and a Delphi study incorporating two surveys and an international consensus meeting. Following the OMERACT guidelines, we used a 70% threshold for consensus. We gained ethical approval from the University of Queensland research ethics committee (reference 2020001340) and registered the protocol with the COMET database (reference 1497).

Results: 38 clinicians/researchers and 9 patients participated. After reviewing 256 full-text papers, 60 outcome measurement instruments were identified and assessed for inclusion. We only included studies in the English language. The only instrument that was recommended for the COS-LET was the Patient Rated Tennis Elbow Evaluation (PRTEE) for the disability domain. For the other domains, we agreed to use the following interim measures: the PRTEE function sub-scale for the function domain; PRTEE pain sub-scale items 1, 4 and 5 for the pain over a specified time domain; pain-free grip strength for the physical function capacity domain; a numerical rating scale measuring pain on gripping for the pain on activity/loading domain; and time off work for the participation in life activities domain. No recommendations could be made for the quality-of-life, patient rating of condition and psychological factors domains.

Conclusions: The COS-LET comprises the PRTEE for the disability domain. Interim-use recommendations include PRTEE items, time off work, pain-free grip strength and a numerical rating scale measuring pain on gripping. These measurement instruments should be used in all future studies related to LET. Further work is required to validate the interim measures and develop suitable measures to capture the other domains.

FP.19.02

RADIOSTEREOMETRIC ANALYSIS OF TENDON MIGRATION FOLLOWING ARTHROSCOPIC AND MINI-OPEN BICEPS TENODESIS: INTERFERENCE SCREW CONFERS GREATER CONSTRUCT STABILITY THAN ALL-SUTURE SUTURE ANCHOR FIXATION

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Background: To quantify the postoperative migration of the BT construct between arthroscopic suprapectoral (ASPBT) and open subpectoral (OSPBT) techniques via interference screw (IS) or all-suture anchor with a single suture (SSSA) fixation with radiostereometric analysis (RSA).

Methods: Distal migration of the biceps tendon following OSPBT with a Polyetheretherketone (PEEK) IS, OSPBT with one SSSA, ASPBT with PEEK IS, and ASPBT with two SSSAs was measured prospectively. Patients with symptomatic biceps tendinopathy and preoperative Patient-Reported Outcome Measures (PROMs) including CMS, SANE, or PROMIS-UE scores were included. A tantalum bead was sutured on the proximal end of the long head biceps tendon before fixation. AP radiographs were performed immediately postoperatively, 1 week, and 3 months. Bead migration was measured, and PROMs were compared.

Results: Of 115 patients, 94 were available for final follow-up (82%). Average age was 52.1 ± 10.5 years, and BMI was 30.8 ± 5.4 kg/m². There was no difference in tendon migration between OSPBT and ASPBT performed with an IS ($P=0.70$). OSPBT performed with one SSSA (21.70 mm) demonstrated significantly greater migration than ASPBT with IS (4.31mm, $P<0.001$) and OSPBT with IS (5.04 mm, $P<0.001$). Three patients (9.4%) who had OSPBT with one SSSA and one who had ASPBT with two SSSAs (3.8%), developed a Popeye deformity; none occurred in the IS groups. Mean 12-week bead migration in patients with versus without Popeye deformity was 60.8 mm and 11.2 mm, respectively ($P<0.0001$). PROMs did not differ at final follow-up.

Conclusions: ASPBT and OSPBT with IS fixation demonstrated the least tendon migration, while OSPBT with one SSSA yielded the most. Compared to IS, fixation with one, but not two, SSSAs resulted in significantly greater migration. Average bead migration following a Popeye deformity was 6.1cm. To minimize migration when using SSSAs, at least 2 sutures should be used with an interlocking pattern within the tendon.

FP.19.03

RADIOLOGIC EVALUATION AND CLINICAL EFFECT OF CALCIFICATION IN MEDIAL EPICONDYLITIS

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Background: Although most radiologic findings of medial epicondylitis (ME) are normal, up to 25% show calcification, and little is known about the clinical relevance of soft-tissue calcification in ME. The purposes of this study were to reveal the characteristics of calcification in ME and to identify their clinical relevance.

Methods: This study included 187 patients (222 elbows) with a diagnosis of ME. We classified calcification according to its anatomic location and further evaluated its distribution. Logistic regression analysis was performed to calculate the odds ratios and 95% confidence intervals for possible factors that may affect calcification in ME: age, sex, laterality, hand dominance, visual analog scale (VAS) pain score, Mayo Elbow Performance Score, symptom duration, history of steroid injection, number of steroid injections, concomitant ulnar neuropathy, and treatment method in terms of conservative treatment or surgery.

Results: Of a total of 222 elbows, 53% (118 of 222 elbows) showed calcification in radiologic findings. The VAS pain score, the number of steroid injections, and concomitant ulnar neuropathy were significantly associated with calcification in ME. Calcification was most commonly identified at the anatomic insertion site of the common flexor tendon (33%), followed by the pronator teres (18%) and the medial collateral ligament (10%). Of the total cases of calcification, 45% were distributed at multiple sites, and age was strongly associated with multiple-site distribution.

Conclusions: Calcification in ME was more commonly identified than previously reported and was distributed over a relatively broad area. Calcification was associated with a higher VAS pain score, a history of steroid injection, and combined ulnar neuropathy. The anatomic insertion site of the common flexor tendon most commonly showed calcification, and age was a strong indicator of a broad distribution of calcification.

FP.19.04

LATERAL EPICONDYL FRICTION SYNDROM: A NEW CLINICAL ENTITY

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Background: Lateral epicondylitis is the most frequent cause of lateral elbow pain. We describe a separate clinical entity that resembles lateral epicondylitis, but which is not actually a tendon problem, rather a friction – compression problem at the lateral epicondyle, similar to Iliotibial Band Friction Syndrom at the knee.

Methods: We document the clinical, radiological and intra-operative presentation of a group of patients with what we call lateral epicondyle friction syndrome. Clinically these patients present with lateral elbow pain, exacerbated by physical activity. There is a prominent lateral epicondyle, typically not covered by subcutaneous fat tissue, and the patients experience pain on compression of the lateral epicondyle, not or less on the ECRB insertion. Our patients had normal X-rays, no signs of arthritis or calcification at the lateral epicondyle. Ultrasound showed aspecific tendinosis, no tear of extensor tendon insertion. On surgical exploration, through a standard lateral incision over the lateral epicondyle and ECRB insertion, we found a superficial fascia covering the lateral epicondyle and the extensor tendons insertion. After opening this fascia we found inflammatory changes on the lateral epicondyle itself. We performed a wide excision of this fascia and checked in flexion and extension that there would be no more catching of this fascia on the epicondyle. ECRB insertion was left untouched. After that we closed subcutaneously and the skin. Patient was given an elbow cast for a short period (max 2 weeks), then fysiotherapy started.

Results: We found no complications following this procedure in a small group of patients. Mean time of recovery is shorter or similar as for lateral release of ECRB insertion.

Conclusions: We present a new clinical entity which we call lateral epicondyle friction syndrome. It mimics lateral epicondylitis, but can be differentiated by compression pain on the lateral epicondyle itself and not on ECRB insertion. Surgical treatment should consist of releasing the fascia overlying the lateral epicondyle. We believe this friction-compression problem can be present separately or in combination with lateral epicondylitis.

FP.19.05

EVALUATION OF ARTHROSCOPIC MANAGEMENT OF TENNIS ELBOW; EMPHASIS ON RESECTION OF RADIO-CAPITELLAR CAPSULAR COMPLEX (RCCC)

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Background: Since the early description of tennis elbow, there has been controversy regarding the pathogenesis and treatment of lateral epicondylitis. Nonoperative measures such as physiotherapy or steroid injection usually are successful, although the recovery period may be prolonged. In some studies, the percentage of failed conservative management is up to 25%.

Methods: A retrospective study reviewed 20 consecutive patients in whom arthroscopic lateral epicondylitis procedures were done. There were 9 men and 3 women with an average age of 38 years (range, 30–53 years). They were 15 right elbow affections, and 5 left side. All patients had a trial of conservative treatment for at least 6 months (range, 6–12 months).

Results: Arthroscopic evaluation showed type II lesions in 15 patients, Type I in four patients, and type III in one patient. There was no correlation between the result and the three different types of the lesions. The average time for return to work was 7 days (range, 1–21 days). No patients were receiving workers' compensation.

Conclusions: Arthroscopic release in patients with radial epicondylitis is a reproducible method with a marked postoperative increase in function within a short rehabilitation period. In this study, the presence of a dense radiocapitellar capsular complex impinging on or in the radiocapitellar joint, found in majority of our patients, were resected arthroscopically with good results.

FP.19.06

CORRELATIONS OF MAGNETIC RESONANCE IMAGING CLASSIFICATIONS WITH PREOPERATIVE FUNCTIONS AMONG PATIENTS WITH REFRACTORY LATERAL EPICONDYLITIS

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Background: For refractory lateral epicondylitis (LE) patients, MRI has been widely used to assess the severity of the tendon lesions. This study is to evaluate the correlations between three magnetic resonance imaging (MRI) classifications and preoperative function in LE patients.

Methods: We retrospectively reviewed patients with refractory LE who underwent arthroscopic treatment. Signal changes in the origin of the extensor carpi radialis brevis (ERCB) were evaluated based on three different MRI classification systems. Spearman's rank correlation analysis was used to analyse the correlation between each MRI classification and the preoperative functional and VAS. The LCL in all patients was evaluated using both MRI and arthroscopy. The Mann-Whitney U test was used for the comparison of preoperative VAS and all functional scores between patients with refractory LE combined with LCL lesions, and those without.

Results: There were 51 patients diagnosed with refractory LE between June 2014 to December 2020, all of whom were included in this study. The patients included 32 women and 19 men with a mean age of 49.1 ± 7.6 years (range, 39–60 years). The average duration of symptoms was 21.1 ± 21.2 months (range, 6–120 months). The intra-observer agreements for Steinborn et al.'s classification were 77.9%, 76.0%, and 76.7%, respectively. The inter-observer reliabilities of the three classifications were 0.734, 0.751, and 0.726, respectively. The average intra-observer agreement for the diagnosis of abnormal LCL signal was 89.9%, with an overall weighted kappa value of 0.904. The false-positive rate was 50%, and the false-negative rate was 48% for LCL evaluation on MRI. Spearman's rank correlation analysis did not find significant correlation between any of the three MRI classifications and preoperative VAS or any functional scores (all $P > 0.05$). There were no significant differences in the VAS and functional scores between patients with abnormal LCL signals on MRI and those without LCL lesions (all $P > 0.05$).

Conclusions: Preoperative MRI findings in patients with refractory LE cannot reflect the severity of functional deficiency. Preoperative MRI grading of the origin of the ERCB and preoperative MRI for LCL signal change cannot assist the surgical plan for the treatment of patients with refractory LE.

FP.19.07

POSTOPERATIVE HETEROTOPIC OSSIFICATION AFTER DISTAL BICEPS TENDON REPAIR WITH A SINGLE-INCISION BICORTICAL ENDOBUTTON TECHNIQUE, WITH OR WITHOUT AN INTERFERENCE SCREW: NO CORRELATION BETWEEN IMAGING A

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Background: Heterotopic ossification (HO) following surgical fixation of the distal biceps tendon is prevalent, but is likely to have been underreported in the past, as imaging is usually reserved for symptomatic patients. The purpose of this study is to evaluate the incidence and clinical implications of heterotopic ossification after surgical repair of the distal biceps tendon.

Methods: This retrospective multicentric study assessed the prevalence and clinical relevance of postoperative heterotopic ossification after distal biceps tendon repair in 36 patients. In 23 an interference screw was used in addition to an endobutton. Postoperative CT-scans were used to analyze the incidence of HO. Visual Analogue Score (VAS) score, Mayo Elbow Performance Index (MEPI) score, Disabilities of Arm, Shoulder and Hand (DASH) scores and range of motion (ROM) were assessed to evaluate the clinical and functional outcome. Data was checked for normality using the Shapiro-Wilk test. Comparisons of the pain and function outcomes between groups (HO and non-HO) were based on the Mann-Whitney U test for independent samples. Significance level was set at $P < 0.05$.

Results: All patients included were male with a mean age of 47 years at the time of surgery. Heterotopic ossifications were visualized on CT imaging in 13 out of 23 patients in the interference screw group (57%) and 4 out of 13 in the group where no screw was used (31%). This difference was however not significant. The total incidence was 47% (17/36). Average VAS was 0.3/10 in patients with HO and 0.5/10 in the non-HO group, MEPI was on average 98 vs 97 and DASH 3.2 vs 3.9 in patients with HO vs non-HO. Pronation was 71 (HO) vs 74 degrees (Non-HO) and supination 83 (HO) vs 78 degrees (non-HO) The presence of HO had no statistically significant impact on the VAS scores ROM measurements, MEPI scores and DASH scores.

Conclusions: The incidence of asymptomatic HO is higher than previously reported. Despite the high incidence of postoperative HO after distal biceps tendon repair, results are excellent with no significant difference in pain, function and patient satisfaction could be found between the HO group and the non-HO group.

FP.19.08

CLINICAL AND RADIOLOGICAL EFFECTS OF PLATELET -RICH PLASMA, GLUCOCORTICOID AND SALINE INJECTIONS IN THE TREATMENT OF LATERAL EPICONDYLITIS PATIENTS: PROSPECTIVE RANDOMIZED CONTROLLED STUDY

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Background: There are many studies in the literature comparing platelet- rich plasma (PRP), glucocorticoid, and saline treatments (1, 2). However, there is little literature showing the changes in ultrasound (USG) findings in the relevant anatomical area during clinical diagnosis and after treatment.

Methods: Study was reported to clinicaltrials.gov (NCT04875338) after approved by the Istanbul University Faculty of Medicine Ethics Committee (02.04.2021). Between April 2021 and April 2022 Patients who had pain and tenderness around the lateral epicondyle with palpation, had for at least 3 months, were older than 18 years, and did not receive any treatment were included in study (3). The study was planned prospectively. Patients who have any disease in the same upper extremity excluded. Fifty-four elbows (50 patients) who met the criteria were randomized. Vascularity and superb microvascular imaging (SMI) index was measured by USG in patients before and 3 months after injection (4). In addition, visual analog scale, personalized tennis elbow assessment, and arm, shoulder, and hand problems questionnaire scores were evaluated.

Results: Ten patients (13 elbows) did not come to follow ups and excluded. 14 of the patients were male and 26 were female. The mean age was 42.4 ± 6.15 (26-52) years. There were 14 elbows in the glucocorticoid group, 13 elbows in the PRP group, and 14 elbows in the saline group. There was no significant difference between the groups in pre-injection, baseline functional scores and radiological evaluations. There was no significant difference between PRP and glucocorticoid in VAS score at 3 months ($p=0.7$), while the PRP group was significantly better in both DASH and PRTEE scores, while the saline group was the worst ($P<0001$). In the 3rd 6th month DASH and PRTEE scores, it was the best PRP group while it was the worst saline group ($p<0.001$). When the 3rd month USG evaluations were examined, no difference was found between the groups in terms of vascularity, SMI ($p=0.3$, $p=0.2$).

Conclusions: it is understood that the functional results of PRP treatment are better both in the early and late periods. It was revealed that vascularity and SMI ultrasound measurements were not associated with functional results.

FP.20.01

DYNAMIC ANTERIOR STABILIZATION WITH MIXED REALITY NAVIGATION SYSTEM

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Background: Anteroinferior glenohumeral instability can be treated by different techniques. The concept of dynamic anterior stabilization (DAS) is the transferring of the long head of the biceps (LHB) within a subscapularis split to the anterior glenoid margin, creating a sling effect. There are approaches to secure the LBH, and a posterior suture button is one the most rigid and less invasive options, but there's a minor caution about the suprascapular nerve. With new technologies such as Mixed Reality (MR), the surgeon can display real anatomy in the virtual world. We explore a new method for DAS procedure guidance using MR.

Methods: To solve these problems, we proposed a novel mixed-reality navigation system using 3D-holographic models. The arthroscopic surgery was performed in 8 fresh shoulder cadavers with a modified technique described by Ladermann with a custom drill guide developed by the author. Using a HoloLens 2 MR Headset system (Microsoft Corporation, Redmond, Washington, USA) the shoulder 3D hologram was virtually positioned to match the cadaver anatomy and a 3D virtual guide was positioned in the desired location, parallel to the glenoid surface and a safe distance to the neck of the scapula (nerve). The location of the drill exit was measured with a calliper after the posterior open approach.

Results: The time to set up the system was 5 minutes. The headset was used only during the drilling process. The 3D-holographic anatomic model and the 3D drill-guide model could be placed in the same field of view as the patient real anatomy and the camera from the arthroscopy.

The mean distance from SSN and the posterior drill hole was 2.5 cm.

Conclusions: The advantage of a mixed reality system is that the surgeon can have the patient, camera views, and 3D holographic imaging in the same field of view and depth, and the use of 3D-holographic models can aid in the positioning instrument during the procedure. As there's uncertainty about the exiting point of the drilling guide and the risk for SSN lesions, MR guidance can be a helpful tool even for arthroscopic procedures.

FP.20.02

IS THERE A BENEFIT OF SLING IMMOBILIZATION AFTER OPEN LATARJET SURGERY FOR ANTERIOR SHOULDER INSTABILITY? A RANDOMIZED CONTROL TRIAL

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Background: Recurrent traumatic anterior shoulder instability occurs most commonly in young to middle-aged male athletes. Recent research has highlighted the negative effect of immobilization on shoulder rehabilitation. However, only few studies evaluated different rehabilitation programs after Latarjet and their impact on complication rates.

Methods: The aim of this study was to evaluate the benefit of sling immobilization after open Latarjet procedure for anterior shoulder instability. The hypothesis was that immediate self-rehabilitation without sling immobilization would result in improved functional scores at 6 months compared to patient wearing a sling for 3 weeks postoperatively. We randomized 72 patients with anterior shoulder instability scheduled for open Latarjet procedure into sling and no-sling groups. Two partially 1 cm apart threaded 4.0-mm cancellous screws were used to secure the graft. Both groups started the same immediate self-rehabilitation protocol. Patients were evaluated clinically using Rowe score, the Single Assessment Numeric Evaluation (SANE) instability score as well as visual analogue pain scale (VAS) preoperatively and at 1.5, 3, and 6 months. A computed tomography was performed at 6 months to evaluate graft healing.

Results: Both groups had similar preoperative patient characteristics. Both groups had a significant improvement in Rowe score (from 38.8 ± 20.4 to 81.6 ± 17.8 , $p < 0.001$), SANE instability score (from 42.5 ± 20.5 to 84.7 ± 13.2 , $p < 0.001$) and VAS (from 27.7 ± 21.8 to 13.9 ± 16.1 , $p < 0.001$) at 6 months postoperative. There was no difference in functional outcomes between the two groups at 6 months. Mean Rowe score was respectively 80.7 ± 15.9 and 82.6 ± 19.6 in the sling and no-sling group ($p = 0.64$). Mean SANE instability score was 83.7 ± 13.0 and 85.7 ± 13.6 ($p = 0.53$) and mean VAS 15.6 ± 14.8 versus 12.2 ± 17.5 ($p = 0.38$), for sling and no-sling group respectively. Finally, computed tomography evaluation revealed no significant differences regarding bone graft healing between both groups ($p = 0.35$).

Conclusions: Both treatment groups resulted in excellent early functional outcomes. Absence of sling immobilization did not increase complication rates after open Latarjet. Sling immobilization seems therefore optional after open Latarjet procedure.

FP.20.03

SHOULDER INSTABILITY IN CHILDREN BELOW 12 YEARS OF AGE; ARTHROSCOPIC MANAGEMENT AND RESULTS

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Background: Patients below 12 years of age with recurrent anterior shoulder dislocation (RAD) not responding to conservative treatment are rare. The decision to do a surgical treatment of failed conservative therapy cases is a difficult one as the joint is still growing with changing in bone size and implants may cause growth complications. To our knowledge this is the first clinical study on the results of arthroscopic surgical reconstruction of RAD in children below 12 years of age.

Methods: In this retrospective study between 2010 and 2021, 30 (19 males and 11 females) patients younger than 12 years (average 10.2 years) sustained several anterior shoulder dislocations and 17 (14 high performance athletes) from 20 cases underwent arthroscopic modified Neer Inferior Capsular Shift with a post operative immobilization in neutral rotation and 20 degrees abduction for 4 to 6 weeks followed by 2 months rehabilitation, while the other 3 underwent superior capsulo-tendoneous reefing. No anchors were used. The other 10 cases were successfully treated with conservative means. The minimum follow-up was 2 years (mean, 6.3 years), and patients were evaluated with the Rowe Score.

Results: The mean Rowe score was 95.0, with 98% good or excellent results. The rate of recurrence of dislocations was 0%. The return-to-sports rate was 83%. In competitive athletes 13% respond to conservative treatment and 87% needed surgery. In non-competitive athletes 26% respond conservative treatment and 74% needs surgery. Only 7% of recurrent dislocation cases responded to Conservative treatment while in the Subluxation cases 69% had a successful conservative therapy.

Conclusions: The present study showed favorable results for arthroscopic surgical treatment after recurrent dislocation in children under 12 years of age. Arthroscopic modified Neer capsular shift was an effective and safe treatment option in this population.

FP.20.04

NO CLINICAL OR RADIOGRAPHIC DIFFERENCE SEEN IN ARTHROSCOPIC BANKART REPAIR WITH KNOTTED VERSUS KNOTLESS SUTURE ANCHORS: A RANDOMIZED CONTROLLED TRIAL AT SHORT-TERM FOLLOW-UP

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Background: Arthroscopic Bankart repair with knotted anchors is the most commonly used treatment for anterior shoulder instability. In 2001, the concept of tissue fixation through knotless anchors was established, and its applicability for the fixation of labral lesions was demonstrated. The objective of this study was to compare the clinical and radiographic results of patients undergoing arthroscopic repair of labral lesions using knotted and knotless anchors.

Methods: Sixty-four patients with anterior labral lesions (bone defects of the glenoid up to 13.5% or up to 20% if the instability severity index score was less than 4) and without other shoulder pathologies were randomly assigned to 2 groups, with 32 patients in each group. Clinical outcomes were assessed 6, 12, and 24 months after surgery by the Rowe score, Western Ontario shoulder instability index (WOSI), single assessment numeric evaluation (SANE), visual analog scale for pain (VASp), range of motion, and rate of post-operative recurrence. Postoperative magnetic resonance imaging (MRI) was performed, and the anterior and inferior labrum glenoid height indexes and anterior and inferior labral slopes were measured. The primary endpoint was the Rowe score at 24 months postoperatively.

Results: Fifty-one patients, 24 in the knotted group and 27 in the knotless group, completed 24 months of follow-up. At 24 months, the Rowe scores were 81.7 points and 85.9 points, respectively ($P = .623$); the WOSI scores were 509.2 points and 555.9 points, respectively ($P = .533$); the SANE scores were 90.7 points and 89.2 points, respectively ($P = .427$); and the VASp scores were 1.7 points and 2.5 points, respectively ($P = .275$). There was no significant difference in range of motion, postoperative recurrence, or MRI parameters between the groups. All subjects (100%) in both groups exceeded the minimal clinically important difference of 9.7 for the Rowe score ($P > .999$).

Conclusions: Repair of Bankart's lesion through the use of knotted and knotless suture anchors yielded similar clinical and radiographic results on analysis at 24 months after operation.

FP.20.05

ASSESSING THE IMPACT OF OFF-TRACK INSTABILITY LESIONS FOLLOWING ARTHROSCOPIC ANTERIOR SHOULDER STABILISATION WITHOUT ADDITIONAL REMPLISSAGE RECONSTRUCTION

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Background: Glenoid tracking lesions have been highlighted as a factor for shoulder instability. Recent studies have recommended concomitant management of off-track lesions in order to mitigate the risk of recurrent instability. Such studies advocate arthroscopic Remplissage in addition to Bankart repair. In turn neglected off-track Hill-Sachs lesions of the humeral head are considered by some as a risk factor for recurrent instability after arthroscopic stabilisation and Bankart repair.

Methods: Patients were included if they had recurrent anterior glenohumeral instability with Bankart tears and Hill-Sachs lesions on MRI imaging. Patients were excluded if they had additional bony Bankart injuries or were revision procedures. Patients were managed with an arthroscopic anterior stabilisation, Bankart repair and capsular shift over a 5-year period. The primary outcome assessed was the presence of recurrent instability or the need for revision surgery. MRI pre-operative imaging was used to calculate: the glenoid track and the presence of on or off-track Hill-Sachs lesions. Minimal acceptable follow up was 18months. Secondary outcomes were assessed with the Oxford Shoulder Instability Score (OSIS), EuroQol-5D-3L and EuroQol visual analog scale questionnaires.

Results: 62 patients (male 88.7%, female 11.3%, average age 28 years; age range 18-41 years) were reviewed. Mean follow-up was 32 months. On-track lesions were present in 59.7%(n=37) and off-track lesions in 40.3% (n=25). Overall rate of recurrent instability or need for further surgery was 3.2% (n=2/62). When assessed from the prism of glenoid tracking the on and off-track revision rates were 4% (n=1/37) 2.7% (n=1/25) respectively. The difference in recurrence rates between these groups was not statistically significant (p>0.05). The mean OSIS for the off-track was 36.4 vs 37.1 for the on-track group. This was not statistically significant (p>0.05). EQ 5D- 3L index off-track was 0.739 with an EQ-VAS 80 compared to on-track index 0.876 and EQ-VAS 81.

Conclusions: In contrast to other work this study suggests that arthroscopic stabilisation without Remplissage reconstruction can be a successful surgical strategy for patients with Bankart tears independent of whether there are on or off-track lesions.

FP.20.06

BIOMECHANICAL EVALUATION OF THE TWO DIFFERENT LEVELS OF CORACOID GRAFT POSITIONS IN THE LATARJET PROCEDURE FOR ANTERIOR SHOULDER INSTABILITY

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Background: There are multiple variations of coracoid placement for a Latarjet procedure. The ideal position of the graft in the medial-lateral position is flush with the anterior glenoid rim. However, the ideal position of the graft in the superior-inferior position (sagittal plane) for restoring glenohumeral joint stability is still controversial. This study aims to compare the coracoid graft position between the traditional 3-5 o'clock and a more inferior coracoid graft position of 4-6 o'clock (right shoulder) with regards to glenohumeral joint stability in the Latarjet procedure.

Methods: Ten fresh-frozen cadaveric shoulders were tested in a dynamic custom-built robotic shoulder model. Each shoulder was loaded with a 50N compressive load while an 80N force was applied in the anteroinferior axes in 90-degree abduction and 60-degree of shoulder external rotation. Four conditions were tested: (1) intact, (2) 6-mm glenoid bone loss (GBL), (3) Latarjet procedure fixed at 3-5 o'clock and (4) Latarjet procedure fixed at 4-6 o'clock. Stability ratio (SR) and degree of lateral humeral displacement (LHD) were recorded. One-factor random intercepts linear mixed effects (LME) models and Tukey's method were used for statistical analysis.

Results: The SR significantly decreased after creating a 6-mm GBL compared with the intact state ($p=0.009$). There was no significant difference in SR between Latarjet 3-5 o'clock and 4-6 o'clock compared with the intact state with $p=0.51$ and $p=0.62$. LHD decreased significantly in shoulder with GBL compared with intact state ($p<0.001$) and Latarjet 4-6 o'clock ($p<0.001$). The displacement decreased significantly after performance of the Latarjet procedure 3-5 o'clock ($p=0.04$) compared with the intact state but not with the Latarjet procedure 4-6 o'clock ($p=0.71$).

Conclusions: The Latarjet procedure in both coracoid graft positions (3-5 and 4-6 o'clock) restored the stability ratio to the values measured in the intact state. An inferior coracoid graft fixation, 4-6 o'clock position, may benefit in restoring normal shoulder biomechanics after Latarjet procedure. Additional in vivo studies are needed to establish clinical relevance.

FP.20.07

CLINICAL AND RADIOLOGICAL EVALUATION OF THE BRISTOW-LATARJET TECHNIQUE IN PATIENTS WITH 30 OR MORE YEARS OF FOLLOW-UP

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Background: Bristow-Latarjet (BL) surgery is one of the most used procedures around the world for the treatment of recurrent anterior shoulder dislocation (RASD). There are few studies in the literature using this technique with long postoperative follow-up. Our objectives are to evaluate the clinical and radiographic results of patients undergoing BL procedure with more than 30 years of follow-up.

Methods: We performed a retrospective case series study (level of evidence 4) with prospective evaluation. Forty-four patients with RASD operated by the BL technique with a minimum postoperative period of 30 years were selected for clinical and radiographic evaluation. Twenty-seven patients (30 shoulders) were evaluated. Outcome was assessed using Rowe score; WOSI - Western Ontario Shoulder Instability Index; ASES - American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form; SANE - Single Assessment Numeric Evaluation; VASp - Visual Analog Scale for pain. The glenohumeral arthropathy was assessed with plain radiographs using the Samilson and Prieto classification.

Results: Mean age was 56.5 ± 4.4 (average=56.0; IQI-4.4; min.47/max.66); mean follow-up was 35 ± 4.5 years (average=35.0; IQI-6; min.29/max.47). The scores were: Rowe 88.28 ± 15.9 (average=95.0; IQI-20; min.50/max.100); WOSI 208 ± 244.2 (average=100.0; IQI-230; min.0/max.790); ASES 95.11 ± 10.4 (average=100.0; IQI-3; min.58/max.100); SANE $92.5\% \pm 10.4\%$ (average=99.0; IQI- 10; min.60/max.100); EVAd 0.45 ± 1.3 (average=0; IQI=0; min.0/max.5). Recurrence: dislocation and subluxation 4 (13.3%); apprehension 1 (3.3%); total 5 (16.6%). Regarding the graft: consolidated 13 (86.7%); flush with glenoid 12 (80%); inferior to glenoid equator 14 (93.3%). Regarding the screw: bicortical fixation 10 (66.7%); angulated less than 15° 10 (66.7%), complications 5 (33.3%). The glenohumeral arthropathy was found to be normal 6 (40%), mild 5 (33.3%), moderate 3 (20%) and severe 1 (6.7%) - 60% total arthropathies.

Conclusions: This long term study showed that BL procedure allows excellent and good results and patient satisfaction regarding their daily living activities (work, leisure and sport), and is effective to control shoulder instability, despite the high rate of glenohumeral arthropathy.

FP.20.08

THE INLAY STRUCTURE CAN IMPROVE THE STABILITY OF BONE GRAFT IN BRISTOW PROCEDURE

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Background: Compared with the Latarjet procedure, Bristow procedure has lower screw-related complication rate, but poor bone healing. A modified Inlay Bristow procedure has been reported to significantly improve the bone healing rate, but the biomechanical mechanism in it is unclear. The aim of this study was to evaluate the biomechanical stability of the bone graft between a modified Inlay Bristow and the classic Bristow procedure.

Methods: Sixteen left scapula models (Sawbones®, Composite Scapula, 4th generation) were randomly divided into two groups (8:8). The bone graft in the first group was fixed with 3.5mm screw using the Inlay structure. And the bone graft in the second group was fixed with 3.5mm screw via traditional method. Maximum cyclic displacement, ultimate failure load and stiffness were evaluated biomechanically. The failure type was recorded for each model.

Results: Cyclic loading test demonstrated that the maximum cyclic displacement of the Inlay procedure (0.0125 ± 0.0059 mm; 95%CI, 0.01-0.02mm) was significantly smaller ($P = 0.001$) than that of classic procedure (0.0327 ± 0.0106 mm; 95%CI, 0.02-0.04mm). The Inlay Bristow technique resulted in a significantly higher ($P = 0.024$) ultimate failure load (548 ± 110 N; 95%CI, 449.64-646.86N) compared with the classic Bristow (405 ± 102 N; 95%CI, 313.89-496.36N). The stiffness of the classic group was 19.17 ± 4.01 N/mm(95%CI, 15.58-22.75N/mm), and that of the Inlay group was 22.34 ± 5.35 N/mm(95%CI, 17.56-27.11N/mm) ($P = 0.232$). Failure was mainly due to bone graft fractures through the drill hole or glenoid bone fractures.

Conclusions: Inlay Bristow fixation of the bone graft in a Sawbones® model provides significantly stronger fixation and early postoperative stability than classic Bristow. With proved to be more resistant to graft displacement, the stable graft-glenoid structure in the Inlay Bristow suggests a higher likelihood of graft union. Though the current clinical outcome is satisfactory, the Inlay Bristow procedure should be further evaluated with cadaveric experiments and long-term follow-up.

FP.21.01

HYPERTROPHY OF THE ANTERIOR CORACOACROMIAL LIGAMENT AS AN ETIOLOGY OF SHOULDER PAIN IN THE YOUNG OVERHEAD ATHLETE. THE CALYPSO CONDITION

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Background: Shoulder pain in young overhead athletes is often associated with instability or SLAP pathology, but we encountered a series of these patients without these conditions. We report the characteristics and treatment results of these cases.

Methods: 92 young (mean age 19 [13-26]) overhead athletes (54 male, 38 female) presented with shoulder pain unresponsive to conservative treatment. 76% had anterolateral acromial corner pain. 71% had overhand arc pain. 53% had SLAP-type findings; none had instability symptoms.

All underwent EUA and arthroscopy with no evidence of instability or labral pathology. The primary pathology was subacromial bursitis with a thickened anterior band of the CA ligament (CAL). The hypertrophic CAL extended laterally under the deltoid, forming an anterolateral acromial corner "awning" and compromising subacromial space. The hypertrophic edge and lateral extension were excised and bursectomy performed in all; 90% also received an osseous acromioplasty. 16% had posterior capsular contracture with GIRD.

Results: At average follow-up of 2.2 years (1-5), all had returned to sport (81.5% to the same level), with an average time of 19 weeks (8-52). At final follow-up, pre-operative mean VAS, ASES, and SST scores had improved from 3.7, 63.1, and 8.8, respectively, to 0.6, 93.8, and 11.6. There were no complications or re-operations and no occult instability was revealed.

Conclusions: Younger age and year-round overhead sports participation were defining factors in this series. We feel that symptomatic subacromial bursitis with a hypertrophic anterior CAL is an impingement variant, likely due to overuse in an overhead sport. Overuse is recognized as an etiology of instability, SLAP lesions, and labral injuries, but subacromial pathology is usually associated with older age groups. However, the clinical entity in this series belonged to the latter group.

We have developed the mnemonic CALYPSO for this clinical entity:

- Coracoacromial ligament
- Anterior band hypertrophy
- Lateral extension of the CAL under the deltoid
- Youth
- Posterior capsular contracture, Play year-round
- Subacromial bursitis
- Overuse.

Clinicians should maintain a high index of suspicion for this entity when evaluating young overhead athletes. In all cases, arthroscopy was successful in identifying and treating the pathology and all were able to return to sport.

FP.21.02

SUBPECTORAL BICEPS TENODESIS WITH ENDOBUTTON FIXATION IN THE YOUNG POPULATION - WHICH TECHNIQUE WORKS BEST?

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Background: Injuries of the long head of the biceps (LHB) tendon are commonly treated with tenodesis. Stable fixations and anatomical restoration of the length-tension relationship play central roles to provide satisfying functional and cosmetic outcomes in young patients. We report the clinical outcomes of two different subpectoral tenodesis techniques using unicortical button fixation.

Methods: Patients under 50 years that were treated between April 2015 and January 2020 with one of the following two subpectoral tenodesis techniques were retrospectively selected and enrolled for follow-up examination >2 years after surgery: Subpectoral in situ tenodesis followed by resection of the intraarticular portion leaving a residual tendon stump in the bicipital groove (group I) vs. tenotomy first followed by stump resection and subpectoral tenodesis (group II). Patients with concomitant rotator cuff repair, subsequent shoulder surgery or contralateral biceps surgery were excluded. Clinical outcome was evaluated using LHB Score, Constant-Murley Score (CMS), isometric elbow flexion and supination strength measurements. Sonographic evaluation included assessment of the integrity of LHB and tenodesis, signs of inflammation and measurements of distalization of the myotendinous junction (MTJ) of the LHB compared to the non-operated side.

Results: Thirty-four patients in group I (24 males, mean age 40.3 years, mean follow-up 57.2 months) and 24 patients in group II (19 males, mean age 39.8 years, mean follow-up 51.9 months) were evaluated. Total CMS and respective subcategories did not reveal significant differences between groups. Overall LHB score was on average 10 points higher in group I (mean 94 points) compared with group II (mean 84 points) ($p=0.016$). In the LHB score subcategories, group I showed significantly better results regarding patient-dependent cosmesis (group I mean: 15 points; group II mean: 12 points; $p=0.005$) and examiner-dependent cosmesis (group I mean: 14 points; group II mean: 10 points; $p=0.001$). This was substantiated by a significantly increased distalization of the MTJ in group II (group I mean: 3.0 cm; group II: 3.8 cm; $p=0.030$).

Conclusions: This study shows that subpectoral in situ tenodesis of the LHB followed by arthroscopic resection of the intraarticular portion provides higher LHB scores and better cosmetic outcome compared with proximal intraarticular tenotomy followed by subpectoral tenodesis.

FP.21.03

EFFECTS OF CROSS-EDUCATION ON ROTATOR CUFF MUSCLE STRENGTH AND SHOULDER FUNCTION IN PATIENTS WITH BANKART REPAIR: RANDOMIZED CONTROLLED STUDY

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Background: There is an inadequate rotator cuff (RC) muscle strength and decreased functional capacity at the postoperative sixth months following arthroscopic Bankart repair though it is the most preferred timeline for returning to play. The purpose of this study was to investigate the effects of cross-education on rotator cuff strength recovery and shoulder function on patients with Bankart repair.

Methods: Twenty-eight patients with Bankart repair were included to the study (age: 24.5 ± 5.6 years and -mass index: 24.7 ± 3.6 kg/m²). The patients were randomly divided into either intervention (n=14) or control (n=14) groups. All patients received a standardized rehabilitation program until the postoperative 12th weeks. The intervention group also received an isokinetic training with the non-operated shoulder focusing on the RC muscles (twice a week, 2 sets of 10 repetitions) between the postoperative 2th and 12th weeks. RC muscle strength was measured preoperatively and, three and six months postoperatively using the isokinetic dynamometer at 60°/sec and 180°/sec angular velocities. Shoulder function was assessed with Closed Kinetic Chain Upper Extremity Stability Test (CKCUEST) and Y-balance Test for Upper Quarter (YBT-UQ) at the postoperative six months. Analyses of co-variance was used during the statistical analyses.

Results: There were no difference in the RC muscle strength at the postoperative three months between the groups ($p > 0.05$). At the postoperative six months, the intervention group demonstrated higher RC muscle strength compared to the control group ($p < 0.05$). The CKCUEST YBT-UQ scores were similar between the groups at the postoperative six months.

Conclusions: Cross-education in the early periods of the postoperative rehabilitation following the Bankart repair improves the RC muscle strength recovery in mid-term. Integrating the cross-education in to the postoperative rehabilitation program can help improving the dynamic shoulder stability and decrease the risk of re-injury.

FP.21.04

ARTHROSCOPIC LATARJET FOR RECURRENT ANTERIOR SHOULDER INSTABILITY TREATMENT PROVIDES HIGH RATE OF RETURN TO SPORT IN PROFESSIONAL ATHLETES

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Background: Professional athletes with glenoid bone loss are susceptible of recurrence of shoulder instability while returning to sport. In such high-demanding population Latarjet procedure is recommended. Open surgery has been reported inferior to arthroscopic Latarjet procedure in terms of longer return to sport (RTS) time.

Methods: Professional athletes with recurrent anterior shoulder instability who underwent arthroscopic Latarjet procedure between 2010 and 2016 were eligible for a retrospective analysis. Patients were divided into 3 groups accordingly to the type of sport (Group 1[G1] non-collision and non-overhead sports, Group 2 [G2] collision and martial-art type of sports, Group 3[G3] overhead sports). To evaluate sport results within the groups Kerlan-Jobe Orthopaedic Clinic Score (KJOC Score) (0-100 pts), SPORTS Score (0-10 pts) and return to sport time (RTS) were used. To evaluate clinical results, pre-operative and postoperative Constant-Murley Score (CMS) (0-100 pts), Walch-Duplay Score (WDS) and range of external and internal rotation were measured and compared.

Results: There were 46 patients (G1- 22 patients, G2 - 13 patients, G3- 11 patients) with mean age 27.1(± 7.3) years and the mean follow-up was 50.7(± 18) months. Of the 46 patients, 44 (95.7%) returned to the previously practiced sport, of which 40 (87%) returned to pre-injury level. The mean overall time to return to sport (RTS) was 1.4±5 months, while for G1 it was 5 months, for G2 4.6 months and 5.3 months for G3 (p>0.05). The mean KJOC and SPORTS scores were 95.2±5.6 and 9.5±1 respectively. The mean CMS increased from 54.3±9.4 to 87.9±8.2 (p=0.001) and the mean WDS increased from 53.7±7.3 to 88.1±10.7 (p=0.001). The mean postoperative ER and IR were 72.8±18.6 and 81.3±11.3 degrees respectively, which consisted of 97.5% of ER and 95.3% of IR of the contralateral shoulder. Recurrence of shoulder instability was observed in 4 (8.7%) patients. Procedure related complications occurred in 12 patients (26.0%) and revision was necessary in 4 cases (8.7%).

Conclusions: Arthroscopic Latarjet procedure has a success rate of >90% in treatment of recurrent anterior shoulder instability in professional athletes and provides a high rate of return to sports. However, despite promising clinical results procedure is not free from complications.

FP.21.05

EPIDEMIOLOGY OF UPPER LIMB INJURIES IN TWO MAJOR BRAZILIAN SOCCER CHAMPIONSHIPS FROM 2016 TO 2019

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Background: Soccer is the most popular sport globally, and Brazil has a worldwide representation, leading the sales of athletes abroad. There are still no epidemiological studies that assess the incidence of upper limb injuries in Brazilian professional soccer and just a few that evaluate these cases worldwide.

Methods: A prospective cohort study was conducted to evaluate the teams of two divisions over four seasons within the Brazilian Soccer Championship and the Paulista Soccer Championship. Clubs and their doctors were contacted to participate in the study and guided on the correct way to enter data via online platforms: Transfermarkt (Transfermarkt GmbH & Co. KG) and SurveyMonkey (Momentive.AI). Demographic data, injury characteristics, and FIFA Incidence Formula were analyzed.

Results: Overall, the study analyzed 3,828 matches and 126,357 hours of play. Upper limb injuries were registered 169 times, representing 6.8% of total injuries, with a FIFA incidence of 1.34. Most lesions occurred in forward players (21.3%), the shoulder exhibited the highest number of injuries (63.3%). The player's position was related to the location on the field where the injury occurred ($p < 0.001$); however, there was no relationship between the type of injury and the location on the field ($p > 0.001$). The average time to return to play was 19.1 days (range 0-200 days) and it was longer for goalkeepers. The necessity of surgical treatment was statistically associated with additional time to return to play ($p < 0.001$).

Conclusions: Shoulder injuries were the most frequent upper limb injury sustained during the two major Brazilian soccer championships. Forward players suffered the most upper limb injuries and goalkeepers experienced the longest time to return to play.

FP.21.06

FOUR-YEAR TREND IN SHOULDER AND ELBOW INJURIES IN COMPETITIVE-LEVEL HIGH SCHOOL BASEBALL PITCHERS: A REPEATED CROSS-SECTIONAL SURVEY

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Background: Shoulder and elbow injuries are the main cause of throwing disability among high school baseball pitchers. However, longitudinal studies on shoulder and elbow injuries among competitive-level high school baseball pitchers have been insufficient. This study aimed to investigate shoulder and elbow injuries in competitive-level high school baseball pitchers over a four-year period and elucidate the effects of implementing medical checkups on the incidence of shoulder and elbow injuries.

Methods: Five hundred fifty-two high school baseball pitchers, who received preseason medical checkups from February 2012 to February 2015, were enrolled in this study. Shoulder and elbow injuries occurring during the season after medical checkups were prospectively evaluated by a postseason questionnaire. Pitchers who were not able to pitch for >7 days owing to shoulder or elbow pain were defined as having shoulder and elbow injuries during the season. The incidence rates of shoulder and elbow injuries during the seasons were calculated and compared over the 4-year period.

Results: Ninety-six percent of medical checkup participants were included in the study. The mean questionnaire collection rate of the prospective study was 71.6% (range: 67.7-78.9%). The incidence of shoulder and elbow injuries significantly decreased from 20.0% in 2012 to 7.7% in 2015 ($P = .013$).

Conclusions: The four-year trend in the incidence of shoulder and elbow injuries in competitive-level high school baseball pitchers was evaluated. The incidence of shoulder and elbow injuries during the season significantly decreased with a linear downward trend during the survey period after the implementation of medical checkups.

FP.21.07

TRENDS IN SURGICAL MANAGEMENT OF ADHESIVE CAPSULITIS BETWEEN 2010 AND 2019

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Background: Adhesive capsulitis results from progressive fibrosis of the glenohumeral joint capsule resulting in pain and stiffness of the shoulder. Surgical treatment options include manipulation under anesthesia (MUA) and arthroscopic intervention to lyse adhesions. This study aimed to observe the overall trends in (1) surgical management for adhesive capsulitis, (2) surgical treatment modality for adhesive capsulitis, and (3) demographics and comorbidities of patients undergoing surgical management of adhesive capsulitis between 2010 and 2019.

Methods: The PearlDiver database, a national all-payer's claims database containing over 120 million patient records, was used to perform a retrospective trends analysis. Incidence of adhesive capsulitis was analyzed between 2010 and 2019. Incidence of surgical management for adhesive capsulitis as well as average age, gender, and average Charleston comorbidity index (CCI) were analyzed. Surgical management included MUA and arthroscopic lysis of adhesions (ALOA). Compound annual growth rate (CAGR) was calculated for each trends analysis and a p-value < 0.05 indicated significant findings.

Results: A total of 908,980 patients with a diagnosis of adhesive capsulitis were identified between the years of 2010 and 2019. The incidence of adhesive capsulitis was 93,736 per 100,000 in 2010 and 83,886 per 100,000 in 2019 amounting to a significant decrease in the incidence during this period (CAGR: -2.01%, p < 0.001). The trend of overall incidence of surgical management significantly decreased between 2010 and 2019 (CAGR: -5.77%, p < 0.001) with 8,370 patients per 100,000 in 2010 and 4,870 per 100,000 in 2019. The utilization of MUA significantly decreased (CAGR: -2.25%, p < 0.001) while the utilization of ALOA significantly increased (CAGR: 3.13%, p < 0.001) during this period. The average age and number of comorbidities of patients undergoing MUA and ALOA significantly increased (p < 0.05 for all).

Conclusions: This study showed that the incidence and surgical management of adhesive capsulitis decreased between the years of 2010 and 2019. There has been an increase in the utilization of MUA and a decrease in the utilization of ALOA during this period. Further sub-analysis of patient comorbidities as well as further investigation into complications following surgical treatment of adhesive capsulitis can add to the growing of literature discussing management of adhesive capsulitis.

FP.21.08

ANTERIOR GLENOHUMERAL CAPSULAR LIGAMENT RECONSTRUCTION WITH HAMSTRING AUTOGRAFT FOR INTERNAL IMPINGEMENT WITH ANTERIOR INSTABILITY OF THE SHOULDER IN OVERHEAD ATHLETES

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Background: Shoulder pain and dysfunction are common in baseball players, and although “internal impingement” is recognized as one of the most common pathologies of shoulder dysfunction, the optimal surgical treatment for internal impingement with anterior instability of the shoulder remains controversial. This study evaluated baseball players’ preliminary outcomes following anterior glenohumeral capsular ligament reconstruction for internal impingement with anterior instability of the shoulder.

Methods: Twenty overhead athletes (all male; mean age, 23.1±8.9 years) with internal impingement and anterior instability managed via anterior glenohumeral capsular ligament reconstruction were examined. The mean follow-up period was 19.1±9.6 months. Anterior glenohumeral capsular ligament reconstruction was performed with a knee hamstring autograft for balanced stability and laxity with two major targets: to prevent hyper-angulation and translation in horizontal abduction, and to mimic the individual arm cocking position at the final decision of tension. Preoperative and final follow-up evaluations were performed using Jobe’s postoperative grading system; the Kerlan–Jobe Orthopaedic Clinic Overhead Athletes Shoulder and Elbow Score; Disabilities of the Arm, Shoulder and Hand sports module; plain radiographs; and magnetic resonance imaging.

Results: Jobe’s postoperative grading system score, KJOC, and the DASH sports module score improved significantly from 29.0 ± 16.4, 28.0 ± 9.0, and 80.7 ± 16.3 points preoperatively to 87.1 ± 14.1, 77.2 ± 15.1, and 19.1 ± 17.8 points postoperatively, respectively (P < .001, .0025, < .001, respectively). Both clinical and imaging evaluations revealed improved internal impingement with anterior instability after anterior glenohumeral capsular ligament reconstruction. The mean external rotation at abduction significantly decreased from 109 degree preoperatively to 101 degree postoperatively. At follow-up, 16 of the 20 athletes (80.0%) returned to their prior competitive level. Plain radiographs and magnetic resonance imaging revealed no obvious loosening of the graft or screws.

Conclusions: Anterior glenohumeral capsular ligament reconstruction resulted in preferable clinical outcomes for young baseball players who experienced pain during the throwing motion. Stabilization of the glenohumeral joint with autografting of the knee hamstring may thus represent a solution for internal impingement with anterior instability in overhead throwing athletes.

FP.22.01

CORRELATION OF RISK FACTORS WITH ODDS OF INSTABILITY AFTER REVERSE SHOULDER ARTHROPLASTY

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Background: The goal of this clinical study is to better facilitate pre-operative identification of patients at-risk for instability after rTSA and to quantify the impact of accumulating risk factors on the occurrence of dislocation.

Methods: We retrospectively analyzed a multi-center database of a single shoulder prosthesis (Equinox; Exactech Inc, Gainesville, FL USA) and quantified the instability rate with this implant. Risk factors were based on prior work by Le et al. and included: male gender, < 67 years of age, not repairing the subscapularis, cemented humeral stem, expanded thickness glenosphere, and >40mm glenosphere. 8,301 patients (mean age: 71.9yrs) treated with primary rTSA between 2007 and 2022 were included with an average follow-up of 27.2 months (range: 0.1 to 173 months). We quantified the prevalence of instability risk factors and the instability rate for each category of risk factor number. We further calculated the odds ratio for each cohort to quantify the impact of accumulating risk factors on instability.

Results: 119 (45F/74M) of 8,301 primary rTSA patients (1.4%) experienced instability. Risk factors that resulted in significantly higher rates of instability included: males vs. female gender (2.3% vs. 0.9%, $p<0.0001$); patients <67 vs. >67 years (2.6% vs. 1.0%, $p<0.0001$); cemented vs. press-fit stems (2.7% vs. 1.3%, $p<0.0001$); glenosphere diameter >40mm vs. <40mm diameter (2.2% vs. 1.0%, $p<0.0001$); and expanded vs. standard offset glenospheres (3.2% vs. 1.3%, $p<0.0001$). 36.1% had 1 risk factor, 42.5% had 2 risk factors, 14.7% had 3 risk factors, 1.6% had 4 risk factors, and 0.2% had 5 risk factors. A higher prevalence of risk factors correlated with a higher rate of instability. Stratifying instability rate by multiple risk factors identified numerous cohorts with odds ratios >4, and 3 cohorts with odds ratios >15.

Conclusions: This study demonstrated that 1.4% of rTSA patients experienced instability with this implant. We demonstrated the impact of accumulating risk factors on incidence of dislocation. Doing so we identified that patients with the most pronounced risk of instability were males <67 years, without subscapularis repair. Patients considering rTSA with these risk factors should be made fully aware of this elevated complication risk.

FP.22.02

REVERSE TOTAL SHOULDER ARTHROPLASTY IS NOT COST-EFFECTIVE IN PATIENTS OVER 67 YEARS OF AGE WITH GLENOHUMERAL OSTEOARTHRITIS AND AN INTACT ROTATOR CUFF: A DECISION-ANALYTIC COST-UTILITY ANALYSIS

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Background: Reverse total shoulder arthroplasty (RTSA) has become increasingly utilized in patients with symptomatic glenohumeral osteoarthritis (GHOA), even in the absence of a full-thickness rotator cuff tear. With substantial differences in cost between RTSA and anatomic total shoulder arthroplasty (TSA), it remains unclear whether the increased risk of rotator cuff dysfunction justifies the increased cost of RTSA. Therefore, this investigation utilized a decision-analytic Markov model to 1) quantify the cost-effectiveness of TSA vs. RTSA in patients with GHOA and intact rotator cuff and 2) determine whether an age exists at which RTSA is more cost-effective than TSA in this population.

Methods: A Markov model was generated to determine accumulated costs and quality-adjusted life years (QALYs) over a lifetime horizon for patients with GHOA and an intact rotator cuff who undergo either TSA or RTSA. Sensitivity analyses were performed to identify age cutoffs at which one treatment option is more cost-effective than the other. Costs, health utility values, and transition probabilities were derived from the published literature.

Results: For the baseline case of a 72-year-old patient, TSA resulted in 9.43 QALYs and \$29,077 in accumulated costs, while RTSA produced 9.44 QALYs at a total cost of \$31,199 (incremental cost-utility ratio [ICER] comparing RTSA to TSA: \$188,222.94/QALY). Because the ICER for RTSA fell above the \$50,000 willingness-to-pay (WTP) threshold, TSA was determined to be the most cost-effective strategy for patients of this age. Two age cutoffs were identified from the sensitivity analysis performed on patient age. Sixty-seven years was found to be the age below which RTSA became cost-effective over ATSA, while at 77 years, TSA became the dominant strategy, resulting in both equal QALYs and lower costs for patients of this age and older.

Conclusions: TSA was the cost-effective treatment strategy for GHOA in the absence of a rotator cuff tear in adults aged 67 years or older. For patients between the ages of 67 and 77, RTSA resulted in marginally higher QALYs, but this increase was not enough to offset the increased costs to be considered cost-effective. RTSA may be considered cost-effective for individuals under the age of 67 years.

FP.22.03

SCAPULAR NECK LENGTH AND MORPHOLOGY - IMPACT ON NOTCHING AND EARLY PATIENT REPORTED OUTCOMES AFTER REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: Background: Scapular notching after reverse total shoulder arthroplasty occurs for multiple reasons. Cadaveric and clinical studies have identified that the scapular neck morphology and length may be associated with the development of notching, and subsequently worse patient reported outcomes.

Methods: Methods: We reviewed a consecutive series of patients over two years following reverse total shoulder arthroplasty at our institution. Preoperative radiological factors such as scapular neck length (SNL) and a new measurement of the length of a perpendicular line from the glenoid articular surface to the lateral pillar of the scapula were measured. Post operative radiographs at 12 months included assessment for notching. All patients were screened at 12 months for range of motion, and outcome measures such as the Oxford Shoulder Score, Quick-DASH and VAS.

Results: Results: We had 44 patients in our cohort, of which 34 (74%) demonstrated notching on post operative radiographs. Using univariate analysis, the scapular neck length to glenoid height ratio was found to be statistically significant for the presence of notching ($p=0.012$), although the perpendicular line length and scapular neck length itself did not show significance. When looking at functional outcomes, there was no statistical significance between the notched and non-notched cohorts. However, patients with a scapular neck length of $<15\text{mm}$ had a mean Oxford Shoulder Score of 36.93 whilst those $>15\text{mm}$ had a score of 42.0, which was statistically significant on univariate analysis ($p=0.037$). Similarly, when assessing the perpendicular lengths, those with $<20\text{mm}$ had a mean of 38.17 Oxford Shoulder Score, and those $>20\text{mm}$ were 43.15 which was significant ($p = 0.044$). On this basis we propose a new classification based on SNL and subsequent function.

Conclusions: **Conclusions:** Scapular morphology and in particular decreased offset and neck length may influence the development of notching post total shoulder arthroplasty. This in turn can be associated with inferior patient reported outcome measures.

FP.22.04

PRIMARY AND REVISION REVERSE SHOULDER ARTHROPLASTY USING CUSTOM-MADE BASEPLATE FOR SEVERE GLENOID BONE DEFECTS

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Background: We hypothesized that patients underwent reverse shoulder arthroplasty (RSA) using a custom-made baseplate for severe glenoid bone defects would have reliable clinical outcomes and low complication rates.

Methods: Twenty-four patients (24 shoulders; mean age: 67 years) with a preoperative diagnosis of gleno-humeral osteoarthritis (primary group; 13 patients, 54%) or failed anatomic arthroplasty (glenoid component loosening in 2 total shoulder arthroplasty and 2 RSA; glenoid wear in 9 hemiarthroplasty) (revision group; 11 patients, 46%) were included.

Glenoid bone loss was evaluated according to Gupta-Seebauer, Favard and Bercik-Walch classification systems. Clinical outcome measures included active range of motion (anterior and lateral elevation [AAE and ALE], external and internal rotation [ER and IR]), pain and the Constant- Murley scores (CS). Global glenoid offset of RSA was measured using preoperative computer-aided design (CAD). Postoperative radiological changes around the prosthetic components (radiolucent lines [RL], scapular notching, heterotopic ossifications (HO), scapular spurs, and humeral cortical thinning) were assessed.

Results: Glenoid bone defects were classified as: Gupta-Seebauer type C3 (1, 4.1%), C4 (6, 25%), E3 (2, 8.3%), and E4 (8, 33.3%); Favard type E3 (6, 25%); Bercik-Walch type C (4.1%). Delta values of clinical scores improved significantly (all $p < 0.001$ for AAE, ALE, pain and CS; $p < 0.01$ for IR; $p = 0.027$ for ER). One patient who experienced recurrent dislocation after 4 months underwent implant revision with exchange of the humeral component. The mean global glenoid offset was 29.8 mm. We found 1 shoulder with grade I scapular notching and HO; $RL < 2$ mm were found around the glenoid component in 6 shoulders (25%) and around the humeral component in 4 shoulders (17%). Humeral cortical thinning was depicted in 4 cases (17%). A subgroup analysis showed no differences in clinical and radiographic outcomes between primary and revision group.

Conclusions: RSA with custom baseplate is a reliable surgical option to address severe glenoid bone defects. The satisfactory mid-term outcomes and low complication rates found in this study encourage the use of RSA with custom-made glenoid components in primary and revision setting.

FP.22.05

SLEEP QUALITY AND RESPONSE AFTER ROTATOR CUFF REPAIR, TOTAL SHOULDER ARTHROPLASTY, AND REVERSE SHOULDER ARTHROPLASTY

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Background: Sleep disturbance secondary to shoulder pathology is a common complaint. Preliminary studies have shown improvement in sleep quality following common shoulder procedures. The purpose of this study was threefold: 1) to compare the sleep quality response between rotator cuff repair (RCR), total shoulder arthroplasty (TSA), and reverse shoulder arthroplasty (RSA); 2) to determine which comorbidities predict sleep response; and 3) to determine which patient reported outcome measures (PROMs) correlate with sleep quality metrics.

Methods: The Pittsburgh Sleep Quality Index (PSQI) and Visual Analog Scale - Quality of Sleep (VAS-QOS) were utilized to measure sleep quality in consecutive patients undergoing RCR, TSA, or RSA. Sleep quality and PROMs, including the American Shoulder and Elbow Surgeons (ASES) Shoulder Score, Single Assessment Numeric Evaluation (SANE) score, and VAS pain score, were measured preoperatively and at 2 weeks, 6 weeks, 3 months, and 6 months postoperatively. Patient demographics, preoperative diagnosis, and comorbidities were recorded. Univariate and multivariate analyses were performed. Correlations between sleep quality metrics and PROMs were assessed.

Results: Included in the study were 141 patients who underwent shoulder surgery (RCR: n = 34, TSA: n = 58, RSA: n = 49). When all shoulder surgeries were pooled, there were significant improvements in sleep quality as measured by PSQI and VAS-QOS preoperatively to final follow-up (8.8 vs. 6.0, 55.4 vs. 75.2, $p < 0.01$ for both, respectively). The rate and magnitude of sleep quality improvement varied by surgical intervention. Sleep quality after RSA and TSA showed statistical improvement by 6 weeks postoperatively, which was durable through final follow-up. After RCR sleep quality metrics were incongruous, demonstrating a trend toward worsening at 2 weeks, with improvement at 3 and 6 months postoperatively. In multivariable regression analyses, only surgical intervention, and not preoperative diagnosis or comorbidities, was associated with sleep quality at final follow-up. Quality of sleep strongly correlated with SANE scores ($r = 0.45$, $p < 0.01$).

Conclusions: Sleep quality improves after shoulder surgery, though the rate of recovery varies by surgical intervention. Sleep quality improves more rapidly after shoulder arthroplasty when compared to RCR. The SANE score may be a useful surrogate in assessing sleep quality.

FP.22.06

RELIABILITY OF THE TWIST TEST IN ASSESSING THE STABILITY OF SHORT STEM IN SHOULDER ARTHROPLASTY

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Background: In the last few decades, there has been an increase in the popularity of using short stems in shoulder arthroplasty. Essential advantages of short stems, developed to overcome the limitations of long stems, are preserving bone stock and ensuring less stress shielding. The short stem should reduce stress shielding, especially if it has a low filling ratio. In order to reduce stress shielding, it is better to use narrow stems, but adequate primary stability is necessary to obtain appropriate osseointegration. The twist test has been described to assess the rotational stability in the short stem. This study aims to calculate the twist test specificity and sensitivity in two short stems and correlate with a bone quality and demographic index.

Methods: The first 71 patients undergoing shoulder arthroplasty with short stems between 2018 and 2021 were enrolled. In all patients, the Twist-test was performed intraoperatively on the short stem; sensitivity and specificity of the Twist-test were calculated. In addition, a univariate analysis was performed to test the association between Deltoid Tuberosity Index (DTI), age, and sex with Twist Test. Patients were re-evaluated at the FU at 3, 6, and 12 months.

Results: The final mean FU was 12.8 months (range 12 to 38 months). A press-fit stem was used in 61 patients, and a cemented stem in 10. Implant survival was 98.6%; 1.4% (1 case) underwent a revision for aseptic loosening at 4 months. The calculated sensitivity of the Twist-test was 91%, specificity 100%, and test accuracy 99%. Concerning gender, the Student's t-test showed a significant difference in mean DTI values between males and females (p value=0.016). As age increases, the DTI tends to be lower: Pearson's correlation coefficient = -0.196, but the test is not statistically significant (p value=0.17).

Conclusions: From our study, the Twist Test is sensitive and specific, proving effective in assessing the intraoperative stability of the humeral stem, but the study demonstrated that female patients with poor bone quality tend to have an inadequate rotational stability.

FP.22.07

EFFECTS OF DIFFERENT HUMERAL STEM LENGTH ON STEM ALIGNMENT AND PROXIMAL STRESS SHIELDING IN REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: Humeral stem length in reverse total shoulder arthroplasty (RTSA) tends to be continuously decreased for bone preservation. However, few comparative studies have been conducted on correlation between stem length and stem alignment and/or stress shielding. Therefore, we aimed this study to investigate the effects of different humeral stem length on stem alignment and proximal stress shielding after RTSA.

Methods: We retrospectively reviewed 318 patients who underwent primary RTSA from October 2010 to May 2020 with at least 2 years follow-up. The participants were classified into 3 groups according to stem length of different types of prosthesis used in surgery: group A (short stem, range 55-80 mm, n = 88), group B (medium stem, range 80-100 mm, n = 155), and group C (standard stem, range 100-122 mm, n = 75). For the radiologic assessment of alignment, the axis of humeral stem and humeral diaphysis and distal tip decentering of humeral stem were measured at postoperative 4th week. The angular value of two axes $> 5^\circ$ was defined as malalignment. The proximal humeral stress shielding was evaluated at the final follow-up. To find correlations between stem length, malalignment and stress shielding, subgroup analyses according to presence of stress shielding were conducted. For the functional assessment, preoperative range of motion and functional scores were compared to those of last follow-up.

Results: Humeral stem malalignment was significantly higher in group A than group B and C (21.6%, 11.6% and 9.3%, respectively, $P = 0.042$). However, stress shielding at medial ($P = 0.015$) and lateral metaphysis ($P = 0.002$) was more frequently observed in group C. The stem length ($P = 0.018$) and malalignment incidence ($P < 0.001$) were significantly higher in the subgroup with stress shielding. Functional outcomes were not different according to the stem length (all $P > 0.05$).

Conclusions: Humeral stem alignment and proximal stress shielding in RTSA had significantly affected by different stem length. Although shorter stem could be beneficial for bone preservation, it could lead to stem malalignment resulting in increased proximal humerus stress shielding. Therefore, surgeons should be careful when selecting the stem length and place humeral stem in proper alignment.

FP.22.08

COMPARISON OF BONE RESORPTION AFTER SHOULDER ARTHROPLASTY BETWEEN TWO DIFFERENT SHORT STEMS

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Background: Bone resorption around a humeral stem has been one of the major complications after shoulder arthroplasty. Short stems are expected to decrease humeral bone resorption; however, occurrence rate or pattern of bone resorption depending on stem design are still unclear. The objectives of this study are to evaluate bone resorption after shoulder arthroplasty using two different short stems and to analyze risk factors of bone resorption.

Methods: Forty shoulders that underwent reversed shoulder arthroplasty (RSA) or hemiarthroplasty (HA) using short stems for cuff tear arthropathy between November 2016 and December 2020 were included. Eighteen shoulders used a curved stem (Ascend Flex, 5 males, 13 females, average age; 76.9 years-old) and 22 shoulders used a straight stem (Comprehensive, 7 males, 15 females, average age; 73.5 years-old). On the plain X-ray at more than 2 years after surgery, bone resorption (Inoue's classification Grade 4; complete disappearance of cortex), radiolucent line, spot welds, condensation line, metaphyseal / diaphyseal filling ratio (FR_{met} / FR_{dia}), and cortex contact of stem (CC) were investigated. As risk factors of bone resorption, age, gender, surgical procedure, stem, and radiographic parameters were analyzed by multiple logistic regression analysis.

Results: Grade 4 bone resorption in Inoue's classification occurred in 14.3% of Comprehensive and 52.9% of Ascend Flex. Ascend RSA showed significantly high occurrence ratio of bone resorption than Comprehensive RSA and Ascend HA. In Comprehensive, bone resorption was observed in zone 1 and 7. In Ascend Flex, bone resorption occurred in zone 1, 2, and 7, and zone 2 was prominent especially in cases with cortical contact. Spot welds occurred more in Comprehensive than Ascend Flex (86% vs 24%). FR_{met} and FR_{dia} (bone resorption (+) vs (-)) were 0.82 vs 0.68 and 0.84 vs 0.81, and FR_{met} was significantly higher in bone resorption (+) group. Multiple logistic regression analysis revealed that FR_{met} was a significant independent risk factor for bone resorption.

Conclusions: It was suggested that avoiding cortical contact and minimizing FR could prevent bone resorption. It should be taken into consideration that occurrence ratio and pattern, and maybe cause, of bone resorption can differ depending on the stem.

FP.23.01

ALTERATION OF ELBOW JOINT CONTACT AREA IN SYMPTOMATIC VALGUS INSTABILITY OF THE ELBOW IN BASEBALL PITCHERS

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Background: The effect of elbow medial ulnar collateral ligament (UCL) injury on elbow joint contact area in living subject is unknown, although several cadaveric and kinematic studies have analyzed the effect of UCL. We hypothesized that an original tracer program would be able to evaluate the joint space in symptomatic valgus instability pitchers during elbow valgus stress and to compare the joint contact area of dominant side with symptomatic pitcher and that of non-dominant side.

Methods: Computed tomography (CT) data from the dominant elbows of 10 symptomatic pitchers with valgus instability (mean age 25.9 ± 3.9) were obtained with and without elbow valgus stress. CT imaging data from the non-dominant asymptomatic elbow were also collected. The CT imaging data of each elbow joint were reconstructed using a 3D reconstruction software package. The elbow joint, including the humerus, radius, and ulna surface, was extracted, and the radiocapitellar and ulnohumeral joint contact areas were calculated from the 3D bone models using custom-written software. The center of the contact area was also calculated, and translation from the position without stress to the position with valgus stress was calculated using custom-written software. The dominant and non-dominant sides were compared statistically.

Results: The data showed that there were no apparent differences in the mean radiocapitellar and ulnohumeral joint contact areas between the dominant and non-dominant sides without valgus stress. With elbow valgus stress, the contact area changed, and the center of the radiocapitellar joint contact area translated significantly more laterally in the unstable elbow than in the non-dominant elbow ($P = 0.0361$). In addition, the center of the ulnohumeral joint contact area translated significantly more posteriorly in the unstable elbow than in the non-dominant elbow ($P = 0.0413$).

Conclusions: Our analysis indicates that the UCL insufficiency affected the contact area of the humerus and the Olecranon. The characteristic alteration of contact areas associated with the UCL insufficiency indicate that abnormal cumulative forces affected the particular part of elbow joint. These alteration of contact areas could explain the reason of cartilage injury at posterior trochlea in UCL insufficient pitchers.

FP.23.02

OSTEOLYSIS AND OUTCOME AFTER TOTAL ELBOW ARTHROPLASTY: IMPACT OF PUDA AND RADIO-CAPITELLAR RATIO

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Background: Loosening rates of 15% to 30% after Total Elbow Arthroplasty (TEA) at 5 years make osteolysis a concern. Using recently described radiological parameters, the posterior ulna dorsal angulation (PUDA) and the radio-capitellar ratio (RCR), this study aimed to evaluate the impact of PUDA and RCR on loosening and outcome after TEA.

Methods: This single center, retrospective study included all available TEA cases since 1996. Demographic and surgical data were collected from patient charts. Assessment included range of motion (ROM), strength and function (Q-DASH, PREE, MEPS) and bilateral x-rays to determine implant position and limb length discrepancy. PUDA and RCR were measured with lateral x-rays on the TEA side and the native side. PUDA was increased $> 7^\circ$, and RCR was abnormal $< 5\%$ or $> 13\%$. Loosening and osteolysis (Mayo classification) were assessed on the last follow-up radiographs.

Results: Thirty patients (34 TEA total) agreed to return for assessment; mean age was 66 years and 83% were female ($n = 25$). Nine patients had revision surgery after initial TEA for mechanical failure, polyethylene wear or loosening. Initial surgery was for trauma in 12 patients and degenerative pathologies for 15 patients. No infection was noted. Mean follow up since last TEA was 7.4 years. TEA was performed with the Conrad Morrey approach in 22 patients and the triceps on approach in 12. Radiological evaluation was done for 28 patients (30 TEA). Mean values for PUDA and RCR were 6.7 and -0.0125, respectively. PUDA was greater than 7 degrees in 33% ($n = 10$) and in 53% ($n = 16$) for RCR. MEPS score was significantly better in patients with lower PUDA versus patients with greater PUDA ($86.58 (\pm 12.59)$ versus $73.5 (\pm 16.67)$, $p = 0.038$, respectively). Loosening of the humeral and cubital components was higher, although not significant (Humeral component 40% versus 10%, $p = 0.141$; cubital component 20% versus 5%, $p = 0.251$). There was no difference in loosening and functional scores regarding the RCR.

Conclusions: PUDA had an impact on the functional score, MEPS was significantly better when PUDA was normal. It also seems to affect loosening of the humeral and cubital components. RCR had no impact on loosening and outcome after TEA.

FP.23.03

ELBOW JOINT LOADS DURING EIGHT SIMULATED ACTIVITIES OF DAILY LIVING: ARE CURRENT POST-OPERATIVE INSTRUCTIONS FOR PATIENTS FOLLOWING TOTAL ELBOW ARTHROPLASTY SUFFICIENT?

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Background: Survival rates following total elbow arthroplasty (TEA) are low compared to hip and knee arthroplasty. Elbow joint overloading is hypothesized to be one of the failure mechanisms. However, the current post-operative instruction of “not lifting more than 1kg” is not evidence-based and it is unclear whether it would lead to lower elbow loads. The aim of this study is to investigate the elbow joint loads, expressed as joint moments, in three directions (flexion-extension (FE), pronation-supination (PS), varus-valgus (VV)) during eight simulated activities of daily living (ADLs). Furthermore, we examine whether the current post-operative instruction affects elbow joint loads, expressed as joint moments.

Methods: Nine healthy participants (49.8±14.7years) performed eight simulated ADLs in an uninstructed and an instructed condition, in a laboratory setting. Elbow joint angles and moments (FE, PS, VV) were calculated using inverse dynamic analysis (OpenSim, Stanford University, CA). Wilcoxon signed-rank test was used to investigate the influence of the instruction on peak joint moments.

Results: The most demanding ADLs were rising from a chair (-14±6.7Nm FE, -3.7±1.7Nm PS), and opening a door (7.7±1.9Nm FE, 2.9±1.9Nm PS). The slide task shows the lowest elbow moments (4.1±0.8Nm FE, 0.6±1.3Nm PS). No significant effect of instruction was found on elbow joint FE-PS moment (all $p > 0.05$). VV moments (4.9Nm median) appear to be of comparable magnitude to FE moments (4.9Nm median) in all tasks (preliminary results from 2 of 9 participants).

Conclusions: Our results show that current instructions did not lead to lower elbow joint moments, and thus loads, in the selected ADLs. The future post-operative instructions should consider the biomechanical evidence on elbow loads and stress limits of the prosthesis. In particular VV moments should be taken into account as in vitro evidence showed that damage to prosthesis materials can occur with VV moments of comparable magnitude as those found in this study. These outcomes provide a first step in formulating a more evidence-based and specific post-operative instruction for patients following TEA. Future research should focus on joint contact forces in both healthy adults and patients following TEA.

FP.23.04

CLINICAL OUTCOMES OF REVISION ARTHROSCOPIC OSTEOCAPSULAR ARTHROPLASTY IN PRIMARY ELBOW OSTEOARTHRITIS: A RETROSPECTIVE COHORT STUDY

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Background: Arthroscopic osteocapsular arthroplasty achieves significant medium-term outcomes in patients with primary elbow osteoarthritis (OA); however, outcomes after revision arthroscopic osteocapsular arthroplasty (OCA) are not well-known. Herein, we assessed the clinical outcomes after revision arthroscopic OCA compared to after primary surgery in patients with OA.

Methods: Patients who underwent arthroscopic OCA due to primary elbow OA between January 2010 and July 2020 were enrolled. Range of motion (ROM), visual analogue scale (VAS) pain score, and Mayo elbow performance score (MEPS) were assessed. Operation time and complications were assessed by chart review. Clinical outcomes between PRIMARY (primary surgery) and REVISION (revision surgery) groups were compared, and subgroup analysis for radiologically severe OA was performed.

Results: Data from 61 patients (PRIMARY: 53 patients, REVISION: 8 patients) were analyzed. The mean age was 56.3 ± 8.5 and 54.3 ± 8.9 years in the PRIMARY and REVISION groups, respectively ($P = 0.684$). Mean interval from primary to revision surgery was 76.4 (range, 26-168) months. The PRIMARY group had significantly better preoperative ($P = 0.021$) and postoperative ROM arc ($P = 0.019$) than the REVISION group; however, the degree of improvement was comparable ($P = 0.445$). Both postoperative VAS pain score ($P = 0.164$) and MEPS ($P = 0.581$) were comparable between the groups, as were degree of improvement in VAS pain score ($P = 0.691$) and MEPS ($P = 0.604$). The REVISION group required significantly longer operative time than the PRIMARY group ($P = 0.004$) and had a non-significant higher complication rate ($P = 0.065$). Subgroup analysis showed significant difference in pre- and postoperative ROM arc between two groups and comparable pre- and postoperative VAS pain score ($P = 0.609$, $P = 0.155$, respectively) and MEPS ($P = 0.473$, $P = 0.658$, respectively).

Conclusions: Revision arthroscopic OCA is a favorable treatment option for primary elbow OA patients with recurrent symptoms. Compared to primary surgery, postoperative ROM arc was worse after revision surgery; however, the degree of improvement was comparable. Postoperative VAS pain score and MEPS were comparable to primary surgery.

FP.23.05

IMPLANT SURVIVAL OF TOTAL ELBOW ARTHROPLASTY; A STUDY FROM THE DUTCH NATIONAL REGISTRY

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Background: Total elbow arthroplasty (TEA) is a relatively rare procedure, and current evidence on the outcomes of TEA relies on few and small cohort studies. Therefore, we aimed to use data from the national registry to report the implant survival of TEA and to assess the patient and treatment characteristics associated with revision.

Methods: All TEAs performed between 2014 and 2020 registered in the Dutch National Arthroplasty Registry were included. Anonymous data on patient characteristics, surgical information, deceased patients, and revised implants were extracted from the registry database. Patient and treatment characteristics were compared between patients who underwent a revision and patients who did not undergo a revision using a logistic regression model.

Results: In total, 514 patients were included that underwent a total elbow arthroplasty between 2014 and 2020. The mean age at the time of surgery was 66 years (standard deviation: 12), and most patients were female (75%). The most common indication for a total elbow arthroplasty was rheumatoid arthritis (33%), followed by posttraumatic sequelae (28%), osteoarthritis (21%), and an acute fracture (10%). Forty-two per cent of patients had undergone previous surgery to the ipsilateral elbow. Of the 514 patients, 35 (7%) underwent a revision. The most common reason for revision was aseptic loosening (34%), followed by infection (23%), instability (23%), polyethylene wear (14%), a peri-prosthetic fracture (14%). The implant survival was 98% after one year, 93% after three years and 91% after five years. Male sex, mass index, and previous surgery were independently associated revision ($p < 0.036$). After the first revision, ten patients (29%) underwent a secondary revision within the inclusion period, with a median time between primary and secondary revision of 1.4 years (interquartile range: 0.3-2.6).

Conclusions: The implant survival after TEA was 91% after 5 years. Male sex, mass index, and previous surgery were independently associated with a revision. Notably, a large proportion (29%) of patients that underwent a revision had to undergo a secondary revision. These results can be used by orthopaedic care providers to optimise informed consent and decision-making by setting accurate and individual evidence-based expectations.

FP.23.06

INFLUENCE OF THE TYPE OF IMPLANT USED ON THE SURVIVAL RATE OF THE COONRAD-MORREY TOTAL ELBOW ARTHROPLASTY

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Background: One of the main complications of the Coonrad-Morrey TEA remains the aseptic loosening of the implants. The main objective of this study was to assess the influence of the type of humeral and ulnar implants used on the survival rate of the total Coonrad-Morrey TEA.

Methods: A retrospective monocentre study was carried out on a series of 186 Coonrad-Morrey TEA. The survival rate without aseptic infection was analyzed according to the characteristics of the humeral implant (length and size) and the ulnar implant (resurfacing, length and size) used in the whole cohort and in 3 subgroups according to the main indications: rheumatoid arthritis, trauma, or prosthetic revision.

Results: The survival rate without aseptic loosening was 90% at 10 years for the entire cohort. For the ulnar implant, the survival rate of implants with PMMA resurfacing was significantly lower than that of implants with resurfacing by projection of plasma; there was no difference in survival rate depending on the length and size of the implant used. For the humeral implant, the survival rate was significantly less satisfactory with the implant of 20 cm-length. There was no difference in survival rate between the 10 cm and 15 cm-length implants. In the Rheumatoid group, a significantly higher aseptic loosening rate was found with the extra-small implant.

Conclusions: This study has confirmed the negative influence of PMMA resurfacing of the ulnar Implant on the rate of survival rate without aseptic loosening of the Coonrad-Morrey TEA. No aseptic loosening has been reported with the latest generation of ulnar implants with resurfacing by plasma projection. Concerning the humeral implant, if the survival rate was significantly less satisfactory for 20cm-length implants, it was not found any difference between 10 cm and 15 cm-length implants. Humeral implants of 10 cm-length could therefore be privileged as first intention implant regardless of the indication, if there is no imperative to use a longer stem. The size of the humeral implant did not seem to influence the survival rate of the prosthesis.

FP.23.07

SHEAR FRACTURES OF THE DISTAL HUMERUS TREATED WITH CANNULATED HEADLESS SCREWS: OUR RESULTS AND COMPLICATIONS

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Background: Coronal shear fractures of the distal humerus represent an uncommon lesion and could be burdened by high complications. This complex lesion requires an accurate reduction and surgical fixation. Different techniques have been described, however no standard protocol have been proposed. We evaluate the clinical and radiological outcomes with posterior cannulated self-tapping headless screws followed by an early-active-motion protocol and related complications.

Methods: From 2013 to 2020, a consecutive series of 29 patients (13M, 16F) with coronal shear fracture undergoing ORIF were included in the study. Fractures were classified according to Dubberley's classification: 4 patients 1A, 6 patients 1B, 2 patients 2A, 4 patients 2B, 5 patients 3A and 8 patients 3B. Cannulated self-tapping headless screws were used to fix the fragments. When necessary, additional cannulated half-threaded screws on the lateral edge of the humerus were used. All patients underwent an assisted early-active-motion rehabilitation protocol. Mean follow-up was 30 months; patients underwent standard X-rays and clinical outcome assessment with range of motion, Broberg and Morrey score and MEPI score.

Results: Surgical fixation with headless screw guaranteed complete healing of all shear fractures examined, no loss of reduction were reported. ROM assessment showed good results with an average arc of 113.1°. Excellent to good Broberg-Morrey and MEPI score were reported. No cases of avascular necrosis nor post-traumatic osteoarthritis resulted in our series. Complications occurred in 10.3% of the patients: 1 heterotopic ossification, 1 complex regional pain syndrome and 1 LUCL secondary lesion

Conclusions: Coronal shear fracture represents a challenging injury to treat. Anatomical reduction and the use of cannulated self-tapping headless screws from posterior provide a stable fixation, high union rates and good elbow function. Patients should be informed regarding significative complication rate associated to these fractures.

FP.23.08

CHANGE IN HUMERAL ANCHOR POSITION SIGNIFICANTLY AFFECTS ISOMETRY IN UCL REPAIR: A 3-DIMENSIONAL COMPUTER MODELING STUDY

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Background: Medial ulnar collateral ligament (UCL) repair utilization is increasing in recent years, bolstered by shorter rehabilitation and satisfactory clinical outcomes. There remains a paucity of literature guiding anchor placement in UCL repair. Herein, we describe a 3-dimensional (3D) elbow model to measure and optimize anchor location during UCL repair.

Methods: A computer model of a human elbow joint was created using CT and MRI images from a single patient. The humeral and ulnar attachments of the UCL were plotted using three methodologies: 1) geometric cloud mapping; 2) quantitative measurements as described by the anatomical studies by Camp et al; and 3) Frangiamore et al. A 3.5mm clockface was placed on each attachment site which allowed for simulation of 12 distinct deviations in anchor position. The three models were ranged through 0-120 degrees at 10-degree increments, and the distances were measured between the ligament centroids. The humeral and ulnar anchors were sequentially repositioned around the clockfaces, and ligament lengths were again measured to evaluate changes in isometry.

Results: Using method 1, the UCL length at 90 degrees of elbow flexion was 26.8mm. This ligament underwent 13.6mm of total excursion for a 46.4% change in length throughout arc of motion. Method 2 produced a 19.3mm ligament that underwent 0.8mm of excursion for a 3.9% length change throughout the arc. Method 3 produced a 24.5mm ligament that underwent 2.3mm of excursion for a 9.4% length change throughout arc. Identifying ligament footprints using the quantitative anatomical measurements produced better ligament isometry through 120 degrees of flexion (ligament length changes of 3.9% and 9.4%, respectively) when compared to using the geometric cloud technique (46.4% length change). Humeral anchor deviations produced a statistically significant increase in ligament excursion when compared to ulnar anchor deviations ($p < 0.001$).

Conclusions: When performing UCL repair, small deviations in humeral anchor position may significantly influence graft and ligament isometry. Anchor position was most isometric while using the quantitative measurements. Particularly when addressing detachments of the humeral footprint, surgeons should be critical of the humeral anchor position in order to restore native anatomy and optimal biomechanics.

FP.24.01

BROWNING OF FIBROADIPOGENIC PROGENITORS WITH PARATHYROID HORMONE INHIBIT FATTY INFILTRATION AND MUSCLE ATROPHY AFTER ROTATOR CUFF TEAR IN A RODENT MODEL

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Background: Progressive fatty infiltration and muscle atrophy after rotator cuff tears lead to tendon repair failure. Fibroadipogenic progenitors (FAPs) are involved in fatty infiltration of skeletal muscle. Inducing FAPs to differentiate into brown adipocyte-like beige adipocytes suppresses ectopic fatty infiltration of skeletal muscle, and their secreted factors promote muscle regeneration. This study aimed to determine whether parathyroid hormone (PTH) suppresses fatty infiltration and muscle atrophy after rotator cuff tears by browning of FAPs.

Methods: PTH was administered for 4 or 8 weeks (30 ug/kg teriparatide, 3 days/week) to a massive rotator cuff tear model of SD rats with unilateral supraspinatus and infraspinatus tendons resected and suprascapular nerve transected. After treatment, fatty infiltration of rotator cuff muscles was assessed by Oil red O staining, and muscle atrophy was assessed by wet muscle weight and muscle fiber cross-sectional area. FAPs isolated from mice were cultured and evaluated for expression of browning-related genes and adipogenic differentiation. Myogenic differentiation of C2C12 was evaluated by co-culture of PTH-treated browning FAPs with C2C12 cells.

Results: PTH administration significantly suppressed fatty infiltration in rats after rotator cuff tear. The decrease in wet muscle weight of the rotator cuff muscle of PTH-treated rats was significantly suppressed. Furthermore, the PTH-treated rats had a larger myofiber cross-sectional area than untreated rats. PTH increased the expression of browning-related genes in FAPs and suppressed the accumulation of fat droplets in vitro. Co-culture with PTH-treated FAPs promoted the differentiation of C2C12 cells into myotubes.

Conclusions: PTH inhibited fatty infiltration and muscle atrophy after rotator cuff tear by browning FAPs. The results suggest that PTH has the potential as a therapeutic agent for the treatment of muscle degeneration after rotator cuff tears.

FP.24.02

DOES THE OSTEOARTHRITIC SHOULDER HAVE ALTERED ROTATOR CUFF VECTORS WITH INCREASING GLENOID DEFORMITY? AN IN SILICO ANALYSIS

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Background: A transverse force couple (TFC) functional imbalance has been demonstrated in osteoarthritic shoulders by recent 3D muscle volumetric studies. Altered rotator cuff vectors may be an additional factor contributing to a muscle imbalance and the propagation of glenoid deformity.

Methods: CTs of 33 Walch A and 60 Walch B shoulders were evaluated. The 3D volumes of subscapularis, supraspinatus, and infraspinatus-teres minor (ISP-Tm) and scapula were manually segmented. The volume masks and scapular landmarks were imported into MATLAB to create a coordinate system, enabling calculation of muscle force vectors. The direction of each muscle vector was described in transverse and vertical plane, with respect to the glenoid. Each muscle vector was then resolved into compression and shear force across the glenoid face. The relationship between muscle force vectors, glenoid retroversion or inclination, compression/shear forces on the glenoid, and Walch type was determined using linear regression.

Results: In transverse plane with all RC muscles combined, increasing retroversion was associated with increasing posterior drag ($p < 0.001$). Glenoid Walch type B had significantly more posterior drag than type A ($p < 0.001$). Analysis of individual muscle groups showed that anterior thrust of ISP-Tm and SSP switched to posterior drag at 8.4° and 10.3° of retroversion respectively. Compression force on the glenoid face by ISP-Tm and SSP did not change with increasing retroversion for type A's ($p = 0.592$ and $p = 0.715$, respectively), but they did for type B's ($p < 0.001$ for both). The glenoid shear force in transverse plane for ISP-Tm and SSP moves from anterior to posterior shear with increasing glenoid retroversion, crossing zero at 8.1° and 10.3° of retroversion, while SSC provides a posterior shear for every retroversion angle.

Conclusions: Increased glenoid retroversion is associated with increased posterior shear and decreased compression forces on glenoid face, explaining the pathognomonic bone morphometrics of the osteoarthritic shoulder. Although the subscapularis always maintains a posterior thrust, the ISP-Tm and supraspinatus together showed an inflection at 8° and 10° of retroversion, changing from an anterior thrust to a posterior drag. This finding highlights the importance that in anatomic TSA the rotator cuff functional balance might be better restored by correcting glenoid retroversion to less than 8°

FP.24.03

VALIDATION OF THE SHOULDERROM SOFTWARE FOR MEASUREMENT OF SHOULDER RANGES OF MOTION IN CONSULTATION: COUPLING AN RGB-D VIDEO CAMERA TO ARTIFICIAL INTELLIGENCE

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Background: Clinical evaluation of the shoulder range of motion (RoM) may vary significantly depending on the surgeon. We aim to validate an automatic ShoulderRoM measurement system associating image acquisition by an RGB-D (Red/Green/Blue-Depth) video camera to an artificial intelligence (AI) algorithm.

Methods: Thirty healthy volunteers were included. A 3D RGB-D sensor that simultaneously generated a color image and a depth map was used. Then, an open-access convolutional neural network algorithm that was programmed for shoulder recognition provided a 3D motion measure. Each volunteer adopted a randomized position successively. For each position, two observers made a visual (EyeREF) and goniometric measurement (GonioREF), blind to the automated software which was implemented by an orthopedic surgeon. We evaluated the intertester intraclass correlation (ICC) between observers and the concordance correlation coefficient (CCC) between the three methods.

Results: For manual evaluations EyeREF and GonioREF, ICC remained constantly excellent for the widest motions in the vertical plane (ie abduction and flexion). It was very good for ER1 and IR2 and fairly good for adduction, extension and ER2. Differences between the measurements' means of EyeREF and ShoulderRoM was significant for all motions ($p < 0.01$). Compared to GonioREF: ShoulderRoM provided non significantly different results for abduction, adduction and flexion and EyeREF provided non significantly different results for adduction, ER1 and ER2. The three methods showed an overall good to excellent CCC. Between the ShoulderRoM and other methods, the ER1 presented the lowest CCC at 0.82 with the highest bias ($7.5 \pm 12.6^\circ$ with the goniometer and 8.67 ± 12.1 with the EyeREF). In the Bland-Altman evaluation, the mean bias between the three methods remained under 10° and clinically acceptable.

Conclusions: RGB-D/AI combination is reliable in measuring shoulder RoM in consultation, compared to classic goniometry and visual observation. The highest discrepancy appears in external rotation but interobserver agreement with the goniometer is also the weakest for it. The use of an optimized automatic solution will help in standardizing the shoulder motion measurements in a daily practice.

FP.24.04

NEW QUANTIFIED MEASUREMENT OF FATTY INFILTRATION OF THE ROTATOR CUFF MUSCLES USING MRI IN A RABBIT MODEL OF CHRONIC TEAR

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Background: The purpose of this study was to identify the reliability of the quantified measurement of FI of the RC muscles by comparing the volumetric data of FI and histologic findings in a rabbit model of chronic tear. The hypothesis of the present study was that volume of RC muscles and degree of FI measured using quantified method would show significant correlation with the weight and fat proportion of RC muscles.

Methods: Eighteen shoulders of 9 rabbits were randomly allocated into 3 groups: repair (A), non-repair (B), and control groups (C) (n = 6 shoulder in each group). Supraspinatus tendon was detached and repair was performed 6 weeks later in group A. In group B, torn tendon was left, and only skin incision was made in group C. At 12 weeks after repair, radiologic, histologic and mechanical evaluation was performed. Semi-automated quantified measurement of intra-muscular fat proportion of RC muscle was obtained using MRI and Slicer® version 4.6.2 (Slicer community, Boston, MA) software. Oil red O staining was performed and histological degree of FI of RC muscles was measured using ImageJ software.

Results: The RC muscle to weight proportion in group B was decreased significantly compared to group C (p = 0.002), but was relatively preserved in group A (p = 0.288). The quantitative measurement of RC muscle volume showed a same result (9662 ± 1508 mm³ in group A, 8008 ± 996 mm³ in group B; 10088 ± 919 mm³ in group C, p = 0.028). Radiologic quantified fat proportion increased in both group A and B compared to group C, and there was no statistically significant difference between the 3 groups (5.56 ± 4.01 % in group A, 4.01 ± 5.62% in group B, 0.47 ± 0.37% in group C, p = 0.111). Histologically measured fat proportion of RC muscles revealed correlation with radiologic quantified measurement (3.97 ± 1.17% in group A, 3.24 ± 1.22 in group B, 2.32 ± 1.30 in group C).

Conclusions: The quantified measurement method of fat proportion of RC muscle using MRI and Slicer software was presented to be a reliable method in a chronic tear model of rabbit

FP.24.05

EFFECT OF BONE MARROW ASPIRATE CONCENTRATE WITH DIFFERENT CARRIERS FOR THE REGENERATION OF TENDON IN A CHRONIC ROTATOR CUFF TEAR MODEL OF RABBIT

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Background: Even though bone marrow aspirate concentrates (BMAC) was investigated to promote tendon-to-bone healing in animal and human study, it is still debatable whether stem/progenitor cells could maintain the biological stability without any carrier environment. This study was designed to evaluate the effect of bone marrow aspirate concentrate with different carriers for the regeneration of tendon in a chronic rotator cuff tear (RCT) model of rabbit.

Methods: In vitro, the cellular properties as well as the expression profiles of growth factors of BMAC were analyzed. The multi-lineage differentiation potential of BMAC with different carriers (atelocollagen and polydeoxyribonucleotide) was also assayed. In vivo, sixty-four rabbits were randomly allocated 4 groups (n = 16 each). To create the chronic RCT model, we induced complete supraspinatus tendon tears in both shoulders, and left them untreated for 6 weeks. All transected tendons were repaired in a transosseous manner with saline injection in group A, only BMAC injection in group B, BMAC + polydeoxyribonucleotide (PDRN) injection in group C, and BMAC + atelocollagen injection in group D. Genetic analysis was performed at 4 weeks after repair (8 rabbits per group), and the biomechanical analysis was performed at 12 weeks after repair (8 rabbits per group).

Results: In vitro, the successful multi-lineage differentiations of BMACs were achieved under the both PDRN and atelocollagen environment, forming multiphase tissues with tendon and cartilage-like regions, and there were no differentiation differences between two carrier environments. In vivo, groups with carriers (group C and D) showed higher collagen type IA1, bone morphogenetic protein 2, and aggrecan expressions than the control groups without any carrier ($P < 0.006$, 0.014 and 0.015 , respectively) at 4 weeks after repair. There was no difference between group C and D. For the biomechanical evaluation, group D showed a significantly higher load-to-failure rate than the other groups ($P < 0.001$) at 12 weeks after repair.

Conclusions: BMAC with two different carriers could effectively achieve the multi-lineage differentiations and gene expressions, compared to those without carrier, at the early phase. However, the combination of BMAC and atelocollagen finally had more superior tendon-to-bone healing effects in a RCT model of rabbit.

FP.24.06

GLUTAMATE EXPRESSION IN SUBACROMIAL BURSA IS ASSOCIATED WITH ROTATOR CUFF TEAR AND WITH SHOULDER PAIN

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Background: Glutamate regulates the expression of apoptosis-related genes and triggers the apoptosis of fibroblasts in rotator cuff tendons. Subacromial bursitis is always accompanied by symptomatic rotator cuff tear (RCT). However, no study has been reported on the presence of glutamate in subacromial bursa and on its involvement of shoulder pain in patients who had RCT. The purposes of this study were to determine whether the glutamate expression in subacromial bursa is associated with the presence of RCT and with the severity of shoulder pain accompanying RCT.

Methods: Subacromial bursal tissues were harvested from patients who underwent arthroscopic rotator cuff tendon repair or glenoid labral repair with intact rotator cuff tendon. Glutamate tissue concentrations were measured, using a glutamate assay kit. Expressions of glutamate and its receptors in subacromial bursae were histologically determined. The sizes of RCT were determined by arthroscopic findings, using the DeOrto and Cofield classification. The severity of shoulder pain was determined, using visual analog scale (VAS). Any associations between glutamate concentrations and the size of RCT were evaluated, using logistic regression analysis. The correlation between glutamate concentrations and the severity of pain was determined, using the Pearson correlation coefficient. Differences with a probability <0.05 were considered statistically significant.

Results: Glutamate concentrations showed significant differences between the torn tendon group and the intact tendon group ($P = 0.009$). Concentrations of glutamate significantly increased according to increases in tear size ($P < 0.001$). In histological studies, the expressions of glutamate and of its ionotropic and metabotropic receptors have been confirmed in subacromial bursa. Glutamate concentrations were significantly correlated with pain on VAS ($Rho=0.56$ and $P = 0.01$).

Conclusions: The expression of glutamate in subacromial bursa is significantly associated with the presence of RCT and significantly correlated with its accompanying shoulder pain.

FP.24.07

USE OF THE PECTORALIS MINOR AND CORACOACROMIAL LIGAMENT FOR A BIPLANAR CORACOCALVICULAR AND ACROMIOCALVICULAR RECONSTRUCTION: A CADAVERIC FEASIBILITY STUDY

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Background: There is no gold standard for the treatment of chronic acromioclavicular dislocation. Nowadays, there is growing relevance in using a biological and mechanical construct to allow good clinical results focused on vertical and horizontal stabilization. Although multiple techniques have been described, none of them have proven to be superior. We propose a novel technique that focuses on vertical and horizontal stabilization of the AC joint using two local grafts, the pectoralis minor (Pm) and the coracoacromial ligament (CAL).

Methods: Ten fresh-frozen shoulder cadaveric pieces were dissected. Length and Width of the Pm and CAL were measured in their anatomical position and anatomical variants were noted. The Pm tendon was harvested at the myothenidinous junction keeping the insertion at the coracoid process. The CAL was detached from the coracoid process keeping the acromial insertion. The free limb of both grafts were then prepared in a krackow fashion. The primary coracoclavicular reduction and fixation was with Tightrope® system or two subcoracoid fibertape® loops through and around clavicle. The Pm graft was fixed inside a clavicular tunnel by a cortical button and the CAL was transferred and fixed to the lateral clavicle using a knotless anchor or intramedullary when lateral clavicle resection was performed.

Results: The median length of the Pm was 50 mm (IQR: 50-54), and the median length of the CAL was 36.5 mm (IQR 34-40) which decreased by 15% and 23% once prepared with Krackow sutures to 44.5 mm (IQR: 30 - 65) and 30 mm (IQR: 22 - 32) respectively. The diameter of the prepared Pm graft was 5 mm (IQR: 4.5-6) and the CAL graft 5.5 mm (5-6). All grafts were able to reach the fixation points. The procedure was feasible in 100% of the cases.

Conclusions: A biplanar reconstruction using autologous Pm and CAL appears feasible and potentially effective in restoring the AC joint stability.

FP.24.08

DETACHMENT OF DELTOTRAPEZIAL COMPLEX IS A KEY DETERMINANT OF JOINT DISLOCATION IN ACROMIOCALVICULAR INJURY

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Background: Detachment of the deltatrapezial complex is described as highly probable in radiologic staging of Rockwood stages III to V. Previous cadaveric studies have analysed the contribution of the AC and CC ligaments to joint stability. Data on deltatrapezial complex contribution remains scarce. Aim of this pilot study was to assess the contribution of each of these structures during abduction.

Methods: Five fresh-frozen (9 shoulders) were obtained for this study. Abduction was applied by a robotic manipulator attached to the humerus. Clavicle and scapula were instrumented with reflective markers mounted on bone pins, and their 3D kinematics was recorded using a 11-camera optoelectronic system. Coupled with CT-scan images, these records allowed to compute joint kinematics. This procedure was applied to 4 conditions: 1) native (N), 2) AC ligaments and capsule (AC) disruption, 3) AC with deltatrapezial complex detachment (AC-DT), 4) AC-DT with an induced CC ligament lesion. Joint dislocation (i.e. articular junction point displacement at minimal abduction) and range of motion were computed for each degree of freedom.

Results: The Friedman's test revealed a significant difference for superior-inferior ($p < 0.001$), anterior-posterior ($p < 0.01$), and medial-lateral ($p < 0.001$) dislocations. Post-hoc analysis (Fisher's LSD) revealed non significant difference between N and AC, but significant differences between N and AC-DT ($p < 0.01$), and between N and AC-DT-CC ($p < 0.001$), whatever the dislocation direction. The Friedman's test revealed a significant difference for medial/lateral rotation ($p < 0.001$), as well as for inferior/superior ($p < 0.001$), anterior/posterior ($p < 0.001$), and medial/lateral ($p < 0.001$) displacements. Post-hoc analysis revealed non significant difference between N and AC (except for medial-lateral displacement, $p < 0.05$), but significant differences between N and AC-DT ($p < 0.05$, except for anterior-posterior displacement), and between N and AC-DT-CC ($p < 0.001$), both for rotations and displacements.

Conclusions: Our study shows the importance of the deltatrapezial complex in AC joint stabilisation. The detachment of this complex appears as critical, even without a CC ligament lesion, and may be a reason for the failure and recurrence of dislocation following surgical management. Furthermore, deltatrapezial complex detachment may be used for evaluation of surgical indication in stage III acromioclavicular injury.

FP.25.01

TREATMENT OF CALCIFIC TENDINOPATHY OF THE SHOULDER BY ULTRASOUND GUIDED LAVAGE WITH STEROID INJECTION. A SHAM CONTROLLED EFFICACY TRIAL

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Background: Ultrasound guided lavage with steroid injection aiming at removing calcific deposits is an established treatment for patients suffering from calcific tendinopathy. Case studies have shown good short- and mid-term results for the method. It is however unclear if this reflects a true treatment effect, the often spontaneous healing course of the condition, or a placebo effect. The present study represents the first sham controlled trial to assess the true effectiveness of the method.

Methods: This is a 3-arm, parallel-group, double-blind, sham-controlled, randomized trial performed at six hospitals in Norway and Sweden. 220 patients, with at least 3 months of symptoms from calcific tendinopathy, were randomized to one of three study treatments: (1) ultrasound-guided lavage+steroid injection (2) sham lavage+steroid injection or (3) sham lavage+sham steroid injection (the sham group). Double blinded follow-up was performed after 2 and 6 weeks and 4 months. Primary outcome was the 4-month result on the 48 point scale of the Oxford Shoulder Score (OSS).

Results: Data from 217 of 220 patients (98.6%) were included in the primary analysis. Analysis of the 4-month results on the OSS did not show any treatment benefit for the two active treatment groups over the sham group. The difference between the lavage+steroid and the sham group was 0.32 points (95% CI -2.15 to 2.78; $p=1.0$), and between the sham lavage+steroid and the sham group 2.14 points (95% CI -0.32 to 4.60; $p=0.27$). Only temporary but significant differences in favor of the 2 active treatment groups were found after 6 weeks with the result from the lavage+steroid group exceeding sham by 3.8 points ($p<0.01$) and the result from sham lavage+steroid exceeding sham by 4.7 points ($p<0.001$).

Conclusions: At 4-month follow-up, this study found no benefit for ultrasound-guided lavage with a steroid injection or for sham lavage with a steroid injection compared to sham treatment in patients with calcific tendinopathy of the shoulder. Differences found at 6 weeks should be interpreted as a temporary steroid effect. Our results contradict previous reports from studies without a sham group as comparator and should lead to a reconsideration of established treatment algorithms for these patients.

FP.25.02

A NOVEL ASSESSMENT TOOL FOR SUBSCAPULARIS LESIONS ON CORONAL MAGNETIC RESONANCE IMAGING: FIND THE "COMMA"

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Background: When repairing large to massive rotator cuff tears (RCTs), recognition of subscapularis tear and following anatomical fixation is critical to restore shoulder function. However, even with developed imaging modalities (Magnetic Resonance Imaging (MRI), ultrasonography), detecting subscapularis lesions pre-operatively is still challenging. The "comma" sign is a well-known pathoanatomic landmark representing medially retracted torn subscapularis tendon but can only be observed arthroscopically. Even though it is essential to anatomically repair this "comma" tissue for successful surgery, it is extremely difficult to predict the "comma" and design repair configuration until arthroscopically visualized. We hypothesized that the "comma" may also be utilized alternatively on pre-operative MRI to better characterize subscapularis lesions, which will help improve surgical planning in challenging large to massive RCTs.

Methods: Fifty-nine large to massive RCTs repaired arthroscopically were retrospectively assessed. The appearance of tendinous continuity between subscapularis and supraspinatus on oblique-coronal MRI slices was divided into 4 types based on its shape (I, L, J, and C) to predict the "comma", and associated with the size of subscapularis tear using Lafosse's classification by reviewing operating notes and arthroscopic pictures. Spearman's Rank Correlation was utilized to determine the correlation between 'tear size' and 'MRI appearance' of subscapularis. Receiver operating characteristic curve was analyzed to calculate the area under the curve (AUC).

Results: Forty-four RCTs involved subscapularis (19 upper one-third, 16 upper two-thirds, and 9 complete tears) whereas 15 tears did not. I-shape and L-shape were mostly observed in the RCTs with no or upper one-third subscapularis tear. J-shape was present only in upper one-third or two-thirds subscapularis tears whereas C-shape predominantly represented severe subscapularis tears. When J-shape and C-shape were deemed a sign indicating torn subscapularis, its sensitivity, specificity, positive predictive value, and negative predictive value revealed 79.5%, 100%, 100%, and 62.5%, respectively, with an AUC of 0.898.

Conclusions: Coronal MRI assessment of the "comma" may be a useful tool to pre-operatively characterize subscapularis lesions in large to massive RCTs, especially in cases with severe subscapularis tearing. This will help surgeons prepare for thorough releases of retracted subscapularis tendon to achieve anatomical repair, or alternative procedures in case it is irreparable.

FP.25.03

LONG-TERM CLINICAL AND STRUCTURAL OUTCOMES OF ARTHROSCOPIC SUPERIOR CAPSULE RECONSTRUCTION FOR IRREPARABLE ROTATOR CUFF TEARS: 10-YEAR FOLLOW-UP

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Background: Short-term follow-up studies have reported favorable clinical outcomes after arthroscopic superior capsule reconstruction (SCR) for irreparable rotator cuff tears. Our objective here was to assess whether these positive outcomes are maintained long-term and whether cuff tear arthropathy worsens over time after fascia lata autograft SCR.

Methods: This study analyzed data collected prospectively from 34 consecutive patients (36 affected shoulders) with irreparable rotator cuff tears who underwent arthroscopic SCR from 2007 through 2011. Active shoulder range of motion (ROM) and American Shoulder and Elbow Surgeons (ASES) score, Japanese Orthopaedic Association (JOA) score, rates of return to sports and physically demanding work, graft survival rate, postoperative cuff tear arthropathy were evaluated during 10-year follow-up after SCR.

Results: Compared with preoperative values, ASES and JOA scores and active ROM (elevation and external rotation) were increased significantly at 1 year after SCR ($P < 0.001$) and maintained throughout follow-up. At 10 years after SCR, 88% (15 of 17 patients) of workers with physically demanding jobs and 90% (9 of 10 patients) of sports players still participated in these activities. Graft survival rate was 94% (34 of 36 shoulders) at 1 year after SCR, 92% (33 of 36 shoulders) at 2 to 4 years, and 89% (32 of 36 shoulders) at 5 to 10 years. In healed grafts, graft thickness was maintained for at least 10 years after SCR (7.8 ± 2.0 mm at 3 months after SCR, 7.8 ± 1.6 mm at 10 years). The incidence of acetabularization (affected shoulder, 9%; unaffected shoulder, 6%) and glenohumeral osteoarthritis (affected shoulder, 28%; unaffected shoulder, 16%) during the 10 years after SCR did not differ between affected and unaffected shoulders. The complication rate was 2.8% (1 of 36 patients, anchor pull-out).

Conclusions: For irreparable rotator cuff tears, arthroscopic SCR restored shoulder function and relieved shoulder pain, with high rates of return to recreational sports and physically demanding work, and it maintained significant improvements in clinical and structural outcomes for at least 10 years after surgery. In addition, graft healing completely prevented any progression of cuff tear arthropathy. Arthroscopic SCR is an effective surgical option for irreparable rotator cuff tears and retains positive outcomes for at least 10 years.

FP.25.04

A COMPARATIVE STUDY OF PATCH GRAFT PROCEDURE AND SUPERIOR CAPSULAR RECONSTRUCTION IN THE TREATMENT OF IRREPARABLE LARGE TO MASSIVE ROTATOR CUFF TEARS

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Background: This study compared clinical and radiographic outcomes after fascia lata autograft patch procedure (PG) and superior capsular reconstruction (SCR) in treatment of large to massive rotator cuff tears (RCTs).

Methods: This study included 47 shoulders in 47 patients who underwent the patch graft procedure (Group PG) and 45 shoulders 45 patients who underwent SCR (Group SCR) for irreparable large or massive RCTs. Clinical assessments were assessed using Constant score ASES Scores. We evaluated the graft integrity or retears of the native cuff tendons, the presence of Sugaya type 5 re-tear (large sized re-tear) using MRI.

Results: The clinical findings were significantly improved at the final follow-up in both groups ($P < .001$). There were no significant differences between groups A and B in terms of postoperative two clinical scores ($P = .176$ and $.280$, respectively). There was significant difference in term of re-tear rate (74.5% for Group PG, and 40.0% for Group SCR, $P = .001$), but no significant difference in term of the type 5 re-tear rate (74.5% for Group PG, and 40.0% for Group SCR, $P = .501$). There were no significant differences between shoulders with or without retears, but significant differences between shoulders with or without the type 5 retears in terms of postoperative two clinical scores. Stepwise multivariate logistic regression analysis identified the presence of preoperative infraspinatus (ISP) Stage 3 or 4 as the significant predictive factors for shoulders with Sugaya 5 retears (odds ratio, 9.202; 95% CI, 1.566-54.093; $P = .014$). Receiver operating characteristic curve analysis revealed a cutoff value to predict the occurrence of the type 5 retears as Goutallier stage 3 or 4 in the ISP, with area under the curve values of 0.818 ($P < .001$) and 0.745 ($P = .013$) in the PG and SCR groups, respectively.

Conclusions: The present study showed that operative treatment of shoulders with preoperative Goutallier stage 3 or 4 in the ISP may be risky for occurrence of large re-tear after performing SCR or patch procedure in the treatment of large to massive rotator cuff tears, though clinical outcomes were significantly improved in the both groups at the final follow-up.

FP.25.05

ROTATOR CUFF REPAIR WITH BIOINDUCTIVE ALLOGRAFT PATCH ACHIEVES EQUIVALENT PATIENT-REPORTED OUTCOMES AT 2 YEARS POSTOPERATIVELY

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Background: To compare patient reported outcomes, range of motion (ROM), and complications of patients undergoing arthroscopic rotator cuff repair (RCR) augmented with a bioinductive patch compared to standard repair.

Methods: A retrospective review was conducted of patients undergoing primary RCR with and without bioinductive bovine collagen patch augmentation for MRI or Ultrasound confirmed supraspinatus/infraspinatus tears from 2016 to 2021. Exclusion criteria included the following: open RCR, ipsilateral shoulder surgery, active infection, or less than 6-week postoperative follow-up. Patch RCR was matched 2:1 to controls based on age, sex, BMI, tear size, and the number of tendons involved. Patient Reported Outcome Information System (PROMIS) for upper extremity function (-UE), pain interference (-PI), and depression (-D) scores were recorded up to 2 years.

Results: Overall, 81 patients underwent RCR with patch augmentation and were matched to 162 controls. No significant differences were found between groups in terms of age ($p=0.62$), sex, smoking, diabetes, partial vs. full-thickness tears, and tear size. ROM in forward-flexion (FF) and abduction were significantly increased at 6-month follow-up for the augmented group compared to controls (FF 156.8 ± 21.6 vs. 148.1 ± 23.2 degrees, $p<0.01$; abduction 133.1 ± 33.2 vs. 114.1 ± 36.5 degrees, $p=0.019$) but not at 1-year follow-up. No differences were seen for PROMIS-UE, PROMIS-PI, or PROMIS-D scores. The augmented group had ten complications (12.3%) and the control had 20 (12.3%). The augmented group had four retears (4.9%) of which three required revision compared to 11 retears for the control (6.8%) of which eight required revision. The augmented group had six cases (7.4%) of adhesive capsulitis, five of which took place in mid-late 2020, compared to the four cases (2.5%) of adhesive capsulitis (three before mid 2019 and one in early 2021) seen in the control and all patients underwent manipulation under anesthesia.

Conclusions: Bioinductive patch augmentation for RCR demonstrated increased ROM at six months and equivalent physical function, pain in daily life, and depression levels at 2 years when compared to standard RCR. There was a lower re-tear rate in the augmented group compared to the controls. The increased incidence of postoperative adhesive capsulitis in the augmented group is a concern and needs to be further evaluated.

FP.25.06

POSTOPERATIVE PAIN AND RANGE OF MOTION ARE INDEPENDANT RISK FACTORS FOR FAILURE AFTER ARTHROSCOPIC SUPRASPINATUS REPAIR

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Background: Our study aimed to identify predictive factors for failure at 6 months after supraspinatus (SSN) repair based on patient-related postoperative variables such as range of motion (ROM) recovery and pain. We hypothesized that better ROM and less pain in the early postoperative period would be detrimental for tendon healing.

Methods: This was a retrospective study of prospectively collected data. All primary arthroscopic SSN repairs for full-thickness tears, with retraction Patte grade <2, fatty infiltration Goutallier grade <3, no glenohumeral osteoarthritis were eligible. Patients who did not complete all follow-ups were excluded. One orthopaedic surgeon performed all procedures using a double-row technique. All patients followed the same rehabilitation protocol with an abduction pillow for 4 weeks and immediate passive ROM. Active motion was only initiated after sling removal. One observer assessed all patients pre- and at 1.5, 3 and 6 months postoperatively. Collected data included ROM and PROMs. One radiologist experienced in ultrasound assessed 6-month repair integrity. 2 groups were established based on repair integrity, and univariate, multivariate, and ROC curve analysis were performed.

Results: 1207 shoulders were included. The overall failure rate was 13%. Failed repairs had a significantly higher overall VAS pain as well as motion and night subscores at 6 months. Constant score was similar between groups. Failed repairs had higher 6-week anterior elevation (EA) (143vs128, $p<0.001$) and external rotation (ER) (32vs23, $p<0.001$). This gap had faded by 6 months. 6-week day (OR:0.91) and night (OR:1.11) VAS pain subscores, 6-week passive EA (OR:1.36) and ER (OR:1.16) were independent risk factors for failure. The failure rate of 20.4% and 18.4% if 6-weeks passive EA >140° (AUC:0.67) and ER >30° (AUC:0.64), respectively. Model precision to predict failure based on the aforementioned criteria was 75%.

Conclusions: This study illustrates the importance of the early postoperative period in tendon healing. The pattern of ROM recovery and pain differed depending on the fate of the SSN repair. Failed repairs had a lower transitory postoperative ROM limitation. Pain and 6-weeks ROM were independent risk factors for 6-month repair failure. Passive 6-weeks AE >140° and ER >30° at were associated with a considerably higher failure rate.

FP.25.07

PREDICTING GOOD CLINICAL OUTCOMES AFTER REPAIR OF RECURRENT ROTATOR CUFF TEARS: ITERATIVE CUFF REPAIR PREDICTIVE SCORE

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Background: We aimed to develop and validate a scoring system based on preoperative characteristics to predict good clinical outcome at 2 years postoperatively, after recurrent rotator cuff repair.

Methods: Retrospective multicenter study including 195 patients with a recurrent rotator cuff tear operated on for a new repair with a clinical evaluation - Constant Score (CS), Simple Shoulder Value (SSV) and patient Satisfaction (S) (yes/no) - at 2 years post-operatively. A simple scoring system was developed, based on the variables associated with clinical outcomes (CS, SSV, S), in multivariate analysis. Weighing of these variables in the scoring system was defined according to the frequency of the association of these variables with 1, 2 or 3 of the clinical outcomes (CS, SSV, S). ROC curves (Area Under the Curve - AUC) were used to assess the ability to predict CS>70% and SSV>70%, according to Predictive Score. Optimal cut-off value of the score to predict CS>70%, SSV>70% and S were identified by comparing Predictive Positive Values (PPV).

Results: In multivariate analysis, an isolated supraspinatus (SSP) tear was associated with higher CS ($p=0.019$), SSV ($p=0.00018$) and S ($p=0.004$). Work-related condition was associated with lower CS ($p=0.0194$) and SSV ($p=0.0049$). Female sex was associated with lower CS ($p=0.0018$) and manual profession with lower SSV ($p=0.046$). Smoking and a delay from primary repair to iterative repair >6 months were associated with lower S ($p=0.0485$ and $p=0.0195$). Weighing of these variables in the scoring system: 3 points in case of an isolated SSP tear, 2 points in case of non work-related condition. 1 point in case of non manual profession, non smoking, male sex, delay<6 months. Finally, we obtained a scoring system ranging from 0 to 9 points. Our Predictive Score showed a good discriminative ability to predict CS>70% (AUC=0.72) and SSV>70% (AUC=0.73).

When Predictive Score was >5/9 points, PPV was 80% to predict CS>70%, 91% to predict SSV>70% and 91% to predict S, at 2 years post-operatively.

Conclusions: This simple scoring system for patients with recurrent rotator cuff tear, based on 6 preoperative characteristics, accurately predicts good clinical outcome at 2 years, after a new rotator cuff repair.

FP.26.01

THE GLENOID GLOBE TRACK CONCEPT

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Background: The glenoid track (GT) concept is utilized to determine preoperatively whether a Hill-Sachs defect is engaging or not. Currently the GT concept relies on measurements of bony structures but also on confines and elasticity of the rotator cuff as a reference point which varies extensively among individuals and therefore limits its reliability and accuracy. Goal of the current study was to evaluate the reliability of the 3D Glenoid Globe Track (GGT) concept which determines the angular distance of the Hill-Sachs defect from the center of the articular surface of the humeral head as a new reference point with the help of an automated image analysis software.

Methods: CTscans of 100 patients treated for anterior shoulder instability with different sizes of Hill-Sachs defects were evaluated manually by two orthopedic surgeons independently using the software OsiriX (Geneva, Switzerland) as well as automatically using a dedicated prototype software (ImFusion, Munich, Germany). Obtained manual and automated measurements included the length (HSL), width (HSW) and depth (HSD) of the Hill-Sachs defect, the Hill-Sachs interval (HSI), and the glenoid width (GW) for the GT concept as well as the angular distance of the Hill-Sachs defect from the center of the articular surface of the humeral head (GGT concept). The reliability of the different measurement techniques was compared by calculating intraclass correlation coefficients (ICCs).

Results: There was a significant difference for all obtained parameters comparing manual and automatic measurements. For manually obtained parameters, measurements referring to bony boundaries (glenoid width/HS length/HS width) showed good to excellent agreement (ICC=0.86/0.82/0.62) while measurements referring to soft tissue boundaries (HSI/glenoid track; ICC=0.56/0.53) or not directly identifiable reference points (center of articular surface/glenoid globe track) only showed fair reliability (ICC middle excision=0.42).

When measuring the same parameters with the help of an automated software, good reliability for the glenoid track concept and excellent reliability for the glenoid globe track concept was achieved.

Conclusions: The present study showed that the more complex 3D Glenoid Globe Track measurements are more reliable than the current gold standard 2D Hill-Sachs interval/glenoid track measurements. However, this is only true when automated software is used to perform the measurements.

FP.26.02

CADAVERIC BIOMECHANICAL STUDY OF 3D PRINTED PARTIAL GLENOID ARTHROPLASTY VERSUS THE LATARJET PROCEDURE FOR ANTERIOR GLENOID BONE LOSS

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Background: Though the Latarjet procedure is widely performed to address severe anterior glenoid bone loss from chronic shoulder instability, it heavily alters the anatomy, and fixation issues are common. A 3D-printed individualized titanium partial glenoid arthroplasty (PGA) implant was developed as a possible alternative.

Methods: Fourteen matched cadaveric shoulders were allocated to the PGA or the Latarjet group and were tested on a custom testing system. The PGA was 3D-printed based on preoperative CT scans and was fixed with two 3.5mm locking screws. The intact, 25% anterior glenoid bone loss, and the postoperative state were tested sequentially in the scapular and coronal planes. The articular surface area, offset, rotational range of motion (RROM), and relative position of the humeral head apex to the glenoid during RROM were measured, and the respective difference of the intact to the postoperative state was compared between the two groups. The offset between the glenoid and the PGA/coracoid was measured with a digitizer. Linear stiffness and the load to 2mm displacement of the postoperative construct were obtained using a materials testing machine.

Results: Baseline glenoid dimensions were comparable. However, the reconstructed articular surface area in the PGA group was significantly greater (PGA vs. Latarjet, 880.9 ± 123.6 vs. 765.3 ± 129.7 mm², $P=0.006$). The PGA group better approximated the intact state's external (postoperative change, -4.0 ± 4.0 vs. 8.2 ± 8.7 degrees, $P=0.006$) and total (-2.5 ± 6.5 vs. 16.0 ± 16.2 degrees, $P=0.019$) RROM in the scapular plane. The postoperative humeral apex positions during humeral rotation in the PGA group better followed that of the intact state in both scapular (postoperative change, 0.6 ± 2.7 vs. 3.0 ± 5.5 mm, $P<0.001$) and coronal planes (1.1 ± 3.4 vs. 5.7 ± 7.7 mm, $P<0.001$). The PGA group also showed significantly less articular step-off (1.3 ± 0.4 vs. 2.2 ± 0.8 mm, $P=0.030$), greater linear stiffness (387.5 ± 126.2 vs. 197.6 ± 75.3 Newtons/mm, $P=0.031$) and load for 2mm PGA/coracoid displacement (406.5 ± 145.2 vs. 162.2 ± 75.5 Newtons, $P=0.002$).

Conclusions: In addressing 25% anterior glenoid bone loss, 3D-printed PGA better approximated the intact glenohumeral joint kinematics than the Latarjet procedure with greater articular surface reconstruction and less step-off. The postoperative PGA construct was also significantly more robust. Further clinical studies are warranted to validate this novel procedure.

FP.26.03

DISTAL RADIUS ALLOGRAFT FOR GLENOHUMERAL INSTABILITY: A NOVEL OSTEOCHONDRAL ALLOGRAFT RECONSTRUCTION OPTION IN THE SETTING OF GLENOID BONE LOSS

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Background: Distal tibia allograft (DTA) reconstruction for glenoid bone loss is nonanatomic as it does not match the glenoid radius of curvature (ROC) in the anterior to posterior (AP) plane. The dorsal articular portion of the distal radius has not been previously described as an allograft reconstruction option for glenoid bone loss. This study evaluates distal radius fresh frozen allograft (DRA) as a potential match for glenoid reconstruction.

Methods: Eighteen fresh-frozen human cadaveric specimens (6 shoulder, 6 wrist, and 6 tibia) were utilized. The ROC and graft length was measured in the superior to inferior (SI) and AP planes. A thirty percent defect was created in all glenoid specimens and both DTA and DRA were harvested to assess graft fit post-fixation. CTs were analyzed to assess bony ROC and bone mineral density (BMD).

Results: Mean SI glenoid length was 39.7 mm compared to 36.8 mm for DRA and 30.0 mm for DTA. ROC in the SI plane was 29.0 +/- 5.3 for the glenoid, 37.8 +/- 4.9 for DRA and 24.0 +/- 3.7 for DTA; in the AP plane ROC was 39.6 +/- 6.6 for glenoid, 30.4 +/- 18.6 for DRA and 126.3 +/- 9.5 for DTA. On CT analysis, ROC in the SI plane was 30.4 +/- 1.5 for glenoid, 30.3 +/- 5.6 for DRA and 24.5 +/- 9.4 for DTA; in the AP plane ROC was 30.8 +/- 2.0 for glenoid, 19.1 +/- 2.3 for DRA and 46.7 +/- 21.7 for DTA. BMD was 226.3 +/- 79.0 for glenoid, 228.5 +/- 94.7 for DRA, 235.0 +/- 96.2 for coracoid, and 235.1 +/- 84.6 for DTA.

Conclusions: Compared with DTA, DRA had greater graft length in the SI plane providing utilization in cases of larger bony defects; DRA has a more acute ROC in the AP plane (closer to that of the glenoid) providing a greater potential buttress to anterior humeral translation. Compared to currently utilized grafts, DRA BMD was not significantly diminished. This study presents DRA as a novel allograft reconstruction option in the setting of anterior glenoid bone loss; further biomechanical and clinical investigation is indicated.

FP.26.04

MULTIDIRECTIONAL INSTABILITY OF THE SHOULDER. A SYSTEMATIC REVIEW WITH A NOVEL CLASSIFICATION.

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Background: There is high heterogeneity currently regarding the definition and classification of multi-directional instability (MDI), with no universally accepted classification system. A systematic review was performed to determine the variability of the definition of MDI in the existing literature and to propose a standardized classification system.

Methods: A systematic search was performed on PubMed Medline and Embase. A thorough combination of the following 'MeSH' and 'non-MeSH' search terms and respective variations were used: (1) Glenohumeral joint[tiab] OR Glenohumeral[tiab] OR Shoulder[tiab] OR Shoulder joint[tiab] OR Shoulder[MeSH] OR Shoulder joint[MeSH], (2) Multidirectional[tiab], (3) Instability[tiab] OR Joint instability[MeSH]. The inclusion criteria was: (1) Studies involving human subjects with MDI; (2) either diagnostic criteria for MDI stated in methodology or characteristics of MDI patients sufficiently described; (3) at least three patients included in study; (4) level of evidence of study ranging 1 to 4.

Results: The search strategy yielded 866 studies. Sixty-eight studies were included after full-text review. MDI was defined as symptomatic instability of the glenohumeral joint, with 67/68 (98.5%) in agreement. 45/68 (66.2%) deemed symptomatic patients as those complaining of pain and/or pathological instability (apprehension, subluxation and/or dislocation). 28/68 (41.2%) required two or more directions of instability, of which one had to be inferior. Only 6 studies (8.8%) included the presence of global ligamentous laxity as part of the definition of MDI. 25 (36.8%) studies excluded labral and bony injuries. In order to reduce heterogeneity, our proposed classification divides MDI patients into 2 groups, A and B, based on the presence of a traumatic etiology. These 2 groups are further subdivided into normolax and hyperlax patients. There are thus 4 distinct MDI groups, namely: A1 (atraumatic MDI), A2 (hypermobile painful shoulder), B1 (traumatic MDI) and B2 (Hyperlax MDI). These divisions will better define MDI and identify appropriate treatment.

Conclusions: MDI is defined as symptomatic instability of the shoulder joint in two or more directions. A classification system that considers predisposing trauma and the presence of concomitant pathological laxity can provide a more precise assessment of the various subtypes of MDI.

FP.26.05

FREE BONE GRAFT TRANSFER VERSUS LATARJET PROCEDURE FOR TREATMENT OF ANTERIOR SHOULDER INSTABILITY WITH GLENOID BONE LOSS: 5 YEARS OUTCOME OF A PROSPECTIVE RANDOMIZED TRIAL

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Background: Free bone graft transfers (FBGT) and the Latarjet procedure are competing techniques to treat patients with anterior shoulder instability and critical glenoid bone loss. No mid- or long-term outcomes of prospective randomized comparative trials of the two procedures are currently available.

Methods: This prospective bi-centric randomized study included 60 patients with anterior shoulder instability and glenoid bone loss of at least 15% surface area. Patients were randomly assigned in a 1:1 ratio to either open Latarjet procedure or open FBGT (J-bone graft). Clinical and radiological evaluation was performed before, 6, 12, 24 and 60 months after surgery and included the Western Ontario Shoulder Index (WOSI), Rowe Score, Subjective Shoulder Value, satisfaction, pain level, work and sports impairment as well as range of motion and strength. Adverse events were prospectively recorded. Longitudinal radiographic assessment of instability arthropathy was obtained preoperatively, as well as at 6, 12, 24 and 60 months follow-up. The 5 years follow-up rate was of 63.3% for FBGT patients and 66.6% for Latarjet patients.

Results: The main outcome measurement (WOSI) showed no statistically significant difference at the 5 year follow-up time point (FBGT 221 ± 186 Latarjet: 201 ± 239 ; $p=0.529$) or any other time point as did the other clinical outcome scores ($p>0.05$). Both groups were also comparable in terms of postoperative range of motion and strength except for a significantly better internal rotation in the FBGT group ($p=0.004$). A single traumatic recurrent instability event was recorded in 3 patients of the FBGT group (2 subluxations 1 dislocation) and 1 patient of the Latarjet group (1 subluxation) ($p=0.342$). None of the groups sustained additional complications between short and mid-term follow-up. Sensory nerve disturbances at the iliac crest in the FBGT group decreased to 5% over time. The grade of instability arthropathy showed a comparable increase in both groups over time ($p>0.05$).

Conclusions: No differences in clinical outcome were observed for FBGT and the Latarjet procedure at mid-term follow-up except for persistent significantly better internal rotation after FBGT. Both, procedures showed a comparable stabilization success rate but were not able to stop the progression of instability arthropathy over time.

FP.26.06

ARTHROSCOPIC CAPSULAR SHIFT SURGERY IN ATRAUMATIC SHOULDER INSTABILITY - A RANDOMISED DOUBLE BLINDED CONTROLLED TRIAL

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Background: Atraumatic shoulder instability presents with dislocation, subluxation, pain and impaired shoulder function in the absence of significant trauma to the shoulder. Patients are managed with physiotherapy, if symptoms persist arthroscopic capsular shift is recommended. There have been no randomised trials of any surgical interventions for atraumatic shoulder instability.

Methods: Patients aged 18 years and over, who reported feelings of insecurity at their shoulder and had evidence of capsulolabral damage on arthroscopic examination were included. Patients were excluded if their shoulder apprehension symptoms were precipitated by a high collision shoulder injury, they had bony or neural damage, a rotator cuff or labral tear or had previous shoulder surgery on the symptomatic shoulder. 68 participants were recruited (mean age 25.6 years \pm 6.4 SD; 77.0% female; mean symptom duration 7.1 years \pm 7.3 SD). Complete primary outcome data were available for 61 participants at 6 months, 59 at 12 months and 56 at 24 months. All participants underwent a diagnostic arthroscopy followed by arthroscopic capsular shift or diagnostic arthroscopy alone. All participants received the same post-operative clinical care from the surgical and physiotherapy teams. Main outcome measures: Primary outcome was pain and functional impairment measured by the Western Ontario Shoulder Instability Index (minimum clinically important effect = a reduction in pain and disability of 10.4 points).

Results: Mean reductions in pain and disability for both trial groups were similar. Compared to diagnostic arthroscopy, arthroscopic capsular shift increased pain and functional impairment by means of 5 points (95% CI: -6 to 16 points) at 6 months, 1 point (95% CI: -11 to 13 points) at 12 months, and 2 points (95% CI: -12 to 17 points) at 24 months.

Conclusions: Arthroscopic capsular shift does not confer clinically relevant short or medium term reductions in signs and symptoms of atraumatic shoulder instability compared with diagnostic arthroscopy.

FP.26.07

ANTERIOR INSTABILITY IN HIGH PERFORMANCE ATHLETE

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Background: There is controversies in treatment of dislocation in high performance athletes especially in recurrent dislocation, initial dislocation and dislocation among athletic children. In this presentation we will discuss the Natural History of dislocation, Initial dislocation, advances in non-operative Treatment, open or arthroscopic, risk Factors for Failure, our arthroscopic results and Personal Preferences.

Methods: 876 cases of recurrent shoulder dislocation were treated Between 2013 and 2019 in the GOC clinic Bonn, Germany and Alsalaam International Hospital Cairo using the new anatomical reconstruction strategy. All 876 had an arthroscopic Inferior Capsular Shift, 220 had also Overlap Bankart repair with and without Glenoid fracture, 44 had also Shift Stick Bankart Repair and were 54 Revision cases. All patients had more than 3 episodes of anterior recurrent dislocation, near equal age average, and same type of tissue lesion without bony lesion.

Results: All patients were evaluated for function, range of motion, sports and occupational activity. The average follow up was 6 years. 95% had good/excellent result according to Neer Classification., 98% return to normal function with minimal pain, all patients (10% with minimal pain) return to overhead/throwing activities.

Conclusions: Correct assessment of the pathology, targeting reconstruction of the anatomy with a personalized rehabilitation makes an obvious difference in the results leading to an expectation of complete normal shoulder motion and function in high performance athletes

FP.26.08

EXTRA-ARTICULAR SOFT ARTHROSCOPIC LATARJET TECHNIQUE FOR SOFT-TISSUE REVISION MANAGEMENT OF GLENO-HUMERAL INSTABILITY SHORT-TERM OUTCOMES OF A PROSPECTIVE CASE-SERIES STUDY

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Background: For revision management of recurrent anterior gleno-humeral instability in patients with insignificant glenoid bone loss, the currently-evolving techniques using the long head of biceps tendon as a dynamic sling for gleno-humeral re-stabilization (e.g., Extra-articular Soft Arthroscopic Latarjet Technique/ex-SALT) might tilt the scales towards re-do arthroscopic soft-tissue repair rather than bony reconstructive procedures; e.g., Latarjet coracoid transfer. The current study investigated short-term functional outcomes and postoperative recurrence of instability following concurrent re-do arthroscopic Bankart repair and Extra-articular Soft Arthroscopic Latarjet Technique (ex-SALT).

Methods: This prospective case-series study included 9 patients diagnosed with postoperative recurrence of gleno-humeral instability following stand-alone arthroscopic Bankart repair. Patients with significant (>20%) glenoid bone loss were excluded from the study. Included patients were managed with re-do arthroscopic Bankart repair in concurrence with Extra-articular Soft Arthroscopic Latarjet Technique (ex-SALT). Remplissage capsulo-tenodesis was superadded in patients with engaging Hill-Sachs lesion. Outcome measurements included 1-year postoperative pain, range of motion and University of California Los Anglos (UCLA) and Rowe Instability scoring systems. Failure was defined as frank or subtle post-revision recurrence of instability episodes.

Results: Age of included 8 male and 1 female patients ranged from 18 to 34 years. Statistical analysis revealed significant postoperative improvement in outcome measurements of pain, range of active forward flexion and external rotation, and UCLA and Row instability scores ($P < 0.05$). By the indexed follow up, no failure could be reported.

Conclusions: For revision management of recurrent anterior gleno-humeral instability in patients with insignificant glenoid bone loss; re-do arthroscopic Bankart repair in concurrence with ex-SALT (and when indicated, Remplissage capsulo-tenodesis) can yield short-term satisfactory outcomes as regards pain, range of motion, function instability recurrence. However, these favorable outcomes should be validated via further biomechanical and longer-term clinical cohort studies.

FP.27.01

INTERPOSITION ARTHROPLASTY WITH DERMAL GRAFT ASSOCIATED WITH AN ARTICULATED EXTERNAL FIXATOR FOR THE TREATMENT OF ELBOW STIFFNESS IN YOUNG ADULTS

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Background: There are few studies with clinical evaluation in the medium and long follow-up after elbow interposition arthroplasty. Our objective is to evaluate the results of interposition arthroplasty with a dermal graft associated with a hinged external fixator in young adults with elbow stiffness up to 60-month follow-up.

Methods: Retrospective case series, with prospectively collected data, with a 5-year follow-up. Data regarding the MEPS, VAS and quickDASH scales and the range of motion (ROM) were collected preoperatively and at 3, 6, 12, 24 and 60 months. Imaging evaluation, performed by plain radiography, computed tomography (CT) and magnetic resonance imaging (MRI), was performed preoperatively and at 60 months of follow-up. Complications were recorded during follow-up.

Results: Forty patients were included in the study. The clinical scales improved statistically significantly ($p < 0.001$), with the median of the MEPS scale evolving from 40.0 to 67.5 at 5 years, the VAS scale from 9.5 to 3.0 and the quickDASH scale from 43.0 to 22.0. The median ROM of elbow flexion-extension evolved from 60° to 110° in the same period ($p < 0.001$). Arthrosis severity improved statistically significantly in the evaluation by plain radiography ($p = 0.006$) and by computed tomography ($p = 0.011$). Complications occurred in 18 cases (45%), but only 2 (5%) required surgical reoperation.

Conclusions: Interpositional arthroplasty with a dermal graft associated with a hinged external fixator in young adults with elbow stiffness leads to a statistically significant improvement in the MEPS, VAS, and quickDASH scales, in the flexion-extension range, and in the radiographic appearance of the arthrosis. The complication rate is high, but few patients require surgical reapproach.

FP.27.02

IS THE ANCONEUS EPITROCHLEARIS MUSCLE A PREDICTOR FOR ULNAR NERVE COMPRESSION?

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Background: Cubital tunnel syndrome (CuTS) is the second most common compression neuropathy that occurs in the upper extremity. The role of the anconeus epitrochlearis (AE) in this pathology, as a protector or potential compressor of the ulnar nerve and its prevalence in symptomatic and asymptomatic patients are still debated. Based on a large cohort of elbow MRI and our own experience in ulnar nerve surgery, we identified the prevalence of the AE, looked for associations with CuTS and determined predictive values for the presence of AE on CuTs.

Methods: First we retrospectively performed a chart review of all patients who were identified to have an AE out of a database of 1249 elbow MRI and looked for major criteria for CuTS. After the same procedure on a matching cohort without AE on MRI we deduced the predictive value of the presence of AE on CuTS. For the second part of this study, we reviewed 350 ulnar nerve surgeries performed in our institution. Pre- and postoperative physical exam findings, electromyographic study results, reason for compression or (sub)luxation, presence of AE, operative technique, time to improvement and need for reoperations were noted. We matched the cohort of patients with an AE determined at the time surgery to a cohort without AE we determined the prevalence of AE in the symptomatic population and looked for possible associations.

Results: The overall prevalence of AE in the population based on MRI was 4,7% compared to 3,5% in the operative population. The positive predictive value of the AE on CuTS is less than 5%. All AE (12 patients) present at surgery were treated with myotomy and in situ decompression. Five of them needed a concomitant transposition. No higher reoperation rate was seen in the AE group compared to the non-AE group. No significant association was found between the examined parameters, age, work status or inflammatory disease. and the presence of AE.

Conclusions: We found a prevalence of 4,7% for AE in the general population. The positive predicting value of AE on CuTS was less than 5%. Based on this large-scale evaluation, AE was not a significant predictor of CuTS.

FP.27.03

TERRIBLE TRIAD INJURY: PROPOSAL OF A NEW CLASSIFICATION

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Background: Elbow terrible triad is characterized by elbow dislocation, radial head (RH) and coronoid fracture. However, this term includes a spectrum of anatomopathological presentation due to an increased fragmentation of radial head and coronoid. Furthermore, these different patterns require different surgical approaches (lateral or lateral and medial combined), procedures (RH fixation versus replacement) and material. Consequently, prognosis and osteoarthritis rate are different and correlated to degree of bony comminution and soft tissue damage. The purpose of this study was to design a classification that can take into account the rate of bone comminution and provide a guide to treatment of these injuries.

Methods: To classifying "terrible triad" we combined Mason RH fracture classification and O'Driscoll coronoid classification. The classification is alphanumeric: number from 1 to 3 indicates the RH fracture according to Mason classification: Type 1: Mason 1, Type 2: Mason 2, Type 3: Mason 3. The letter A or B indicates the coronoid fracture pattern: A is tip 1 (fragment height < 2 mm) coronoid fracture; B is tip 2 (fragment height >2mm) according to O'Driscoll classification. Therefore, the classification includes 6 groups. From 2011 to 2021, a consecutive series of 108 patients affected by terrible triad were treated in Faenza Orthopedics Department. In order to validate the classification patients Xray and CT scan (2 and 3- dimensional) were analyzed by three independent observers in two different moment (three weeks interval). Kohen k statistical parameter was used for the evaluation of interobserver agreement.

Results: Terrible triad classification includes 6 groups. Observers classified 108 cases in the following distribution: 1 A 2%, 2 A 35%, 2B 10%, 3A 25%, 3B 28%. Interobserver k value was 0.775 or more for each pattern subtype. Intraobserver k value was 0,773 or more for each lesion subtype.

Conclusions: We developed a comprehensive terrible triad classification. The classification appeared to be reproducible and represent a guide to treat in a more standardize way such difficult injuries. Further studies are necessities to correlate terrible triad type to patient outcomes and prognosis in terms of function and osteoarthritis.

FP.27.04

RELIABILITY OF ULTRASOUND ELASTOGRAPHY ACCORDING TO COMPETENCE LEVEL AND ANATOMIC LOCATION

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Background: Ultrasound strain and shear wave elastography are relatively new techniques that evaluate the tissue elasticity of human soft tissue. The purpose of this study is to determine inter-, intra-observer and inter-device reliability for elasticity measurements of common extensor muscle and rotator cuff tendon using ultrasound strain and shear wave elastography.

Methods: Ten adult individuals with twenty upper extremities were enrolled; 10 healthy males. Elasticity of common extensor of elbow and rotator cuff were measured; at common extensor muscle belly at proximal forearm, common extensor tendon near lateral epicondyle and distal end of supraspinatus tendon in longitudinal plane, respectively. Strain elastography (SrE) and shear wave elasticity (SwE) were measured twice by one senior orthopedic surgeon and 1 year-experienced orthopedic fellow. Inter-, intra-observer and inter-device reliability were assessed by means of the intraclass correlation coefficient (ICC).

Results: For the common extensor muscle belly stiffness with SrE, inter-observer reliability (ICC, 0.489, $p=0.076$), intra-observer reliability of senior (ICC, 0.563, $p=0.039$) and fellow (ICC, -0.155, $p=0.622$) were poor. With SwE, on the other hand, inter-observer reliability (ICC, 0.756, $p=0.002$) was good and intra-observer reliability of Senior (ICC, 0.843, $p=0.001$) and fellow (ICC, 0.886, $p=0.001$) were excellent.

For the common extensor tendon stiffness with SrE, inter-observer reliability (ICC, 0.408, $p=0.131$) and intra-observer reliability of fellow (ICC, -0.360, $p=0.745$) were poor, but intra-observer reliability of senior (ICC, 0.702, $p=0.006$) was good. With SwE, the results were as follows; poor inter-observer reliability (ICC, 0.369, $p=0.162$) but excellent intra-observer reliability of senior (ICC, 0.800, $p=0.001$) and good intra-observer reliability of fellow (ICC, 0.592, $p=0.029$).

For the rotator cuff tendon stiffness with SrE, inter-observer reliability (ICC, -0.296, $p=0.711$), intra-observer reliability of senior (ICC, -0.219, $p=0.665$) and fellow (ICC, -1.968, $p=0.989$) were poor. With SwE, inter-observer reliability (ICC, 0.565, $p=0.039$) and intra-observer reliability of fellow (ICC, 0.682, $p=0.008$) were good and intra-observer reliability (ICC, 0.825, $p=0.001$) was excellent.

Conclusions: In strain elastography, inter- and intra-observer reliabilities were relatively poor, especially in rotator cuff tendon. Shear wave elastography shows more reliable outcomes, especially in common extensor muscle belly. Shear wave elastography seems to be a more reliable technique for evaluating soft tissue stiffness, in upper extremity, but it is influenced by operator's skill level.

FP.27.06

REGENETEN BIOINDUCTIVE IMPLANT FOR TREATMENT OF LATERAL EPICONDYLITIS: A PROSPECTIVE CASE SERIES STUDY

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Background: Surgical treatment of lateral epicondylitis is unpredictable with varying outcomes. Bioinductive scaffold patch has been previously used in the surgical treatment of rotator cuff repair, with demonstrated rapid recovery, improvement in pain, and increased tendon thickness. The use of the patch in the treatment in lateral epicondylitis has not been previously examined. The purpose of this study is to determine the efficacy of the Bioinductive allograft patch in the treatment of lateral epicondylitis.

Methods: Prospective cohort who failed conservative treatment for minimum 6 months for lateral epicondylitis were included. Patients all underwent standard open lateral epicondylectomy debridement. Demographic variables, Patient-Reported Outcomes Measurement Information System (PROMIS) for Upper Extremity (UE) and Pain (PI), and Visual Analog Scale (VAS), Range of motion (ROM), complications were collected. Ultrasounds were performed preoperatively and at the 6-month post-operative time period to evaluate tendon healing.

Results: A total of 13 patients, 8 female and 5 males, were included. The average age at the date of surgery was 47.8 years. Overall, there was a significant decrease in VAS at 6-weeks ($p=0.004$) and 3-months ($p=0.01$) as well as PROMIS PI ($p=0.01$) at 6-weeks postoperatively. There was no significant decrease in VAS or PROMIS scores noted at 6 months or 12 months. Nine of the eligible 11 patients acquired a 6-month postoperative ultrasound, and in all 9 patients post-surgical changes were noted. No postoperative complications were reported for any patient.

Conclusions: Our study indicates there is no difference between surgical treatment of lateral epicondylitis, with and without augmentation with the Bioinductive Implant. However, additional studies with greater power and longer-term follow-up are needed.

FP.27.07

PERIOPERATIVE STEROID INJECTION IN ELBOW ARTHROSCOPY

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Background: Elbow arthroscopy is increasingly performed for osteoarthritis, loose bodies, and inflammatory arthritis. This procedure results in better elbow function and diminished pain. Intra-articular steroid injection has shown to prevent heterotopic ossification after arthroscopy. However, previous investigations reported higher risk of infectious complications when used at the time of surgery. The goal of present study was to evaluate the incidence of infection, both superficial and deep, after perioperative intra-articular steroid injection during elbow arthroscopy.

Methods: Starting from May 2019 and ongoing, we prospectively included all patients who underwent elbow arthroscopy. Exclusion criteria were ligamentous repair and patients aged below 18 years. A total of 102 elbow arthroscopies were performed by a single surgeon and were injected with an intra articular steroid injection through a separate injection site after portal closure. All procedures were performed in a lateral decubitus and were treated with a standardized postoperative rehabilitation protocol. Smoking status, age, mass index, current smoking status were reviewed retrospectively. The minimum follow up was 3 months.

Results: 102 elbow arthroscopies were performed in 96 patients with mean age of 43 years. Mean mass index was 26,0 kg/m² and 19 patients were active smokers. Elbow arthroscopy was performed for loose bodies removal alone in 15 cases, for loose bodies removal and plica synovialis resection with extensive synovectomy in 38 cases, for osteocapsular arthroplasty in 49 cases. In 28 cases, we simultaneously performed an ulnar nerve release. We observed no deep or superficial infection. One patient had a seroma that was treated without intervention or antibiotics and resolved spontaneously after 14 days.

Conclusions: We observed no postoperative deep or superficial infection after elbow arthroscopy. Reducing operating time, rigorous attention for sterility and using a separate injection site after portal closure, steroids may avoid postoperative infection. Perioperative steroid injection has been shown reduce the rate of postoperative heterotopic ossification formation and may aid to reduce postoperative pain and improve the rehabilitation. When used in selected cases and with attention to the aforementioned pearls it may be an additional tool in the arthroscopic treatment of elbow pathology.

FP.27.08

INDICATIONS AND TIMING OF GUIDED GROWTH TECHNIQUES FOR PEDIATRIC UPPER EXTREMITY DEFORMITIES: A LITERATURE REVIEW

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Background: Osseous deformities in children arise due to progressive angular growth or complete physal arrest and can be corrected using guided growth techniques. However, little is known about timing and techniques for the upper extremity.

Methods: Clinical and radiological alignment measurements help to provide an impression of the deformity. Treatment options for deformity correction include monitoring of the deformity, (hemi-)epiphysiodesis, physal bar resection, and correction osteotomy. Treatment is dependent on the extent and location of the deformity, physal involvement, presence of a physal bar, patient age, and predicted length inequality at skeletal maturity. An accurate estimation of the projected limb or bone length inequality is crucial for optimal timing of the intervention. The Paley multiplier method remains the most accurate and simple method for calculating limb growth. While the multiplier method is accurate for calculating growth prior to the growth spurt, measuring peak height velocity (PHV) is superior to chronological age after the onset of the growth spurt. PHV is closely related to skeletal age in children. The Sauvegrain method of skeletal age assessment using elbow radiographs possibly is a simpler and more reliable method than the method by Greulich and Pyle using hand radiographs. PHV-derived multipliers need to be developed for the Sauvegrain method for a more accurate calculation of limb growth during the growth spurt.

Results: This paper provides a review of the current literature on the clinical and radiological evaluation of normal upper extremity alignment and aims to provide state-of-the-art directions on deformity evaluation, treatment options, and optimal timing of these options during growth.

FP.28.01

HEMIARTHROPLASTY WITH PYROCARBON HEAD FOR SHOULDER OSTEOARTHRITIS IN YOUNG AND ACTIVE PATIENTS

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Background: Shoulder arthroplasty for osteoarthritis (OA) in young active people has not reached a univocal gold standard. Pyrocarbon has tribological qualities and elastic properties close to those of cortical bone (4) and it has been recently introduced for shoulder hemiarthroplasty as an alternative to metal head. The aim of this study is to report clinical and radiological results of hemiarthroplasty using pyrolytic carbon-head (HA-PYC) for the treatment of OA in young/active or with higher demand patients at midterm follow-up.

Methods: A prospective monocentric study was performed including consecutive patients who underwent HA-PYC. Indication includes primary OA, instability arthropathy, humeral head osteonecrosis fracture sequelae type I or II, inflammatory arthritis in patients under 60 years old and/or with high activity level. At minimum 2 years follow-up all patients were evaluated clinically in term of range of motion, Constant score (CS), subjective shoulder value (SSV) and pain and radiographically, assessing glenoid erosion according to Spearling

Results: 91 patients were included. 2 patients were lost, leaving 89 patients evaluated at a mean follow-up of 53 months (range 24-98). Survival rate considering revision or reoperation as endpoint was 4.5%. One patient presented a traumatic subscapularis rupture, one has an infection, 2 patients presented supraspinatus and subscapularis insufficiency requiring revision. All clinical parameters improved significantly ($p < 0.05$): pain from 5.9 ± 2.0 to 1.5 ± 2.2 , CS from 40 ± 15 to 74 ± 12 , SSV from 37 ± 15 to 82 ± 13 , forward flexion from 104 ± 32 to 153 ± 22 , external rotation one from 13 ± 21 to 46 ± 17 , internal rotation from 3.8 ± 2.3 to 6.9 ± 1.9 . Postoperatively, 90% of the patients (76/84) returned to work and 80% (48/60) returned to sport. Glenoid erosion evolved in 26 patients (29%); however, severity of glenoid wear (Spearling 3,4) has no influence on the functional results.

Conclusions: HA-PYC in active patients provides improved pain relief and satisfactory shoulder function, high return to work and sports, regardless of pre- and post-operative glenoid wear, with low revision rate at 5 years. Further studies reporting long-term results are necessary to assess evolution of glenoid wear and shoulder function.

FP.28.02

THE EFFECT OF ALLERGIES ON OUTCOMES FOLLOWING SHOULDER ARTHROPLASTY: A NATIONAL DATABASE ANALYSIS OF 154,478 PATIENTS

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Background: The objective of this study is to investigate whether having allergies predisposes patients to higher rates of complications and revision surgeries after shoulder arthroplasty.

Methods: The PearlDiver national database was used to identify patients who had undergone TSA between 1/1/2010-10/31/2021. Patients were stratified by whether they had allergies or not, and comparison of complications was made at 30 and 90 days postoperatively. Revisions were further assessed at 1-year, 5-year, and 10-years. The chi-square test was used to analyze comparisons between both groups at a p-value of 0.05.

Results: 28,182 patients with allergies and 126,296 patients without allergies had undergone TSA. Patients with allergies were more likely to require revision surgery at all time points analyzed (30 days: 0.9% vs. 0.6%, OR 1.62 [95% CI 1.40 to 1.87], $p < 0.001$; 90 days: 1.4% vs. 0.9%, OR 1.54 [95% CI 1.38 to 1.73], $p < 0.001$; 1 year: 2.5% vs. 1.8%, OR 1.39 [95% CI 1.28 to 1.73], $p < 0.001$; 5 years: 3.5% vs. 2.8%, OR 1.26 [95% CI 1.17 to 1.36], $p < 0.001$; 10 years: 3.6% vs. 3.0%, OR 1.18 [95% CI 1.10 to 1.27], $p < 0.001$). Patients with allergies were more likely to have sepsis within 30 days (0.7% vs. 0.4%, OR 1.53 [95% CI 1.30 to 1.80], $p < 0.001$) and 90 days (1.3% vs. 0.7%, OR 1.71 [95% CI 1.51 to 1.94], $p < 0.001$) postoperatively. Patients with allergies were more likely to experience a wound complication within 30 days (0.6% vs. 0.3%, OR 1.89 [95% CI 1.58 to 2.26], $p < 0.001$) and 90 days (1.0% vs. 0.6%, OR 1.81 [95% CI 1.58 to 2.08], $p < 0.001$) following surgery. The allergy group experienced higher rates of joint infections (30 days: 0.5% vs. 0.2%, OR 2.10 [95% CI 1.72 to 2.56], $p < 0.001$; 90 days: 0.7% vs. 0.3%, OR 2.14 [95% CI 1.81 to 2.54], $p < 0.001$) and implant complications (30 and 90 days: 4.3% vs. 2.9%, OR 1.52 [95% CI 1.42 to 1.62], $p < 0.001$) at both time points analyzed.

Conclusions: Patients with allergies were more likely to require revision surgery following TSA. They were also more likely to experience implant and wound complications, sepsis, and joint infections.

FP.28.03

SURGICAL NAVIGATION USING MIXED REALITY FOR GLENOID AXIS PIN PLACEMENT IN SHOULDER ARTHROPLASTY: A CADAVER-BASED STUDYMIXED REALITY MAY OFFER AN ALTERNATIVE FOR COMPUTER-ASSISTED NAVIGATION IN SHOULDER

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Background: Mixed reality may offer an alternative for computer-assisted navigation in shoulder arthroplasty. The purpose of this study was to determine the accuracy and precision of mixed reality guidance for placement of the glenoid axis pin in cadaver specimens. This step is essential for accurate glenoid placement in total shoulder arthroplasty.

Methods: Fourteen cadaveric shoulders underwent simulated shoulder replacement surgery by seven experienced shoulder surgeons. The surgeons exposed the cadavers through a deltopectoral approach, and then used mixed reality surgical navigation to insert a guide pin in a pre-planned position and trajectory in the glenoid. The mixed reality system utilized Microsoft Hololens 2 headset, navigation software, dedicated instruments with fiducial marker cubes, and a securing pin. CT scans obtained before and after the procedure were used to plan the surgeries and to determine the difference between the planned and the executed values for the entry point, version, and inclination. One specimen had to be discarded from the analysis because the guide pin was removed accidentally prior to obtaining the post-procedure CT scan.

Results: Regarding the navigated entry point on the glenoid, the mean difference between planned and executed values was 1.7 ± 0.8 mm; this difference was 1.2 ± 0.6 mm in the superior-inferior direction and 0.9 ± 0.8 mm in the anterior-posterior direction. The maximum deviation from the entry point for all 13 specimens analyzed was 3.1 mm. Regarding version, the mean difference between planned and executed version values was 1.6 ± 1.2 degrees, with a maximum deviation in version for all 13 specimens of 4.1 degrees. Regarding inclination, the mean angular difference was 1.7 ± 1.5 degrees, with a maximum deviation in inclination of 5 degrees.

Conclusions: The mixed reality navigation system utilized in this study allowed surgeons to insert the glenoid guide pin on average within 2 mm from the planned entry point and within 2 degrees of version and inclination. The navigated values did not exceed 3 mm or 5 degrees respectively for any of the specimens analyzed. This approach may help surgeons more accurately place the definitive glenoid component.

FP.28.04

SCAPULOHUMERAL RHYTHM IN SHOULDERS WITH REVERSE SHOULDER ARTHROPLASTY MEASURED WITH A NOVEL PORTABLE THREE- DIMENSIONAL SCAPULAR KINEMATICS ASSESSMENT SYSTEM

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Background: Reverse shoulder arthroplasty (RSA) is a valid and increasingly popular treatment option in eccentric arthrosis and cuff arthropathy. We know that the deltoid is the motor of RSA. However, the role of scapular motion has been poorly documented in the literature. The aim of our study is to analyze and quantify the role of the scapular contribution in the functional outcome of patients undergoing RSA.

Methods: Fourteen patients who underwent primary RSA were included in the study. In all cases, a reverse prosthesis with lateralizing stem was implanted. All patients underwent clinical examination, video recording and motion analysis. X-ray and post-operative CT examinations were collected to evaluate positioning and any loosening. ShowMotion (NCS Lab srl, Modena, Italy) 3D kinematic tracking system was used to evaluate and measure the scapular motion in three planes.

Results: All patients show substantial amount of posterior tilting and lateral rotation starting at 30° in forward elevation. A further difference is the anticipation of the retraction during the ROM in the r-TSA side. The contribution of scapular motion in the RSA shoulder was greater than in the healthy shoulder. In patients with bilateral RSA, the contribution of scapular motion was higher in tilting and lateral rotation in the worse shoulder side in terms of ROM. This means that to compensate for the loss of GH motion in RSA, more ST motion is needed to obtain the same thoraco-humeral elevation angle.

Conclusions: The post RSA scapular kinematics has typical characteristics that must be achieved in order to obtain a good functional outcome. We can conclude that on the RSA side, the patients anticipate upward rotation both in flexion and abduction. The contribution of the upward rotation to elevation in the RSA group is therefore more significant. In addition to this, to facilitate elevation movements, there is an anticipation of the scapular retraction and a more prominent tilt resulting in a different scapular kinematics. The analysis of scapular motion could be useful in the post-operative follow-up of patients undergoing RSA surgery and improve adaptative physiotherapy protocols. It potentially can even be included in future arthroplasty planning systems

FP.28.05

LONG TERM RESULTS AFTER PYROCARBON INTERPOSITION HEMIARTHROPLASTY (PISA) FOR SEVERE HUMERAL HEAD NECROSIS

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Background: Humeral head necrosis (HHN) can be successfully treated with a spherical pyrocarbon interposition implant (PISA) when the rotator cuff and glenoid are intact. In the postoperative course (2-3 years) bony remodeling is observed around the implant while the implant rotates within both, the reamed metaphyseal cavity and the glenoid. While short and mid-term results are very promising, we aim to report the outcome after a mean FU of 8.4 years.

Methods: 15 consecutive patients (9 f, 6 males, 56.8 ± 12.1y) with advanced HH necrosis (> 50% head diameter) who were treated with a PISA implant („snooker ball“) were assessed. Functional (DASH, Constant, Euroqol-5L) and radiological data (radiographs, MRI, CT scans) were evaluated after a mean FU of 8.4 years (74-135 months).

Results: At the latest FU (8.4y±21m) the CS was 77.5 (±11.3), adjusted CS 86.8 (±17.2). DASH was 20.4 (±11.3), EQ VAS 78.1 (±17.6). Scores improved from pre-op values: CS: +69.7 (±12.9); adjusted CS: +78.2 (±16.5); DASH: +51,1 (±14.0); EQ VAS: +57.7 (±15.6). Mean glenoid erosion was 1.6mm (±1.7mm), bony substance of the tuberosities further remodeled and increased from 2y and 5y levels and was -0.2mm (±2.0mm) compared to the date of surgery. The implants rotational center was 0.5mm (±1.7mm) above the joint center line. A transparent zone of 2mm (±0.7mm) remained around the implant in all cases.

Conclusions: Pyrocarbon interposition shoulder arthroplasty (PISA) seems to provide excellent functional results at long term follow up when used for the treatment of advanced humeral head necrosis. None of the patients had to be revised. The implants were almost centered (0.5mm) in the glenoid fossa and bony remodeling around the implant was observed in all cases. Functional results further improved in comparison to 5y data and show a mean adjusted CS of 86.8 after > 8 years.

FP.28.06

GLENOID COMPONENT PLACEMENT IN REVERSE SHOULDER ARTHROPLASTY ASSISTED WITH AUGMENTED REALITY THROUGH A HEAD-MOUNTED DISPLAY LEADS TO LOW DEVIATION BETWEEN PLANNED AND POST-OPERATIVE PARAMETERS

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Background: The use of navigated augmented reality (AR) through a head-mounted display (HMD) has been proposed to assist the glenoid component placement in reverse shoulder arthroplasty (RSA), but few articles have measured its accuracy. The purpose of this study is to evaluate the deviation between planned, intra- and postoperative inclination, retroversion, entry point, depth and rotation of the glenoid component placement assisted by a navigated AR through HMD during RSA.

Methods: Both shoulders of six fresh frozen human cadavers (67.2 ± 29.1 years of age, 4 males and 2 females), free from fractures or other bony pathologies were used. Pre-operative computed tomography (CT) scans were performed and used for the three-dimensional (3D) planning of each specimen. The glenoid component placement was assisted using a navigated AR system through HMD in all specimens. Intraoperative inclination, retroversion, depth and rotation were measured by the system. A post-operative CT scan was performed. The pre- and post-operative 3D CT scan reconstructions were superimposed to calculate the deviation between planned and post-operative inclination, retroversion, entry point, depth and rotation of the glenoid component placement. Additionally, a comparison between intra- and post-operative measurements was calculated. Outliers were defined as $>10^\circ$ inclination, $>10^\circ$ retroversion, >3 mm entry point as defined by previous articles.

Results: The registration algorithm of the scapula prior to the procedure was correctly completed in all cases. The deviations between planned and post-operative values were $1.0 \pm 0.7^\circ$ for inclination, $1.8 \pm 1.3^\circ$ for retroversion, 1.1 ± 0.4 mm for entry point, 0.7 ± 0.6 mm for depth, and $1.7 \pm 1.6^\circ$ for rotation. The deviation between intra- and postoperative values were $0.9 \pm 0.8^\circ$ for inclination, $1.2 \pm 1.1^\circ$ for retroversion, 0.6 ± 0.5 mm for depth, and $0.3 \pm 0.2^\circ$ for rotation. There were no outliers between planned, intra- and post-operative parameters.

Conclusions: In this study, navigated AR systems through HMD for RSA led to low deviation between planned and post-operative values and between intra- and postoperative parameters. Controlled and in-vivo studies should be conducted to further evaluate the clinical applicability of this type of system.

FP.28.07

THE TESS STEMLESS REVERSE IS STILL RELIABLE AFTER 10 YEARS

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Background: Cuff tear arthropathy is a common condition that compromises the functionality of the shoulder. Since its introduction by Paul Grammont, reverse shoulder arthroplasty (RSA) has shown to promote good functional outcomes in patients with rotator cuff tear. The results are gradually improving thanks to the new prosthesis designs and the surgical evolutions. Nevertheless, revisions exist due to the rate of complications. RSAs need to be as minimally invasive as possible to preserve the bone stock. The following presented results report the performance of the reverse Total Evolutive Shoulder System (TESS; Zimmer Biomet, Valence, France) after 10 years follow-up.

Methods: From the 53 consecutive patients enrolled for RSA in the original prospective study between 2006 and 2008, 28 remaining patients, whose mean age at surgery was 76 years (54-85), were available for long-term follow-up. Functional outcomes and radiological results that looked for bone modifications and loosening were studied.

Results: At the mean follow-up of 129 months, functional outcomes improved significantly, from 40 to 71 on the Constant score. Complications occurred in 2 cases, one dislocation and one fracture of the acromion. Notching was about 46% and the mean Neck Shaft Angle (NSA) was 153°. No loosening was observed, and no displacement of the reverse corollas from postoperative to last follow-up X-rays. Radiolucent Lines (RLLs) were frequent in the peripheral rim of the humeral side, in zones 1 and 5. Bone modifications were correlated to the position of the stemless components.

Conclusions: The TESS stemless reverse implant provided good long term clinical outcomes. Minimally invasive implants should be favored when performing a reverse surgery in order to save bone stock.

FP.28.08

MID-TERM OUTCOMES OF THE PYROTITAN™ HUMERAL RESURFACING ARTHROPLASTY SHOULDER IMPLANT

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Background: Glenohumeral arthritis increasingly affects young adults. They not only seek relief from pain but also require the ability to return to unrestricted activities. Total shoulder arthroplasty (TSA) is an effective solution for less active patients but has been associated with concerning rates of glenoid wear, aseptic loosening, and a reduced return to full function. Hemiarthroplasty and humeral resurfacing arthroplasty (HRA) may be indicated in patients who have an intact rotator cuff and a congruent glenoid. Anatomic pyrocarbon hemiarthroplasty has shown promise in other joints and pyrocarbon HRA may offer an alternative to traditional TSA or metal hemiarthroplasty

Methods: Since June 2010, 514 shoulders with Pyrocarbon HRA (PyroTITAN™) implants have been followed at five sites as part of a multicentre prospective trial and two single-site prospective trials. Male patients comprised 71% of the participant cohort and 75% had HRA indicated for a primary diagnosis of osteoarthritis. Half had the surgery performed on their dominant side shoulder. Patients were reviewed at regular post-operative intervals including 6 months (n=398), 1 year (n=367), 2 years (n=238) and 5 years (n=119) post-operatively. Patient reported outcome measures and range of motion are reported as mean ± SD.

Results: Pain improved from an average of 63 pre-operatively, to 19 at 6 months followed by 15, 12 and 14 at subsequent post-operative intervals. Similarly function scores improved from pre- to post-op, from 34 on the WOOS at baseline, to an average of 79 at 6 months and 86 at 5 years post-op. Average shoulder flexion was 99 pre-operatively, which improved to 130 by 6 months and to 142 at 5 years post-op. Shoulder abduction and external rotation improved from 89 to 126 and 141; and from 34 to 55 and 61 degrees at the same intervals, respectively. 21 participants had revision surgery at a mean of 23 months post index surgery (range 0 – 61), with most for implant fracture (13) and persistent pain (4).

Conclusions: Pyrocarbon HRA provides an alternative to traditional TSA and metal HRA. It allows earlier intervention, restoration of function and mobility and higher patient satisfaction, whilst mitigating concerns regarding glenoid implants or native glenoid wear.

FP.29.01

SHOULDER PACEMAKER VERSUS CONVENTIONAL PHYSIOTHERAPY FOR TREATMENT OF FUNCTIONAL POSTERIOR SHOULDER INSTABILITY- A MULTICENTRIC, PROSPECTIVE, RANDOMIZED CONTROLLED TRIAL

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Background: Functional posterior shoulder instability is a severe type of instability mostly affecting teenagers and young adults that leads to loss of function, pain, and stigmatization. The Shoulder Pacemaker has been promoted as effective treatment option in patients with functional posterior shoulder instability. However, controlled studies supporting this claim are missing. The hypothesis of this study was that the Shoulder Pacemaker prevails in effectiveness over the current gold-standard in treatment of functional posterior shoulder instability.

Methods: In a multicentric randomized controlled trial study involving 5 study sites, independent data storage and analysis, and an international study quality control board 49 patients with functional posterior shoulder instability were randomly allocated in a 1:1 ratio to 6-weeks physiotherapy (PT) or PT with simultaneous Shoulder Pacemaker stimulation (SPM-PT). Baseline scores, and outcome scores at 6 weeks, 3 months, and 6 months after the intervention were obtained. Crossover to the other treatment group was allowed after the 3 months follow-up. Prior to the beginning of the trial, the study design along with the 3-months Western Ontario Shoulder Instability Index (WOSI) as main outcome measurement was registered online, a power-analysis was performed, and ethical committee approval was obtained.

Results: Despite comparable baseline characteristics, the SPM-PT group showed a significantly better 3-months WOSI Score ($64 \pm 16\%$) than the PT group ($51 \pm 24\%$) ($p=0.047$) and a larger improvement from baseline (SPM-PT: 43% to 64%; PT: 46% to 51%). Two thirds of the patients from the PT group crossed over to the SPM-PT group due to dissatisfaction after the 3-month follow-up and showed a significant increase in their WOSI Score from $49 \pm 8\%$ to $67 \pm 24\%$ ($p=0.023$). The frequency of instability episodes showed a significant improvement in the SPM-PT group at 3 months follow-up ($p=0.001$) and beyond (6 months: $p=0.001$, 12 months: 0.004), while in the PT group no significant difference was observed ($p=0.481$).

Conclusions: The current study shows that Shoulder Pacemaker-aided physiotherapy leads to statistically significant and clinically relevant improvement of outcomes in the treatment of functional posterior shoulder instability compared to conventional physiotherapy alone from which even patients with prior unsatisfactory results after conventional physiotherapy can benefit.

FP.29.02

SUTURE BUTTON FIXATION LATARJET TECHNIQUE-COMPARISON OF TRADITIONAL TOTAL CORACOID OSTEOTOMY AND PARTIAL CORACOID OSTEOTOMY WITH PRESERVATION OF CORACOID LIGAMENT AND PECTORALIS MINOR

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Background: Latarjet surgery must dissociate the coracoacromial ligament and pectoralis minor, which may lead to various abnormal activities of the scapula or concerns about superior shoulder translation of the humeral head in the later stage. Can the Latarjet operation be successfully performed while preserving the coracoacromial ligament and pectoralis minor?

Methods: This prospective, nonrandomized, comparative study included 127 consecutive patients (mean age, 27 years) who underwent arthroscopic suture fixation Latarjet procedure. The first 72 shoulders underwent total coracoid osteotomy, and the next 55 shoulders underwent partial coracoid osteotomy preserving the coracoid ligament and pectoralis minor muscle. There were no significant differences in age, gender, type of exercise, number of failed operations, smoking and follow-up time among the groups. The main outcome measures were the bone block position and healing of the CT scan posteroperatively, and the results of the glenoid best fitting circle restoration at the final follow-up. Secondary outcomes included shoulder function scores, shoulder stability, return to sports, and complications at final follow-up.

Results: After an average follow-up of 18 months, the shoulders of all patients in the two groups were stable. 70/72 in the CSL group and 54/55 in the Latarjet group returned to sports. At final follow-up, there were no significant differences in clinical scores between the two groups. The position of the bone block were within the preset value range in 124/127 cases. The healing rate of bone block was 71/72 in the CSL group and 54/55 in the Latarjet group ($P=.843$). There were no significant differences between the two groups in terms of patient age, size of preoperative glenoid bone defect, and surgical history. The best fitting circle coverage rate of the glenoid at the last follow-up was 95.5% in the CSL group and 95.6% in the Latarjet group with no significant difference between the two groups.

Conclusions: In arthroscopic suture button fixation with Latarjet procedure, there was no significant difference in the bone healing time, best fitting circle restoration, and clinical efficacy between the CSL group and the Latarjet group. The suture button fixation of the Latarjet with preservation of the coracoacromial ligament and pectoralis minor is feasible.

FP.29.03

REPLISSAGE IN ADDITION TO ARTHROSCOPIC BANKART REPAIR FOR SHOULDER INSTABILITY WITH ON-TRACK HILL-SACHS LESIONS REDUCES RESIDUAL APPREHENSION WITHOUT EXTERNAL ROTATION LIMITATION

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Background: Bankart repair with Remplissage procedure is considered one of the most promising arthroscopic techniques for management of engaging Hill-Sachs. However, the role of the remplissage in the non engage hill sachs lesion is not well-known. We aimed to evaluate the role of remplissage as an adjunct to Bankart repair in patients with recurrent anterior shoulder dislocation combined with on-track Hill-Sachs lesion.

Methods: Arthroscopic Bankart repair with remplissage data (December 2018–2020) was collected (BR group). Inclusion criteria were (1) recurrent anterior shoulder dislocation, (2) on-track Hill-Sachs lesion, (3) minimal/subcritical glenoid bone loss (<17%), and (4) postoperative follow-up > 1 year. Exclusion criteria were (1) revision surgery, (2) first dislocation with acute glenoid rim fracture, and (3) combined with other surgery. The control group was identified in Bankart repair only cohort (B group). All patients were evaluated preoperatively, and at 3 weeks, 6 weeks, 3 months, 6 months, and then annually postoperatively. Visual analogue scale for pain (PVAS), Self-Assessment Numerical Evaluation (SANE), American Shoulder and Elbow Surgeons Shoulder (ASES) score, ROWE, and Western Ontario Shoulder Instability (WOSI) were evaluated at preoperative and final follow-up. Residual apprehension experience and external rotation deficit were evaluated. Patients, who were followed-up for more than 1 year, were asked how often they experienced any subjective apprehension in 4 grades (1: always, 2: frequently, 3: occasionally, 4: never). Patients who had a history of recurrent dislocation or revision surgery were investigated.

Results: 53 patients (B, 28; BR, 25) were included. At final follow-up, both groups showed improvement in 5 clinical scores ($P < 0.001$). The BR group showed higher ROWE scores than the B group (B: 75.2 ± 13.6 , BR: 84.4 ± 10.8 ; $P = 0.009$). Residual apprehension patient ratio (B: 71.4% (20/28), BR: 32% (8/25); $P = 0.004$) and the mean subjective apprehension grade (B: 3.1 ± 0.6 , BR: 3.6 ± 0.6 ; $P = 0.005$) showed significant difference, while no patients in either group experienced external rotation deficit (B: $14.8 \pm 12.9^\circ$, BR: $18.0 \pm 15.2^\circ$, $P = 0.420$).

Conclusions: Remplissage with arthroscopic Bankart repair in on-track Hill-Sachs lesion has a role in reducing residual apprehension without external rotation limitation.

FP.29.04

CLASSIC LATARJET VERSUS CONGRUENT ARCH TECHNIQUE. COMPARATIVE ANALYSIS OF GLENOID BONE COVERAGE BASED ON POST-OPERATIVE COMPUTED TOMOGRAPHY

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Background: Latarjet procedure (CL) is a well-established procedure for anterior shoulder instability associated with bony injuries. However, much have been discussed about the potentiality of the coracoid to cover glenoid deficiencies exceeding 30% of its articular surface. The congruent-arc procedure (CA) is a modification of classical Latarjet technique, in which the graft is rotated 90°, so that the coracoid undersurface is oriented parallel to glenoid articular surface. Since the width of the coracoid is larger than its height, theoretically the CA has the potential to cover a larger bone deficiency. Nonetheless, considering the real clinical scenario, the percentage of bone coverage are not well-defined for both CL and CA techniques.

Methods: We analyzed how much of the glenoid bone loss was covered after one of the coracoid transfer procedures, comparing CL and CA techniques. Our study compared pre-operative (PRE-CT) and post-operative (POS-CT) computed tomography scans of 38 patients submitted to coracoid transfer for anterior shoulder instability, associated with anterior glenoid bone loss over 20%. Patients were divided by the surgical procedure, with 21 located in CL group and 17 in the CA group. We also compared subjects according to the amount of pre-operative bone damage, comparing patients with bone loss over 30% and between 20 and 30%.

Results: The mean bone loss at PRE-CT was $33,6 \pm 7,9$ % for CL and $34,1 \pm 9,4$ % for CA ($p=0,869$). During POS-CT analysis, the mean bone coverage of glenoid defects was $18,5 \pm 2,1$ % for CL and $36,9 \pm 8,6$ % for CA, showing a 18,0 % difference between groups ($p=0,000$). Considering only patients with very large bone losses (over 30% of glenoid surface), we found a mean post-operative coverage of $18,3 \pm 2,3$ % for CL and $41,9 \pm 6,1$ % for CA, resulting in a 23,6% difference between groups ($p=0,000$).

Conclusions: The CA technique has a significant greater bone coverage than CL technique for glenoid deficient anterior shoulder instability, particularly when bone loss exceeds 30% of glenoid area. In these situations, CA procedure is a suitable option, providing a more reliable bone coverage.

FP.29.06

MID-TERM OUTCOMES FOLLOWING FRESH-FROZEN HUMERAL HEAD OSTEOCHONDRAL ALLOGRAFT RECONSTRUCTION FOR REVERSE HILL SACHS LESION: A CASE SERIES

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Background: Locked posterior glenohumeral dislocations with a reverse Hill-Sachs impaction fracture involving less than 30% of the humeral head are most frequently treated with lesser tuberosity transfer into the defect, whereas those involving more than 50% undergo humeral head arthroplasty. Reconstruction of the defect with segmental femoral osteochondral allografts has been proposed to treat patients between these two ranges, but the medium-/long-term outcomes of this joint-preserving procedure are controversial.

Methods: Between 2001 and 2018, 12 consecutive patients with a unilateral locked posterior shoulder dislocation and an impaction fracture from 30% to 50% (mean 31% \pm 1.32) of the humeral head were treated with segmental reconstruction of the defect with fresh-frozen humeral head osteochondral allografts. Patients were assessed clinically, radiographically and with computed tomography (CT) at a medium follow-up of 66 \pm 50.25 months (range, 24-225).

Results: All twelve shoulders presented a slight limitation in anterior elevation (average, 166.6° \pm 22.76). The mean active external rotation with the shoulder at 90° of abduction was 82.5° \pm 6.61, and that with the arm held in stable adduction was 79.16 \pm 18.80. The mean abduction was 156.25° \pm 25.09. The mean Constant-Murley score (CS) was 82 \pm 15.09 points (range, 40-97 points), and the mean ASES was 94 \pm 8.49 points. The mean pre- and postoperatively Western Ontario Shoulder Instability index (WOSI) was 236.5 \pm 227.9 and 11.20 \pm 10.85, respectively. Development of osteoarthritis (OA) was minimal. The average allograft resorption rate was 4% \pm 2.4. There were no cases of failure (reoperation for any reason) in this series.

Conclusions: Segmental humeral head reconstruction with humeral head fresh-frozen osteochondral allografts provides good to excellent clinical results with low-grade OA and low allograft resorption in patients with locked posterior shoulder dislocation.

FP.29.08

SCREW-RELATED COMPLICATIONS ASSOCIATED WITH THE LатарJET PROCEDURE: A SYSTEMATIC REVIEW

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Background: The aim of this study was to determine the rate of surgical complications attributable to use of screw fixation during the Latarjet procedure and delineate screw-related complications for open and arthroscopic Latarjet surgery.

Methods: A systematic review of the literature was performed by querying MEDLINE and EMBASE computerized databases for relevant articles that reported clinical outcomes associated with the Latarjet procedure. Clinical studies of open and/or arthroscopic Latarjet surgery that employed screw fixation of the coracoid were included in our analysis.

Results: From 692 articles identified initially, 32 studies met eligibility criteria. The study cohort was comprised of 2,758 shoulders, with a mean age of patients ranging from 17 – 62 years, and the mean duration of follow-up ranging from 0.3 – 25.6 years. Twenty-two studies reported outcomes of an open Latarjet technique while 10 studies reported on an arthroscopic Latarjet technique. Across all studies, the overall complication rate ranged from 1.4 to 36%. The rate of screw-related complications ranged from 0 to 16%, and the rate of screw removal ranged from 0 to 18%. Among the subset of studies that reported specific indications for screw removal, the most common indications were pain and screw loosening. Reported rates of screw-removal among arthroscopic Latarjet procedures range from 0-18% and among open procedures range from 0 to 7,3%.

Conclusions: Conclusions: One-third of the overall surgical complications associated with the Latarjet procedure are related to the use of screw fixation. The reported rate of screw-removal can be higher after arthroscopic Latarjet procedures (0 -18%) than after open procedures (0 - 7,3%) and is mainly indicated for shoulder pain and/or screw loosening.

FP.29.09

ISOKINETIC EVALUATION OF THE SHOULDER AFTER BRISTOW/LATARJET SURGICAL PROCEDURE IN ATHLETES

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Background: To evaluate the muscular strength of the internal (IR) and external (ER) rotators of the shoulder after Bristow/Latarjet surgery.

Methods: Cross-sectional study with 18 patients (36 shoulders). The isokinetic evaluation was performed using the Biodex 3 System Pro dynamometer (Biodex Medical System, Inc., Shirley, NY, USA). The athletic shoulder outcome rating scale (ASORS) and the visual analogue scale (VAS) were applied.

Results: The values of peak torque and maximum work in concentric and eccentric mode on the non-operated shoulder were higher than on the operated side for both the IR and ER ($p < 0.01$). The conventional and functional balance between the ER and IR showed no differences between the operated and the non-operated side. When comparing patients with postoperative time < 1 year or 1 year, no differences were observed in peak torque values at $60^\circ/s$ and $240^\circ/s$ and maximum work at $60^\circ/s$ and $240^\circ/s$ of the IR to the operated shoulder. However, the peak torque values of $60^\circ/s$ and $240^\circ/s$ and maximum work at $60^\circ/s$ and $240^\circ/s$ of the ER were higher in subjects with postoperative time ≥ 1 year in all variables ($p < 0.05$).

Conclusions: There was a decrease in the strength of the IR and ER in the operated shoulder compared with the healthy shoulder. However, the conventional and functional balance was maintained.

FP.30.01

MICROFRACTURE LATERAL TO THE GREATER TUBEROSITY OF THE HUMERUS ENHANCES TENDON-TO-BONE HEALING IN A RAT ROTATOR CUFF TEAR MODEL

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Background: Microfracture at rotator cuff insertion has been reported as an established surgical marrow stimulation technique for enhancing rotator cuff healing. However, the effect of lateralized or medialized microfracture to the insertion is unknown. We aim to compare the biomechanical and histological results of microfracture at three locations for repair rotator cuff repair in a rat model.

Methods: A total of 72 Sprague-Dawley rats with bilateral supraspinatus tendon insertion detachment were allocated into four groups with four different interventions: no microfracture at humeral head as a control group(Con), traditional microfracture at footprint area(MFA), medialized microfracture to the footprint area at the articular surface of humerus(MMFA), or lateralized microfracture to the footprint area at greater tuberosity(LMFA) and all underwent the immediate repair. Tendon-to-bone healing was assessed by biomechanical test and histological evaluation 4&8 weeks postoperation.

Results: At 4 weeks, the LMFA group showed significantly superior failure load compared with the Con group($p < .05$). The LMFA group and MFA group showed significantly superior stiffness when compared with the other two groups(all $p < .05$). At 8 weeks, superior failure load and stiffness were observed at LMFA group compared with the control group(all $< .05$). Histological examination revealed that the LMFA group exhibited superior collagen composition and tendon-to-bone maturation at the interface 4&8 weeks compared to the Con group(all $< .05$).

Conclusions: The lateralized microfracture at the greater tuberosity improved the quality of the tendon-to-bone healing biomechanical and histologically after rotator cuff repair in a rat model. The result of the current study suggests the microfracture lateral to the footprint area might be a better way to enhance rotator cuff healing clinically.

FP.30.02

DEVELOPMENT AND VALIDATION OF A MODEL PREDICTING PATIENT-REPORTED SHOULDER FUNCTION AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR IN A SWISS SETTING

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Background: Prediction models for outcomes after orthopedic surgery provide patients with evidence-based post-operative outcome expectations. Our objectives were (1) to identify prognostic factors associated with a post-operative shoulder function outcome: the Oxford Shoulder Score (OSS) and (2) to develop and validate a prediction model for 6-month OSS.

Methods: Patients undergoing arthroscopic rotator cuff repair (ARCR) were prospectively documented at a Swiss orthopedic tertiary care center. The first primary ARCR in adult patients with a partial or complete rotator cuff tear were implemented between October 2013 and June 2021 and followed-up 6 months after surgery. Twenty-two potential socio-demographic, health-related and surgical prognostic factors were used for prediction model development. Various linear regression and Tobit models based on three sets of factors were compared in terms of overall performance before and after a bootstrap validation.

Results: A complete-case analysis of 1,310 patients was performed. The mean baseline OSS for the whole population was 29 points (SD: 8.5) and increased to 40 points (SD: 8.1) six months after the surgery. Overall, 159 patients achieved the maximum OSS value at 6 months (12.1%). Based on R squared values after bootstrap validation, the Tobit regression models showed better model performance (R-squared = 0.188) than the classic linear modeling approaches (R-squared = 0.161). After adjustment, there were five factors significantly associated with a poorer 6-month OSS: one (regression coefficient (beta) = -2.5 [-4.3; -0.77]) and two or more pre-operative steroid infiltrations (beta = -1.78 [-3.55; 0.00]), being at least moderately anxious or depressed (beta = -5.4 [-7.16; -3.64]), tendon delamination (beta = -1.19 [-2.34; -0.05]) and the performance of an acromioclavicular joint resection (beta = -2.27 [-3.59; -0.95]). Conversely, increasing age (beta = 0.10 [0.04; 0.16]) and a higher baseline OSS (beta = 0.29 [0.23; 0.36]) were significantly associated with a better OSS at 6 months post-surgery.

Conclusions: A prediction model for patients undergoing ARCR was developed to provide patients and surgeons with individualized expectations for post-operative shoulder function outcomes. The occurrence of specific adverse events such as repair failure or shoulder stiffness might affect the quality of our predictions.

FP.30.03

THE INCIDENCE OF SUPRASCAPULAR NERVE INJURY INCREASED WITH THE SIZE OF ROTATOR CUFF TEARS: A COMPARISON STUDY IN A RAT MODEL

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Background: Rotator cuff injuries, especially massive rotator cuff tears may cause suprascapular nerve lesions which has been reported as a negative role in rotator cuff healing. However, the incidences of suprascapular nerve lesions after different sizes of rotator cuff injuries were unknown. This study aims to study the incidences of suprascapular nerve neuropathy under circumstances of different sizes of rotator cuff tears in a rat model.

Methods: Forty shoulders from 20 rats under rotator cuff tenotomy from greater tuberosity were divided into four groups: single supraspinatus tendon tear fixed at the insertion, single supraspinatus tendon tear fixed at the middle of humeral head, single supraspinatus tendon tear fixed at the basement of coracoid process and dual tendon (supraspinatus and infraspinatus) tears without fixation to simulate rotator cuff tears of different sizes according to the clinical setting. The incidence of suprascapular nerve injury under different circumstances was tested by electromyography detection under anesthesia in vivo and immunofluorescence staining of the suprascapular nerve after sacrifice, 2 weeks postoperation.

Results: A significant positive correlation was found between the incidence of suprascapular nerve lesions and the size of rotator cuff tear. Dual tendon tear showed a significantly higher incidence of suprascapular nerve lesion than that of single tendon tear without retraction group. There was no significant difference in rotator cuff tears of different sizes group regarding the electromyography test. Further, no significant difference was found between the nerve lesion and no nerve lesion groups in terms of electromyography data.

Conclusions: The size of the rotator cuff tear was positively correlated with the risk of suprascapular nerve entrapment and electromyography has little reference value in detecting suprascapular nerve injury in rats with rotator cuff injury. The result of this study suggests surgeons pay more attention to the suprascapular nerve entrapment under circumstances of large to massive rotator cuff tears and electromyography was not recommended in detecting suprascapular nerve injury accompanied by rotator cuff tears.

FP.30.04

LEUKOCYTE-POOR PLATELET RICH PLASMA AS AN ADJUVANT OF ARTHROSCOPIC ROTATOR CUFF REPAIRS REDUCES RETEARS RATES BUT DOES NOT IMPROVE FUNCTIONAL OUTCOMES A DOUBLE-BLIND RANDOMIZED CONTROLLED TRIAL

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Background: Purpose: to evaluate whether the use of one injection of leukocyte-poor platelet-rich plasma in the tendon-bone interface during surgery, decreases retears rates and improves functional outcomes in patients undergoing an arthroscopic rotator cuff repair for medium to large tears.

Methods: Between November 2019 and March 2021, 100 patients with medium to large RCTs underwent an arthroscopic repair with a knotless transosseous-equivalent repair technique in our institution. After randomization, 50 patients received an isolated arthroscopic repair (Control), and 50 patients received a 5-mL dose of leukocyte-poor PRP at the tendon-bone interface before the tendon repair (intervention). The ASES score, The VAS for pain, the SANE and the Pittsburgh Sleep Quality Index were evaluated at 3, 6 and 12 month follow up. An MRI examination was performed to evaluate tendon integrity at 6 months follow up. Both, patients and assessors were blinded to the intervention received during surgery.

Results: The mean age was 60.6 years ($6.08 \pm$). All the patients completed 1 year follow up. Overall, the ASES, VAS, SANE and Pittsburgh scores showed statistical improvement after the operation ($P < .01$). There were no significant differences in functional scores between the groups at any of the postoperative follow-up times. Eighty-four percent of the patients in the intervention group and 80% of the patients in the control group achieved the substantial clinical benefit (SCB) for the ASES score ($P > .05$). Ninety-five patients (95%) underwent a control MRI 6 months after surgery. The total retear rate was 25% (24 out of 95 patients) There was a statistically significant difference in the retears rate between the groups which was 17% in the intervention group (8 of 47 patients) and 33% in the control group (16 of 48 patients) ($P < .01$).

Conclusions: In patients with medium and large rotator cuff tears undergoing double-row repair using the knotless transosseous-equivalent technique, a 5-mL dose of leukocyte-poor PRP placed at the tendon-bone interface at the time of surgery can significantly reduce the postoperative retear rate. However, the use of leukocyte-poor PRP in terms of postoperative pain and patient reported outcomes failed to show clinically meaningful effects.

FP.30.05

THE EFFECT ON HEALING RATE OF THE ADDITION OF A BIOINDUCTIVE IMPLANT TO A ROTATOR CUFF REPAIR. THE RESULTS OF A RANDOMIZED CONTROLLED TRIAL IN 124 SUBJECTS

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Background: There is a clear need for biologic enhancement of rotator cuff techniques. The Regeneten Bioinductive Implant (RBI) has been proposed as a biological alternative that could increase the healing chances and the quality of the repair. The aim was to determine the effect on the healing rate in MRI at 12-month follow-up of the addition of a RBI over a transosseous equivalent (TOE) repair of supraspinatus tears.

Methods: Multicentric, triple-blinded, randomized controlled trial (ClinicalTrials.gov: NCT04444076). Subjects with isolated symptomatic reparable supraspinatus tendon tears <4cm, without fatty infiltration, were randomized to two groups: In the Control group (CG) an arthroscopic TOE repair was performed; in the Regeneten group (RGT) a RBI was additionally placed over the repair. Primary outcome was retear rate (defined as Sugaya 4 or 5) in MRI at 12 months follow-up. Secondary outcomes thickness at the medial part of the footprint, 10 mm medial and 20mm medial to it, and clinical outcomes (pain levels, EQ-5D-5L, ASES and Constant scores).

Results: The final outcomes of the 124 randomized subjects will be available by March 2023; a full report of the MRI and clinical outcomes for the full study population will be available by June 2023. An interim analysis of the initial 60 randomized subjects has already been performed. Fifty-seven subjects (29 in the RGT group and 28 in the Control group) were available for MRI assessment in March 2022. There were no differences in preoperative characteristics (age, comorbidities, size and retraction of the tear, fatty infiltration) or in postoperative complications. At one year follow-up, the retear rate was 3.5% in the RGT group (1/29) vs. 25% in the Control group (7/28) (significant differences, $p=0.022$). The failure rate at the musculotendinous junction was also lower in the RGT group (3,5% vs.22%, $p=0.044$). There were no significant differences in tendon thickness.

Conclusions: The results of the interim analysis strongly suggest that adding an RBI to a TOE repair of a mid-sized supraspinatus tear improves the tendon healing rate. Results of the full 124 subjects might confirm these findings.

FP.30.06

DOES PAIN SENSITIZATION AFFECT PATIENTS' OUTCOMES AFTER ROTATOR CUFF REPAIR?

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Background: Not all patients show favorable clinical results after rotator cuff repair (RCR). Repetitive stimulation of the central nervous system can cause central sensitization (CS). The purpose of this study was to compare the clinical results between patients with and without CS after RCR. We hypothesized that patients with CS would show poor clinical outcomes after RCR.

Methods: This study is a retrospective analysis of data collected prospectively from patients who underwent arthroscopic RCR. All patients were screened for CS preoperatively using the Central Sensitizing Inventory (CSI). Severity of neuropathic pain was assessed using the Pain DETECT (PD-Q) score. Among 86 patients with minimal 1-year follow-up, 15 patients were identified as being centrally sensitized (CS group) and 71 patients with non-centrally sensitized (non-CS group). Patients were evaluated using the visual analog scale (VAS) for pain and shoulder function was evaluated by using American Shoulder and Elbow Surgeons score (ASES), Constant score, University of California at Los Angeles (UCLA) shoulder score preoperatively and at the last follow-up visit. Range of motion (ROM) was assessed preoperatively, and at the last follow-up visit. In the postoperative 1 year, rotator cuff tendon integrity was assessed by using MRI.

Results: There was no significant difference between groups in the preoperative demographic data. The mean follow-up period was 13.7 ± 3.8 months. CS group showed higher PDQ score (13.6 ± 8.1 vs 8.1 ± 7.0 , $p=0.017$) and poor ROM in abduction ($p=0.028$) and abduction-internal rotation (ABIR) ($p=0.025$) preoperatively. Significant improvements in functional and pain scores were observed in both groups at the last follow-up visit. CS group showed a higher VAS score ($p=0.010$) and poor ASES score ($p=0.014$) at the last follow-up. One case of retear was found in the CS group and 5 cases in non-CS group, representing 7% of retear rate for both groups.

Conclusions: 17.4% of patients were found centrally sensitized in patients who received rotator cuff repair. Although significant improvement was found after rotator cuff repair, preoperative clinical outcomes and both postoperative clinical outcomes and early ROM gain were poor in CS patients.

FP.30.07

DO CONCOMITANT LONG HEAD OF THE BICEPS LESIONS AFFECT CLINICAL OUTCOMES AFTER SUPERIOR CAPSULE RECONSTRUCTION USING FASCIA LATA AUTOGRAFTS IN IRREPARABLE ROTATOR CUFF TEARS?

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Background: It remains unclear whether lesions of the concomitant long head of the biceps (LHB) should be treated when we treat patients with irreparable rotator cuff tears (RCTs) by superior capsule reconstruction (SCR). We aimed to assess whether preserved LHB lesions affected clinical outcomes after SCR.

Methods: This retrospective study initially included 108 patients with irreparable RCTs who underwent arthroscopic SCR using fascia lata autografts. Ten patients with dislocation of the LHB treated by tenotomy or tenodesis were excluded. Consequently, 98 patients (43 women, 55 men; mean age 70.1 years) with irreparable RCTs who underwent arthroscopic SCR using fascia lata autografts were included in this study. According to Lafosse's classification, the arthroscopic finding of the LHB was evaluated intraoperatively and classified into four categories: grade 0, normal; grade 1, minor erosions with 50% loss of tendon sheath; grade 2, major erosions with 50% loss of tendon sheath; and grade 3, complete rupture. All LHB tendons were preserved. We compared visual analog scale (VAS) scores for pain, American Shoulder and Elbow Surgeons (ASES) scores, and graft tear rates among the four groups based on the finding of LHB.

Results: Arthroscopic findings showed 25 shoulders with grade 0 LHB, 20 with grade 1 LHB, 27 with grade 2 LHB, and 26 with grade 3 LHB. ASES scores significantly improved after SCR in all groups (grade 0, 30.7 to 93.3; grade 1, 34.8 to 92.2; grade 2, 40.1 to 94.8; grade 3, 37.9 to 91.4; all $P < 0.01$). VAS scores also significantly improved after SCR in all groups (grade 0, 6.2 to 0.3; grade 1, 5.5 to 0.6; grade 2, 5.6 to 0.2; grade 3, 6.3 to 0.8; all $P < 0.01$). Postoperative ASES and VAS scores did not differ significantly among the groups. In addition, there was no significant difference in the graft tear rate among the four groups (grade 0, 8.0%; grade 1, 10.0%; grade 2, 7.4%; grade 3, 7.7%).

Conclusions: Concomitant LHB lesions without dislocation do not affect clinical and structural outcomes after SCR. The treatment of LHB lesions without dislocation does not appear to be necessary when we treat patients with irreparable RCTs by arthroscopic SCR.

FP.30.08

3D RECONSTRUCTION FOR ROTATOR CUFF TEAR. IS THIS THE BEST METHOD FOR ASSESSMENT AND UNDERSTANDING?

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Background: MRI has become the current standard for diagnosis; however, this examination provides a two-dimensional image with displayed on a monitor, and projected images can lead to difficulties in interpreting anatomy. Prototyping or 3D printing may provide a solution to this problem. Our hypothesis is that three-dimensional models can improve the understanding and knowledge of rotator cuff injuries, improve the application of classifications for total tears, the definition of the size and type of tear and also increase the accuracy of surgical planning. The shape of a rotator cuff tear is an important but understudied feature.

Methods: Prospective single-center study. 3D models for rotator cuff tears will be created. The will analyze preoperative magnetic resonance imaging in conjunction with three-dimensional reconstruction of each patient's individual models. Data collected: 2D plane measurement by MRI in coronal and sagittal planes; description of 3D lesion geometry; 3D measurement in coronal and sagittal planes; arthroscopic classification of rotator cuff injury; arthroscopic measurement in coronal and sagittal planes.

Results: MRI showed similar values in the sagittal plane before bursectomy, measurements did not agree with arthroscopic examination after bursectomy compared to 3D, and 3D showed similar values after bursectomy. MRI and 3D showed similar values in measurement accuracy in the coronal plane compared to measurements before and after bursectomy. By creating three-dimensional objects, it was possible to analyze new geometries with length, width, and depth of each lesion. These include the rectangle, the rectangular trapezoid (with two straight angles), the scalene trapezoid (non-parallel sides are not congruent), the irregular pentagon (five different sides) and the irregular hexagon (six different sides).

Conclusions: Three-dimensional models have increased the understanding and knowledge of rotator cuff injuries and have proven to be a useful tool for diagnosing and interpreting the anatomy of the injury, especially in the sagittal plane. Because of the new 3D understanding of the pathologic process, new geometric features have been described that are not seen in conventional 2D MRI. The results of our study suggest that 3D images of the rotator cuff may be an important tool to better characterize, investigate, and understand rotator cuff injuries.

FP.31.02

VALIDATION OF CLASSIFICATION SYSTEMS FOR RADIAL HEAD AND NECK FRACTURES: POOR INTRA AND INTER-OBSERVER RELIABILITY FOR X-RAY BASED CLASSIFICATION

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Background: The Mason classification for radial head fractures is more than 40 years old and the original radiographic description can be described as imprecise and confusing. Moreover it does not lend itself to guide management options. It also does not differentiate between head and neck fractures. A new fracture classification system of the proximal radius was developed which seeks to be more precise. This study tests the validity of the old Mason classification and the new Melbourne classification based on radiographs. The new classification separated head and neck fractures and introduces a new category of Tripartite fractures that are associated with high rates of capitellar chondral injuries.

Methods: Classification of 84 radiograph image sets of radial head and neck fractures obtained from a statewide orthopaedic trauma registry (the Victorian Orthopaedic Trauma Outcomes Registry, VOTOR) was performed by five observers for both the the Mason and the new Melbourne classification systems. Three rounds of observation were performed at least two weeks apart. Interobserver and intraobserver reliability were then calculated using the kappa statistic.

Results: The highest interobserver reliability for the Melbourne classification was 0.353 +/- 0.011 (95% CI 0.331 - 0.375). The average intraobserver reliability was 0.477. The highest interobserver reliability for the Mason classification was 0.532 +/- 0.022 (95% CI 0.488 - 0.576). The average intraobserver reliability was 0.598.

Conclusions: Both the Mason and new Melbourne classification had poor reliability when based on plain radiographs. The new classification is better able to describe the full array of proximal radius fracture patterns, particularly when compared to the commonly used Mason classification, and may better correlate with appropriate management techniques than current classification systems. However, reliability of the new classification needs to improve before it can be used clinically. Enhanced imaging techniques, such as computed tomography (CT) with 3D reconstructions, would allow better interpretation of fracture patterns in future reliability studies and may result in satisfactory reliability of the new classification system.

FP.31.03

PROXIMAL RADIUS FRACTURES AND ASSOCIATED SOFT TISSUE INJURIES

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Background: Proximal radius fractures are commonly associated with soft tissue injuries. The aim of this study was to assess correlation between proximal radius fracture morphology and associated soft tissue injuries around the elbow joint.

Methods: In a prospective case series, 55 patients with a proximal radius fracture were included. Inclusion criteria were proximal radius fractures in patients over 18 years of age and no other fractures. Patients with concomitant elbow dislocation were excluded. Fracture morphology was assessed using CT scans. The fractures were categorized as engaging the head or the collum. Radial head fracture characteristics was further assessed and the radial head articular surface was divided into 4 quadrants, based on the location of the biceps tuberosity, and grouping fracture line patterns based on the afflicted quadrant. The degree of fracture displacement was measured as articular steps in the radial head or angulation of the collum. Soft tissue injuries were assessed from magnetic resonance imaging, dividing the soft tissue injuries into lateral (common extensor origin, lateral collateral and annular ligaments) and medial (common flexor origin and/or medial collateral ligament).

Results: Mean age at time of injury was 45 years (range, 22-84 years), female/male ratio 30/25. Any form of soft tissue injury was found in 6/7 (86%) radial collum fractures and 30/48 (63%) radial head fractures. Medial soft tissue injury was found in 22 cases and lateral soft tissue injury in 21 cases, of which 12 were concomitant medial and lateral soft tissue injuries. The radial head fractures displayed 7 different fracture patterns, of which 53% were non-displaced and 91% displaced less than 3 mm. No correlation was found between prevalence of soft tissue injuries and different articular fracture patterns or degree of fracture displacement.

Conclusions: Soft tissue injuries are common in association with proximal radius fractures. A higher prevalence was found associated with collum fractures than with radial head fractures. Other fracture patterns or degree of fracture displacement did not correlate with soft tissue injury prevalence.

FP.31.04

INTERNAL FIXATION, PARALLEL PLATING AND SELECTIVE SUPRACONDYLAR SHORTENING FOR DISTAL HUMERUS NONUNIONS: RESULTS OF THE SUPRACONDYLAR OSTECTOMY AND SHORTENING (SOS) PROCEDURE

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Background: Many distal humerus nonunions are associated with bone loss and rigid internal fixation is difficult to obtain, especially for low transcondylar nonunions and those with severe intraarticular comminution. This study analyzed the results of Supracondylar Ostectomy + Shortening (i.e. S.O.S.) procedure for distal humerus nonunions. The goals of this procedure are to (1) optimize bony contact and compression through re-shaping the nonunited fragments at the supracondylar level with selective humeral shortening, (2) maximize fixation using parallel-plating, and (3) provide biologic and structural augmentation with bone graft.

Methods: 28 distal humerus nonunions underwent internal fixation using the S.O.S. procedure at a single Institution. There were 14 males and 14 females with mean age of 47 (range 14-78) years at the time of the S.O.S procedure and an average of 1.7 prior surgeries. Medical records and radiographs were reviewed to determine rates of union, reoperations, complications, and Mayo Elbow Performance Scores. Patients were also prospectively contacted to update their Mayo Elbow Performance Score and gather additional information on complications and reoperations. Mean clinical exam follow-up was 17 months, mean clinical contact follow-up was 19 months, and mean radiographic follow-up was 32 months.

Results: 24 elbows achieved union. Two elbows developed collapse of the articular surface and were converted to a total elbow arthroplasty (TEA) at 14-months and 18-months. Two patients did not have adequate follow-up to determine union. One elbow required an additional bone grafting surgery prior to union. There were complications in 10 elbows. Twelve elbows underwent reoperation. Compared to pre-operative data, there was a significant improvement in post-operative flexion, extension and pronation ($p < 0.01$). The mean range of motion was 19-degrees of extension, 120-degrees of flexion, 79-degrees of pronation, and 77-degrees of supination. At most recent follow-up, the Mayo Elbow Performance Score could be calculated for 25 elbows, with a mean of 80 points (range, 25 to 100 points) and 19 elbows (76%) rated as excellent or good.

Conclusions: Stable fixation and high union rates are possible in distal humerus nonunions with bone loss using a technique that combines supracondylar humeral shortening, parallel plating, and bone grafting.

FP.31.05

INDICATIONS AND CLINICAL OUTCOMES OF DOUBLE PLATE OSTEOSYNTHESIS IN PROXIMAL ULNAR FRACTURES: COMPARATIVE STUDY OF TWO PLATING CONFIGURATIONS

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Background: Few studies analyzed indications and results of double-plate osteosynthesis in proximal ulnar fractures (PUF). The aim of this study is to compare indications and to analyze clinical results of two different double-plate configurations.

Methods: A multicentric-retrospective study was realized on 44 consecutive patients surgically treated with double-plate osteosynthesis for PUF. Out of 44 cases, 32 (73%) had a PUF associated to complex elbow instability (group I) whereas 12 (27%) had an isolated olecranon fracture (group II). In 18 cases a posterior +antero-medial plate configuration was performed (Configuration I), while in 26 cases osteosynthesis was achieved through a postero-medial +postero-lateral plate configuration (configuration II). Treatment of associated lesions was performed according to current therapeutic algorithms. All patients were encouraged to an early functional rehabilitation. At the last follow-up, a radiological and clinical evaluation was performed using MEPS, MEPI, p-ASES-e and DASH scores.

Results: Mean follow-up was 31 months (range, 6-77). Mean MEPS, DASH and p-ASES-e were respectively 96, 5 and 104, while MEPI was "excellent" in 38 cases, "good" in 4, "fair" in 1 and "poor" in 1, without significant differences between groups and configurations, except p-ASES-e and DASH that were inferior in group I. PUF were associated to complex elbow instability in all patients treated with configuration I and in 14 patients that received configuration II; All patients from group II (12) were treated with configuration II. Five complications led to reintervention (3 with configuration I and 2 with configuration II): 1 symptomatic partial radial head resection, 3 symptomatic posterior plates (one associated to LCL laxity), 1 ulnar neuropathy.

Conclusions: Double plate osteosynthesis is mainly indicated in all multifragmentary PUF with a predominant sagittal fracture plane, where stable fixation should be achieved on both coronal and sagittal planes. In particular, configuration I is indicated in fractures where it is necessary to fix both the posterior olecranon region and anterior coronoid fragments or large metaphyseal antero-medial fragments. Configuration II is indicated in comminuted fractures of the olecranon where medial and lateral fragments are identified and fixation should be achieved on the coronal plane. Moreover, configuration II is particularly suitable in all olecranon fractures associated to impaired posterior skin, where posterior plate positioning is contraindicated. With these indications, satisfactory results can be expected in the majority of cases.

FP.31.06

SLIDING OSTEOTOMY FOR OLECRANON NONUNION TREATMENT

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Background: Nonunion is a rare complication after surgical treatment of olecranon fracture, but indeed it is a devastating one because of high potentials for elbow stiffness, pain, soft tissue and skin problems and device complaining. To our knowledge there is no treatment of choice for olecranon nonunion in the literature. We describe a unique New technique by sliding osteotomy of olecranon and refixation with tension band wiring.

Methods: two patients treated by this technique ,osteotomy is performed in the form of a pyramid in the proximal and distal parts of the nonunion so that the distal part is at least twice as long as the proximal part then proximal pyramid is removed and distal pyramid is pulled to proximal so that completely fill the proximal part and cross the non union site .then removed proximal pyramid is placed in slided vacant part of distal pyramiid ant tension band wiring is fastened over the pyramids

Results: two patients had union of the nonunion site at 3 months post operation.no restriction of ROM detected after union

Conclusions: sliding osteotomy is a new simple and effective method for treating nonunion of olecranon process.

FP.31.07

CAPITELLUM AND TROCHLEA FRACTURES. A SYSTEMATIC REVIEW OF THE LITERATURE

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Background: Purpose of this study was to investigate the outcome of capitellum and trochlea fractures through a systematic review of the contemporary literature. The effect on the outcome, of the posterolateral column comminution and the surgical approach used for fixation, was also evaluated

Methods: Various databases were searched for capitellum and trochlea fractures and a systematic review was conducted according to PRISMA guidelines. The minimum one year clinical outcome and the flexion extension arc of these fractures, as well as the risk of developing degenerative arthritis were evaluated. A fixed effect model was performed to compare the outcome and range of motion among Dubberley type A and type B fractures as well as between the extended lateral approach and the posterior transolecranon approach which were performed for Dubberley type B fractures. Furthermore the relative risk of degenerative arthritis (DA) among type A and type B fractures was also estimated. Chi square test was used to test heterogeneity among studies.

Results: Ten nonrandomized case series were eligible to our inclusion criteria, including 76 patients in total. The fixed overall Mayo Elbow Performance Score (MEPS) and the Range of Motion (ROM) of the Dubberley type A fractures was 86 and 124 respectively. The fixed overall MEPS and ROM of the Dubberley type B fractures was 84 and 122 0 respectively. Significant heterogeneity was found though between studies regarding MEPS of type B fractures. The fixed overall MEPS and ROM for fractures treated with an extended lateral approach was 89,4 and 123 0 respectively. The fixed overall MEPS and ROM for fractures treated with a posterior transolecranon approach was 68,75 and 122 0 respectively. The degenerative arthritis relative risk (RR) of type B compared to type A fractures was 3,91.

Conclusions: There is no statistically significant difference among type A and type B fractures, in terms of outcome and ROM. The posterior transolecranon approach leads to a lower MEPS as opposed to the extended lateral approach. High quality studies comparing directly the outcome of type A and type B fractures are required, in order for safe conclusions to be extracted.

FP.31.08

TOTAL ELBOW REPLACEMENT VERSUS HEMIARTHROPLASTY IN THE TREATMENT OF DISTAL HUMERUS FRACTURES: A COMPARATIVE STUDY OF FUNCTIONAL OUTCOMES

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Background: Management of intra-articular distal humerus fractures in the elderly remains a challenge with superior outcomes demonstrated from primary elbow arthroplasty compared to osteosynthesis. Clinical equipoise exists between total elbow replacement (TER) and hemiarthroplasty (HA). Currently, there are no direct comparisons of these reconstructive techniques. The purpose of this study was to compare the functional outcomes and re-operation rates of TER and HA in the management of distal humerus fractures.

Methods: We retrospectively reviewed 14 patients (13 female and 1 male) with a distal humerus fracture who had been treated with either TER (9 patients) or HA (5 patients) between 2016 and 2021. The mean patient age was 72 years and mean follow-up was 31 months. Patient-reported outcome measures (PROMS) were used to assess functional outcomes and quality of life: (1) Mayo Elbow Performance Score (MEPS), (2) Quick-DASH (Q-DASH), (3) Oxford Elbow Score (OES), (4) SF-12 Physical Component Score (PCS), and (5) EQ-5D. Complications requiring re-operation were recorded for all patients.

Results: Better functional outcomes, physical health status and quality of life were reported following HA compared to TER. The mean differences were clinically important with all PROMS but only met statistical significance with the MEPS (MEPS: HA 90 ± 6 vs TER 67.8 ± 20 , $p=0.0357$; Q-DASH: HA 25 ± 15 vs TER 43.9 ± 22 , $p=0.131$; OES: HA 41 ± 8 vs TER 31.1 ± 9 , $p=0.0534$; SF-12 PCS: HA 50.7 ± 12 vs TER 37.9 ± 11 , $p=0.0542$; EQ-5D: HA 76 ± 15 vs TER 64.4 ± 17 , $p=0.228$). In the HA group 2 patients required re-operation for heterotopic ossification. In the TER group, 1 patient required re-operation on 3 occasions for periprosthetic ulna fracture treated with plate fixation complicated by subsequent infection necessitating staged plate removal and revision of the ulna component.

Conclusions: In the treatment of complex intra-articular distal humerus fractures in the elderly, HA provides better functional outcomes compared to TER. This data is limited by low patient numbers given the rarity of this injury. A multicentre randomised controlled trial is warranted to definitively establish best practice.

FP.32.01

THREE-PART HUMERAL HEAD FRACTURES TREATED WITH A DEFINITE CONSTRUCT OF BLOCKED THREADED WIRES: 3D FINITE ELEMENT AND PARAMETRIC OPTIMIZATION ANALYSIS

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Background: Mini open reduction and percutaneous fixation of three-part humeral head fracture with blocked threaded wires has demonstrated functional results similar to locking plates or intramedullary nails but with significantly lower major complication rate. In the context of three-part humeral head fractures, we performed a parametric optimization through a finite element analysis of a recently published construct to verify if the encouraging clinical results can be supported by a more rigorous investigation from a mechanical viewpoint.

Methods: The 3D geometry of a three-part proximal humerus fracture synthesized with a system of blocked threaded wires was created. Tension/bending/shear and compression load tests were simulated. A parametric optimization analysis was performed considering four design parameters (height of wire couples; wire material; inter-distance between two wires). Eighteen simulations were carried out. Additional analyses were performed also considering a varying diameter of the external rod.

Results: Four points where the largest gap occurs, and three points associated with the highest stress concentration were considered. According to the tension/bending/shear loading, a slight gap increase was observed in two different points (8.494 micr.m; 7.540 micr.m) while a slight decrease was detected along the greater tuberosity fracture line (1.445 micr.m). The maximum von Mises stress up to 64.4 MPa was achieved in the humeral head. According to the compression loading, the gap increased along the greater tuberosity fracture line (1.445 micr.m; 7.545micr.m); the maximum von Mises stress attains the value of 64.42 MPa.

The smallest gap distance (15.37micr.m) and the lowest von Mises stress (51.51 MPa) were obtained in two different alternative constructs. The diameter of the external rod had no significant effect.

Conclusions: The studied construct is biomechanically valid; it only allows micromovements (one-thousandth of the characteristic humerus size) that are not able to cause humeral head rotation and translation. Furthermore, the construct generates acceptable pressure stresses on sensible areas of the fractured humeral head. Compared to the original construct, we propose to space the pair of horizontal wires for the great tuberosity by at least 1 cm.

FP.32.02

SUBSCAPULARIS CT-SCAN EVALUATION IN PATIENTS WITH PROXIMAL HUMERUS FRACTURE: REVERSE TOTAL SHOULDER ARTHROPLASTY VERSUS HEMI-ARTHROPLASTY

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Background: Hemiarthroplasty (HA) and Reverse Total Shoulder Arthroplasty (RTSA) are both a reliable treatment option for complex proximal humerus fractures. While subscapularis tendon role is defined in HA, it plays a controversial role in RTSA; The purpose of our study was to compare subscapularis trophism in the postoperative period between patients treated with HA or RTSA. The secondary aim of the study was to investigate whether an association existed between the subscapularis trophism and the clinical outcomes at the final follow-up.

Methods: Sixty-eight consecutive patients were prospectively enrolled into the study from June 2015 to May 2020. Thirty-six patients with preexisting or anticipated rotator cuff deficiency or a comminution of the greater tuberosity underwent RTSA and the remaining thirty-two underwent HA. Shoulder CT scan were performed pre- and postoperatively, and subscapularis muscle cross-sectional area (SMCSA) and supraspinatus fossa cross-sectional area (SFCSA) were measured in squared millimeters. SMCSA/SFCSA ratio was employed to standardize values for individual anatomical differences between patients. Patient reported outcomes were completed at the final follow-up: Constant score (CS), Quick Dash, SST, and VAS. Range of Motion (ROM) was evaluated at the final follow up. Wilcoxon-Mann-Whitney, Chi-square test and Fisher's test for statistical analysis.

Results: RTSA group showed better results in Constant Score, Quick Dash, Simple Shoulder Test compared to HA patients. VAS score was lower in HA group (Table 1). Statistically significant results were found in RTSA group in internal rotation (IR), external rotation (ER), abduction, and forward flexion compared to HA patients (Table 2). Twenty (55%) RTSA-patients versus eight (25%) HA-patients showed a reduction of subscapularis size of >35% ($p = 0.01$). The loss of subscapularis surface was greater in the RTSA patients (RTSA $-682,5 \pm 561,32\text{mm}^2$ vs HA $-338,5 \pm 416,25\text{mm}^2$) ($p=0.018$).

Conclusions: RTSA demonstrated better results compared to HA as a treatment for acute proximal humeral fracture, providing better ROM and higher degree of patient satisfaction. Postoperative loss in subscapularis size was significantly higher in RTSA group than HA group. Subscapularis condition seems to show no correlation with functional outcome in RTSA; nonetheless, repair of the subscapularis tendon could improve other properties not influencing clinical outcomes.

FP.32.03

OUTCOME ANALYSIS FOR INTRAMEDULLARY NAIL FIXATION VERSUS OPEN REDUCTION INTERNAL FIXATION IN HUMERAL DIAPHYSEAL FRACTURES ABSTRACT

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Background: Open reduction internal fixation (ORIF) and intramedullary nail fixation (IMN) are the predominant repair methods for operative treatment of humeral diaphyseal fractures, however, the optimal method is not fully elucidated. The purpose of this study was to analyze whether IMN or ORIF humeral diaphyseal surgeries result in a significantly higher prevalence of adverse outcomes. We additionally sought to evaluate the possible age dependency of adverse outcomes following such procedures. We hypothesize there is no difference in reoperation rates and complications between IMN and ORIF for humeral diaphyseal fractures.

Methods: Data collected from 2015-2017 from the Nationwide Readmissions Database was evaluated to compare differences in the prevalence of six adverse outcomes following IMN and ORIF humeral diaphyseal surgeries: radial nerve palsy, infections, nonunion, malunion, delayed healing, and revisions. Patients treated for a pathological fracture with either IMN or ORIF were matched and compared (n= 2,804 pairs). Patients with metastatic cancer were excluded.

Results: Following an ORIF procedure, there was a greater odds of undergoing revision surgery ($p = 0.03$) or developing at least one of the complications of interest ($p = 0.03$) compared to an IMN procedure. In the age-stratified analysis no significant differences were identified in the prevalence of adverse outcomes between the IMN and ORIF cohorts in the 0-19, 20-39, and 40-59 age groups. Patients who were 60+ had 1.89 times the odds of experiencing at least one complication and 2.04 times the odds of undergoing a revision after an ORIF procedure versus an IMN procedure ($p=0.03$ for both).

Conclusions: IMN and ORIF for humeral diaphyseal fractures are comparable in regard to complications and the need for revision surgery in patients under the age of 60. Meanwhile, patients 60+ years show a statistically significant increase in the odds of undergoing revision surgery or experiencing complications following an ORIF in comparison to those receiving IMN. Since IMN appears to be more beneficial to older patients, being 60+ years old should be considered when determining fracture repair techniques for patients presenting with primary humeral diaphyseal fractures.

FP.32.04

ARTHROSCOPIC TRANSOSSEOUS SUTURE FIXATION OF PROXIMAL HUMERAL FRACTURES

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Background: Arthroscopic techniques have proven to be advantageous in the treatment of greater tuberosity and lesser tuberosity fractures (suture bridging technique) and subcapital humeral fractures (arthroscopic nailing). A new one day surgery method of arthroscopic reduction and fixation of 2-4 parts proximal humeral fracture using sutures will be presented.

Methods: Over a six-year period, a consecutive series of 33 patients with a specifically defined displaced fracture of the proximal part of the humerus underwent arthroscopic reduction and transosseous sutures fixation. All fractures were fixed with arthroscopic transosseous, nonabsorbable, number-2 nonabsorbable sutures. Four patients were lost to follow-up and one died before the time of follow-up. 28 patients; 19 females (70%) and 9 males (30%) out of 33 treated with this technique between December 2011 and June 2017 were examined with an average follow up of two and a half years between 12 and 73 months, 20 of them with osteoporosis (62%), the average age was 60 years, between 24 and 90 years. There were 6 cases (21%) of greater tuberosity two parts fracture, 15 cases (54%) of displaced three parts fracture and 7 cases (25%) of 4 parts displaced proximal humerus fracture, three of them with head splitting displaced fracture and 4 with detected rotator cuff tear (14%) one with 2parts, one 3 parts and 2 four parts fracture were also repaired.

Results: according to Neer classification excellent results were present in all cases of the two parts fracture, 8 (53%) of the 3 parts and 2 (29%) of the 4 parts fracture, satisfactory results were in 7 of the 3 parts (47%) and 3 (42%) of the 4 parts (29%) while unsatisfactory results were present in 2 of the 4 parts (29%). No complications of AVN were present. Malunion was found in 2 of the 4 parts fracture cases and 3 cases of three parts fracture. Two patients had signs of impingement syndrome.

Conclusions: The clinical and radiographic result strongly encourage using the arthroscopic techniques to treat proximal humerus fractures without disturbing the blood supply as open technique irrespective to age or osteoporosis without complications of osteonecrosis or nonunion.

FP.32.05

A NOVEL METHOD OF ACQUIRING HUMERAL ALIGNMENT DURING INTRAMEDULLARY NAILING

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Background: Rotational malalignment during intramedullary nail insertion for humeral shaft fractures is a serious concern. To date, there are no well-documented and accurate anatomic landmarks to guide surgeons during implant placement to correct for rotational deformity. This study aims to describe a new method for humeral alignment during intramedullary nail insertion using the profile of the greater tuberosity and its relation to the transepicondylar axis called the greater tuberosity version angle.

Methods: This study analyzed 506 cadaveric humeri of adult patients. All humeri were CT scanned and used to generate 3D surface models of the humerus. Next, 3D landmarks were automatically calculated on each 3D bone using custom-written software in Microsoft Visual C++. The anatomical landmarks analyzed were the transepicondylar axis, the humerus anatomical axis, and the perpendicular axis of the greater tuberosity. Lastly, the angle between the transepicondylar axis and the greater tuberosity axis was calculated and defined as the greater tuberosity version angle.

Results: The value of GTVA was 20.9 degrees \pm 4.7 with a 95% confidence interval between (21.3 and 20.5). Results of ANOVA revealed that females had a statistically significant larger angle of 21.95 degrees \pm 4.49 compared to males, which were found to be 20.49 degrees \pm 4.8 (p=0.001).

Conclusions: The GTVA is an accurate and reliable method for recreating the anatomic alignment of the humerus during intramedullary nail insertion. We believe reproducing this angle will help mitigate the complications associated with malrotation of the humerus following IMN.

FP.32.06

LIMITED INCISION PLATING OF MIDSHAFT CLAVICLE FRACTURES - A CASE SERIES OF 820 PATIENTS

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Background: Recent literature supports a trend towards operative management of displaced midshaft clavicle fractures. The traditional surgical approach to the clavicle involves a large, approximately 10cm incision that is not infrequently associated with irritation, poor cosmesis and anterior chest wall numbness. This paper describes a novel limited incision approach to clavicle plating and reports long-term functional and radiographic outcomes for a large cohort of operative midshaft clavicle fractures.

Methods: A prospectively maintained database was used to identify 820 patients who underwent surgical treatment for acute midshaft clavicle fractures. All operations were performed using a minimally invasive, 3-5cm incision to expose, reduce and plate the fracture, with retractors used to lever the skin and allow lateral and medial drilling. Clinical and radiographic follow up included measurement of the Disabilities of the Shoulder, Hand and Arm (DASH) score, patient-reported questioners and serial X-rays until union.

Results: The cohort included 820 acute fractures. The mean DASH score at last follow up was 0.9 (range 0 – 46.7). Full range of shoulder movement was achieved in a mean time of 6.2 weeks (range 1 – 52 weeks). The mean time to union was 10.6 weeks (range 4 – 61 weeks) and the non-union rate was 0.24%, in all cases due to infection. Deep and superficial infections occurred in 5 (0.61%) and 13 (1.6%) of cases, respectively. Significant peri-clavicular numbness and plate irritation were rare (1.3% and 2.8%, respectively) and 93.7% of patients felt that their shoulder was 'normal' with a mean follow up duration of 19.3 months (range 39 days – 79.6 months).

Conclusions: In this large cohort with long-term follow up, a limited incision approach for plating of midshaft clavicle fractures achieved good functional and radiographic outcomes with a low complication rate comparable to the reported rate for standard incision techniques.

FP.32.07

RESORPTION OF THE TUBEROSITIES DOES NOT INFLUENCE THE FUNCTIONAL OUTCOMES AFTER RSA IN THE TREATMENT OF PROXIMAL HUMERAL FRACTURES. A RANDOMIZED CONTROLLED TRIAL. RESULTS AT 3 YEARS OF FOLLOW-UP

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Background: The main objective of this study was to evaluate the influence of the resorption of the tuberosities in the functional outcomes of proximal humerus fractures (PHF) treated with reverse shoulder arthroplasty (RSA).

Methods: A prospective, randomized, blinded, therapeutic clinical trial was carried out. Inclusion and exclusion criteria were approved by the ethical committee. Minimum follow-up was 3 years. 78 patients were randomized with uncemented stem RSA into two groups: "Anatomic Concept" (AC) with 135° + 4mm lateralized glenosphere, and "Grammont Concept" (GC) with 155° + 2.5 mm distalized sphere. Evaluation was performed by 3 independent investigators, two shoulder surgeons for radiological results and one rehabilitation doctor, blinded regarding the stem type: for the functional results at 12, 24, and 36 months. Constant score, Q-Dash, VAS, and ROM were evaluated and compared in the cases for resorption (R) or not (NR) of the tuberosities. Likewise, the functional results were evaluated according to the resorption and the type of groups.

Results: The mean age was 75.4 +/- 5.9. The consolidation rate at 12 months was complete in 81.7% (p <.016).

The full resorption of the tuberosities was 16,6% (13 cases, p <.05). Tuberosities resorption was associated with previous fragmentation, minimal contact after surgery, or both (p <.001). The mean external rotation was 25,4° (NR) and 7,31° (R) (p<.002). As a result of the randomization of all fragmented tuberosities, 13 PHFs with resorption were allocated asymmetrically into 2 groups: GC (3) and AC (10). The mean external rotation in AC was +13,5° and GC -13.33° (p<.05). No statistically significant differences in terms of flexion or internal rotation were found. No stem loosening or dislocation was detected, and one case of infection in 3y follow-up was detected.

Conclusions: RSA for PHF has good clinical outcomes with consistent radiological fixation at 3 years. Complete resorption of tuberosities can compromise external rotation. However, our study suggests the loss of ER can be reduced by using RSA with anatomical concept stem.

FP.32.08

ASSOCIATION BETWEEN HUMERAL HEAD BONE DEFECTS AND HUMERAL HEAD ANGULATION IN PROXIMAL HUMERUS FRACTURE

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Background: The humeral head angulation in proximal humerus fracture (PHF) was variable. The medial calcar played an important role in maintaining humeral head position, while the contribution of humeral head bone mass was insufficiently analyzed. We aimed to explore the association between humeral head bone defects and head angulation in PHFs.

Methods: We used the reconstruction function in the Mimics software to obtain the three dimensional fracture models, and used certain bony landmarks to define the calcar and humeral head zone. Boolean subtraction was used to calculate the volume of head bone defects. The Fisher tests were used to verify the statistical differences in calcar fracture incidence between groups. The ANOVA tests were used to test whether the differences in percentage of bone defects between groups were significant or not.

Results: The cohort was composed of four Neer two part, 57 Neer three part and 43 Neer four part PHFs with 69 (66.3%) females and a mean age of 64.7 years. The cohort had 60 (74.1%) varus, 21 (25.9%) valgus and 23 (22.1%) neutral type PHFs. The mean percentage of humeral head bone defects was 38.5 ± 17.8 in varus, 36.3 ± 15.7 in valgus, and 30.1 ± 10.6 in neutral type PHFs. The difference between the varus and neutral groups was significant ($P=0.035$). Further, we analyzed the humeral head bone defects among patients over 65 years old, the mean percentage of humeral head bone defects was 42.7 ± 16.4 in varus (27 cases), 34.8 ± 14.5 in valgus (13 cases), and 28.1 ± 11.8 in neutral type PHFs. Six (10.0%) varus displaced PHFs were not concomitant with calcar fracture, and the mean percentage of humeral head bone defects was 29.3% in these PHFs. Compared to 39.6% in those with calcar fractures, the difference was not statistically significant ($P=0.18$).

Conclusions: Varus displacement could occur in the PHFs with intact calcar, and they all had humerus head bone defects to some degree. Varus deformity was not only associated with calcar fracture, but also with humerus head bone defects. Head bone defects could also be seen in the neutral type PHFs, and the defects were more prominent in the varus displaced PHFs compared to the neutral type.

FP.33.01

MEDIUM-TERM RESULTS OF STEMLESS, SHORT AND CONVENTIONAL STEM HUMERAL COMPONENTS IN ANATOMIC TOTAL SHOULDER ARTHROPLASTY: A NEW ZEALAND JOINT REGISTRY STUDY

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Background: The purpose of this study was to compare the medium-term results for anatomic total shoulder arthroplasty by humeral component stem length. We hypothesise that the newer stemless implants may have comparable results to stemmed implants.

Methods: The 12 most used anatomic total shoulder arthroplasty implants on the New Zealand Joint Registry were included in the study. Implants were categorised by stem length; conventional, short, and stemless. The primary outcome was revision up to 7 years post-surgery. Secondary outcomes included revision cause, implant survival and early functional outcomes as evaluated by the Oxford Shoulder Score. Analysis was stratified by age and surgeon volume to control for potential confounding.

Results: 3952 patients (conventional; 3114, short; 360, stemless 478) were included in the study. No significant difference in revision rate per 100 component years was found between stemless and stemmed implants (revision rate per 100 component years: conventional 1.01 [CI95: 0.89 – 1.14], short 0.54 [CI95: 0.25 – 1.03], stemless 0.99 [CI95: 0.51 – 1.74]). This finding was irrespective of patient age or surgeon volume. There were no cases of humeral loosening up to 7 years follow-up and no cases of intra-operative humeral fracture in the stemless group. Functional outcomes at 6 months post-surgery suggested slightly better outcomes in the stemless group compared with the conventional stem group (mean Oxford Shoulder Score: conventional 39.4; stemless 40.7; P value = 0.023).

Conclusions: The medium-term survival of stemless implants for anatomic total shoulder arthroplasty appears comparable to short and conventional stemmed implants. Further follow up is required to understand the long-term survivorship and functional outcomes between the groups.

FP.33.02

REVISION OF FAILED REVERSE TOTAL SHOULDER ARTHROPLASTY WITH REVERSE: SHORT-TERM CLINICAL OUTCOMES

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Background: The prevalence of failed reverse total shoulder arthroplasty (rTSA) is increasing. This can often present a challenging clinical situation with substantial bone loss and limited reconstruction options. This study reports a single tertiary referral center's experience with revision of failed rTSA managed with revision rTSA of non-modular components.

Methods: Following the local institutional review board's approval, all revision arthroplasty cases performed at our institution between 2012 and 2020 were reviewed. Cases in which rTSA was revised to a new rTSA construct with revision of at least one bone-fixed implant (humeral stem and/or baseplate) with a minimum two-year follow-up were identified. Characteristics of revision cases—including indications, bony stock, revised components, and use of bone graft—were collected. All patients were contacted for patient-reported outcome measures at a minimum of two-years following surgery. In addition, the incidence and indication for any reoperation following revision was determined.

Results: Thirty patients with an average age of 66 years (range: 46-82) with 12 (40%; 12/30) males met inclusion criteria and had a mean follow-up of 4.2 years (range: 2-8). The most common indication for revision rTSA included humeral component loosening (33%; 10/30), baseplate loosening (23%; 7/30), and instability (23%; 7/30). Pre-revision work-up for infection demonstrated no cases of periprosthetic shoulder infection. Eleven cases had massive bone loss—four treated with humeral allograft prosthetic composite, four with glenoid bone grafting, and three with VRS. In total, 9 cases (30%; 9/30) required reoperation at mean of 13 months (range: 1-44) for instability (4), humeral loosening (2), infection (1), baseplate loosening (1), or periprosthetic fracture (1). The re-operation rate for patients with revised baseplates only, humerus only, or combined was 23% (3/13), 28% (5/18), and 27% (3/11), respectively. Overall, VAS pain improved from 6.5 pre-operatively to 2.0 ($p < 0.001$) and the ASES score improved from 30.7 to 67.5 ($p < 0.001$). However, post-operative SANE score averaged only 51.2% (range: 2-100).

Conclusions: This study demonstrates that failed reverse TSA can be salvaged with a revision reverse TSA. However, patient expectations for functional improvements should be tempered and a high re-operation rate should be expected.

FP.33.03

HOW TO CHOOSE THE BEST LATERALIZATION AND DISTALIZATION OF THE REVERSE SHOULDER ARTHROPLASTY TO OPTIMIZE THE CLINICAL OUTCOME IN CUFF TEAR ARTHROPATHY? A RETROSPECTIVE STUDY

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Background: Many factors such as the status of the deltoid (weak, strong), the status of the rotator cuff, scapulothoracic joint mobility, and stiffness influence the functional outcome of reverse shoulder arthroplasty (RSA). The design of the glenoid and humeral components can modify the degree of lateralization and distalization of the prosthesis and the final outcome. The purpose of this retrospective monocentric study is to investigate the best combination in terms of lateralization and distalization to optimize the outcome of RSA for cuff tear arthropathy (CTA) with a functional deltoid.

Methods: Sixty-six consecutive RSAs implanted between 2014-2018 for CTA with a functional deltoid were retrospectively analysed in terms of lateralization and distalization by using the "lateralization shoulder angle" (LSA) and the "distalization shoulder angle" (DSA) according to Barth et al. The measurements were done on standard radiographs by 3 independent surgeons at 2 different times. Revision cases, RSA combined with tendon transfer and RSA with functional cuff in glenoid B2 or C were excluded. In all cases the same prosthesis with a possibility to modify the lateralization and the distalization in both components was used. At minimum 2 years follow-up, the range of motion, Constant score, VAS score for pain and subjective shoulder value (SSV) were recorded.

Results: Patients with active forward elevation (FE) >150° and active external rotation (ER) >21°, displayed LSA angle 70-90° and DSA angle 41°-55°. If the lateralization (LSA) is more than 90°, the active FE decreases and the Constant score, SSV and VAS significantly deteriorate ($p < .001$). If the distalization (DSA) is more than 55° or less than 41° active FE and ER decrease significantly ($p < .001$). Difficulties to reduce the prosthesis were faced intraoperatively in cases that these latter values of DSA and LSA were followed as obtained during the preoperative planning particularly in small patient, soft tissue contracture and stiffness.

Conclusions: The pre-operative measurement of the LSA and DSA angles could represent a helpful tool to optimize the clinical outcomes of an adaptable RSA in CTA with a functional deltoid and a complete passive range of motion.

FP.33.04

MACHINE LEARNING ALGORITHMS FOR PREDICTION OF OUTCOMES OF SHOULDER ARTHROPLASTY: A SYSTEMATIC REVIEW

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Background: The use of machine learning (ML) algorithms in disease classification and outcomes prediction is growing. ML techniques can represent valuable tools for informed decision-making through several prediction models. In the setting of shoulder arthroplasty, recent reports showed that ML predictive models can accurately predict postoperative and functional outcomes, which can help stratify patients according to their preoperative characteristics. In this systematic review, we aimed to assess the utility of ML models in predicting the clinical outcomes after shoulder arthroplasty.

Methods: We searched PubMed, Scopus, Embase, and Cochrane databases of the diagnostic accuracy studies assessing the predictive value of ML models in patients undergoing shoulder arthroplasty from January 2010 to May 2022. The diagnostic accuracy measures were extracted in the form of the area under the curve (AUC).

Results: The present systematic review retrieved four studies assessing patients who underwent either anatomic total shoulder arthroplasty (n = 4895 patients) or reverse total shoulder arthroplasty (n = 10618 patients). All included studies used extreme gradient boosting (XGBoost) and linear regression to develop the ML models. Besides, the Wide and Deep technique was used in one study. The included studies utilised a full range of baseline variables to build the predictive models. In addition, two studies developed abstracted models by omitting preoperative functional scores and morphological features. The following outcomes were assessed: American Shoulder and Elbow Surgeons, pain scores, internal rotation score, and postoperative complications. The full XGBoost models showed high accuracy in predicting ASES (77-94%), Internal rotation score (85-90%), postoperative complications (68.1%), and patient-reported outcome measures.

Conclusions: In conclusion, ML models accurately predicted functional outcomes 2-3 years after shoulder arthroplasty. Both full and abstracted models achieved high accuracy in the prediction of global functional scores, pain scores, and rotation. Nonetheless, the current literature also suggests full ML models have higher accuracy than abstracted models in predicting clinical outcomes. Such findings highlight that implementing ML models in clinical evaluation and preoperative decision-making can help stratify the risk of patients with poor outcomes after shoulder arthroplasty.

FP.33.05

RADIOLOGICAL IMPACT ON BONE DENSITY OF SURGICAL DELAYS FOR PATIENTS AWAITING FOR AN ELECTIVE SHOULDER ARTHROPLASTY SURGERY

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Background: The purpose of this study is to compare shoulder CT images of patients at the time of their inclusion on the waiting list for a shoulder arthroplasty surgery and after at least one year of delay, to determine whether surgical delay could cause radiological deterioration significant enough that it could impair patient outcomes. The hypothesis is that humeral head and glenoid bone densities would be lower on the follow-up scan.

Methods: A retrospective review of surgical waiting lists identified patients awaiting shoulder arthroplasty surgery (anatomic or reverse). Patients underwent control shoulder scan at 1-year interval following inclusion on the surgical waiting list. Data from both scans were subjected to comparative statistical analysis.

Results: Twenty-seven patients were enrolled (7 men, 20 women; mean age 66.89 years). Common indication for arthroplasty included osteoarthritis (40.74%), rotator cuff arthropathy (22.22%), rheumatoid arthritis (18.52%) and osteoarthritis secondary to instability (11.11%). Thirteen patients (48,15%) were consented for anatomic total shoulder arthroplasty, 14 patients (51,85%) were consented for a reverse total shoulder arthroplasty. Bone density values of the humeral head were significantly lower on control CT in all three planes ($p < 0.001$). Bone density values for the subchondral glenoid were also statistically lower on control CT ($p < 0.001$). Subchondral glenoid bone density was also significantly lower on control CT ($p = 0.036$). When comparing patients' diagnosis, the patients diagnosed with rotator cuff arthropathy and rheumatoid arthritis did not have significantly different bone density at the glenoid and humeral head, in contrast with patients diagnosed with primary osteoarthritis.

Conclusions: The results demonstrate that at one year after inclusion on a waiting list, patients have significantly lower bone density values at the humeral head and glenoid. These results could be attributable to non-usage and could potentially results in surgeries at higher risk of complications. Patients suffering from osteoarthritis are at the greatest risk of having a significant decrease in bone density at 1 year when compared to other diagnosis. Further studies will be needed to serially assess radiological deterioration and to correlate surgical delay to radiological and functional post-operative outcomes.

FP.33.06

BILATERAL TSA OUTCOMES IN PATIENTS THAT UNDERWENT BILATERAL ANATOMIC VERSUS ANATOMIC AND REVERSE TOTAL SHOULDER ARTHROPLASTY FOR PRIMARY OSTEOARTHRITIS WITH INTACT ROTATOR CUFF

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Background: Total shoulder arthroplasty (TSA) for primary osteoarthritis has exponentially grown with bilateral anatomic and/or reverse TSA (aTSA or rTSA) similarly increasing. We aimed to compare outcomes in patients that underwent aTSA/aTSA versus aTSA/rTSA for primary osteoarthritis with an intact rotator cuff.

Methods: A single-institution prospectively-collected shoulder arthroplasty database was reviewed. Patients undergoing bilateral TSA with a primary aTSA and subsequent aTSA or rTSA since January 2000 for primary osteoarthritis with an intact rotator cuff and with minimum 2-year follow-up on both shoulders were identified. Outcomes scores (SPADI, SST, ASES, UCLA, Constant), active range of motion (abduction, forward elevation [FE], external and internal rotation [ER and IR]), and shoulder strength (ER and FE) were evaluated. Clinically-relevant benchmarks were adopted from prior literature and included minimal clinically important difference (MCID), substantial clinical benefit (SCB), and patient acceptable symptomatic state (PASS). Incidence of surgical complications and revision rates were examined.

Results: Of the 73 bilateral TSA patients with intact rotator cuff, 62(85%) underwent aTSA/aTSA and 11(15%) underwent aTSA/rTSA. At time of 2nd TSA, patients undergoing aTSA/rTSA were older (72.5 ± 4.9 vs. 67.1 ± 7.0 , $P=0.005$). Overall, 44% were female and 14% had prior surgery ($P>0.05$ between groups); patients who underwent aTSA/rTSA more commonly had inflammatory arthritis (46% vs. 10%, $P=0.009$). Mean time to 2nd TSA was shorter for aTSA/aTSA (2.2 ± 2.6 vs. 4.8 ± 3.3 years, $P=0.031$). Postoperative outcomes were similar after 1st aTSAs between groups with similar proportions achieving the MCID, SCB, and PASS (All $P>0.05$). Comparing 2nd TSAs, aTSA/aTSA had greater improvement in ER ($21 \pm 27^\circ$ vs. $3 \pm 18^\circ$, $P=0.016$) and a higher proportion of patients achieving the MCID (80% vs. 46%, $P=0.029$) and SCB (65% vs. 28%, $P=0.042$) for SPADI. Rates of surgical complications and revision were similar.

Conclusions: Patients with osteoarthritis and an intact rotator cuff have excellent clinical outcomes after either aTSA/aTSA or aTSA/rTSA, with a shorter time between surgeries in aTSA/aTSA. Patients with bilateral aTSA had significantly greater improvement in ER and greater improvement in pain after 2nd TSA.

FP.33.07

GLENOID LATERALIZATION IN REVERSE SHOULDER ARTHROPLASTY: METAL VERSUS BONY OFFSET IN DIFFERENT IMPLANT DESIGNS

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Background: Bony (BIO) or metal (MIO) increased offset on the glenoid in RSA reduces scapular notching, increases range of motion and reduces the risk of postoperative instability. Good results have been published for both techniques. The aim of this retrospective multicentre study was to compare the short-term clinical and radiologic outcome of both techniques in RSA by comparing two different implant designs. We hypothesized that there was no difference between both groups.

Methods: 62 BIO- and 114 MIO-RSA cases with a mean follow up of $29,7 \pm 6,0$ m (range 24-49m) for BIO-RSA and $24,0 \pm 1,1$ m (range 22-28m) for MIO-RSA were included. All BIO-RSA cases underwent surgery in one specialized shoulder centre. All MIO-RSA cases were listed in a multicentric prospective database. For BIO-RSA cases the Ascend Flex system (Stryker) was used and the Apex system (Arthrex) was implanted in MIO-RSA cases. Radiologic imaging were evaluated for scapular notching and lateralization (lateralization indices, lateralization-/ distalization angle) were assessed according to Erickson et al. Baseline and follow-up Constant score (CS) and range of motion (ROM) were analysed for differences between both groups.

Results: Scapular notching was present in 7.0% of MIO-RSA and in 8.1% of BIO-RSA cases ($p=0.801$). The lateralization angle (MIO-RSA: 88.0° , $SD \pm 10.0$; BIO-RSA: 84.3° , $SD \pm 10.0$; $p=0.020$) and distalization angle (MIO-RSA: 45° , $SD \pm 9.2$; BIO-RSA: 49.2° , $SD \pm 9.6$; $p=0,005$) differed significantly. At baseline, mean CS was higher in the MIO-RSA group ($p<0.001$) and significantly increased to 67.3 ± 12.5 P (MIO-RSA) and 69.5 ± 12.3 P (BIO-RSA) without significant difference at follow-up. ROM increased in both groups significantly compared to baseline with a higher forward flexion and external rotation in the BIO-RSA cohort ($p<0.021$).

Conclusions: Both methods provide comparable short-term results with a similar increase in shoulder function and significant deviations of the lateralization and distalization angle were noted between both implants. The presence of scapular notching was low and was not influenced by the applied method. Each method has its own advantages as eccentric bone defects can be addressed by a shaped bone graft while a metaglene with incorporated lateralisation eliminates the risk for malunion or resorption. Follow-up studies are necessary to evaluate the long-term outcome and monitor subsequent differences in shoulder function and complications.

FP.34.01

ARTIFICIAL INTELLIGENCE AUTOMATED ANALYSIS OF SCAPULA DYNAMICS USING DYNAMIC DIGITAL RADIOGRAPHY: A VALIDATION AND RELIABILITY STUDY

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Background: Dynamic Digital Radiography (DDR) is a novel technique that uses pulsed low-dose radiographs during joint motion. In the shoulder, it allows dynamic non-invasive examination of glenohumeral and scapula kinematics with shoulder abduction and can diagnose shoulder pathology by discerning changes in the interplay between scapulothoracic and glenohumeral joint motion. Manual measurement is the current gold standard to calculate the scapulohumeral rhythm (SHR), however this process is time consuming and limits its utility in a clinical setting. The purpose of this study was to assess the reliability of an artificial intelligence (AI) automated image analysis software by comparing it to manual measurements across a range of shoulder pathologies, which could facilitate automated image analysis and diagnostics.

Methods: Using a standardized acquisition protocol, dynamic digital radiography (15 frames/second) was prospectively performed on 73 shoulders (40 right sided, mean age 57.9, 47% female) including normal controls (23 shoulders) and those diagnosed with rotator cuff tears (41 shoulders) and adhesive capsulitis (9 shoulders) based on clinical examination and MRI evaluation. Shoulders with implanted hardware and patients <18 years old were excluded. Manual measurements of the angle between the humerus and the midline and the medial border of the scapula and midline were taken by two trained readers at 30, 60, and 90 degrees of shoulder abduction to calculate the SHR between 30-60, 60-90 and 30-90. An algorithm using computer vision and supervised machine learning was developed and trained on 447 images. Corresponding software measurements were compared using descriptive statistics and intra-class correlations (ICC) using a two-way random effects model.

Results: The total number of paired measurements was 219. Excellent inter-rater reliability (ICC 0.87 (95% confidence interval 0.75 - 0.93)) was found in the manual measurements. Moderate reliability (ICC 0.58 (95% confidence interval 0.4-0.71)) was found between the manual and AI measurements of SHR.

Conclusions: The automated image analysis algorithm shows proof of concept, and early promise but requires further training before it can reliably replace manual measurement of SHR and scapular kinematic analysis. Further enhancement could facilitate rapid measurement and efficient integration of SHR measurement into a clinical workflow for improved analysis and diagnostics.

FP.34.02

PARSONAGE TURNER SYNDROME CAN BE TREATED SURGICALLY TODAY

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Background: Parsonage Turner syndrome (PTS) is a rare but serious condition characterized by spontaneous paresis of the upper extremity. Recent literature reports less optimistic outcome than assumed, with persistent functional impairment in more than half of the patients at two years follow-up. Typical nerves affected around the shoulder region are N.thoracicus longus, N.suprascapularis, N.axillaris, and N. accessories. Shoulder surgeons encounter these patients. It is good for them to know that the starting point of these palsies can often be clarified with new modern research methods so well that it is possible to treat these cases successfully with targeted microsurgery. Ultrasound using modern, high-frequency probes and image processing provides excellent visualization of the peripheral nerve, with good spatial resolution. Ultrasound has the further advantage of being able to assess the entire nerve course in real time. Peripheral nerve compression results in nerve enlargement proximal / or distal to the entrapment site on cross-sectional imaging and can appear as an hourglass configuration on longitudinal views. High resolution MRI of the nerve enables direct imaging of the nerves by optimizing the selectivity for the nerves' own water content, resulting in a detailed image of the nerve.

Methods: The author has conservatively treated some 500-600 nerve lesions around the shoulder, e.g. about 300 serratus palsies and 100 Parsonage Turner syndrome, and operatively some 300-400, e.g. 100 suprascapular nerve compressions and 50 accessory palsies.

Results: Some of my operated patients, e.g. compressions of the suprascapular nerve did not improve. Now it has become clear to me in recent years that a significant part of those patients most likely had PTS, i.e. hour-glass constrictions. I had operated on the patients in a completely wrong place, like Vigasio and Marcoccio in Italy proved a few years ago.

Conclusions: Parsonage Turner syndrome, which manifests itself as severe pain and paralytic symptoms in the shoulder region and upper limb that begin without an obvious reason, can now often be cured by microsurgical nerve surgery. Modern imaging methods help to find the part of the nerve that requires surgery. These patients should be referred to hand surgeons experienced in surgical treatment of peripheral nerves.

FP.34.03

PROFILE AND LEARNING CURVE OF BRAZILIAN SURGEONS REGARDING SHOULDER ARTHROSCOPIC PROCEDURES

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Background: Shoulder arthroscopy procedure is already well established and offers several advantages.

How many operative cases are needed for a surgeon to become an expert in performing shoulder arthroscopy?

The main objective of this study is establishing the number of operative cases is necessary for an orthopedist specializing in shoulder surgery to become safe in performing shoulder arthroscopy. We will seek to present the first steps in establishing a learning curve for shoulder arthroscopy among Brazilian surgeons, as well as to evaluate the best learning and training tools.

Methods: This is a cross-sectional prospective study using a structured online questionnaire for data collection.

The questionnaire is divided into 3 sections. The initial section deals with participant demographic information. The second part of the questionnaire will provide specific definitions for the skill levels in shoulder arthroscopy (beginners, safe, competent, proficient or experts) in which the participant must qualify and quantify the number of surgeries performed for each level and the third part addresses the training methods in shoulder arthroscopy.

Results: 251 participants. Time of shoulder experience was more prevalent in the range of more than 15 years of shoulder experience. The proficient level in shoulder arthroscopy was the most prevalent with 55.8% of participants and the most prevalent number of annual arthroscopies was the range of 51 to 99 total surgeries. When assessing the number of arthroscopies per skill level, everyone agreed that a total number of arthroscopies greater than 500 is necessary for the specialist level. To obtain safety, most interviewees believe that 31 to 50 arthroscopies are necessary. According to the best evaluated methodologies were: acting as a main surgeon and cadaver training.

Conclusions: Overall, surgeons felt it would take 31 to 50 cases to become a safe surgeon and over 500 cases to reach expert-level. Participation as main surgeon and cadaver training are the most valued between all participants. We hope that this study serves as a framework for the clinical validation of the shoulder arthroscopy learning curve among Brazilian surgeons and allows for the optimization of training methodologies.

FP.34.04

A SURVEY OF THE STATUS OF COMMUNICATION BETWEEN PHYSIOTHERAPISTS AND ORTHOPEDIC SURGEONS FOLLOWING ROTATOR CUFF REPAIR IN EGYPT

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Background: Rotator cuff Repair (RCR) is one of the sensitive operations that requires a good surgical technique, skillful surgeon, and a guided rehabilitation program. Despite the advance technology and surgical techniques as well as the availability of rehabilitation guidelines in the literature, there is still increase in the re-tears rate. One of the important factors in treatment of patients with RCR is communication between Physiotherapists (PTs) and orthopedic surgeons.

Methods: we hypothesized that there is insufficient communication between PTs and orthopedic surgeons and PTs don't receive enough information about the operation. The aim also is to measure how frequently do orthopedic surgeons and PTs communicate and by what method, and their opinions on the cause of retears, patient education methods and, accessibility to each other. We targeted 47 orthopedic surgeons and 115 PTs in Egypt and conducted 2 online versions of survey one for PTs and one for orthopedic surgeons.

Results: 29.55% of surgeons usually communicate with PTs but only 22.22% of PTs usually communicate with surgeons, and the frequency of communication was 60% of surgeons communicate with PT when the rehabilitation is too slow or too rapid, or something adverse happens to the patient. 68.89% of PTs communicate with Surgeons when patient progress is slow or when something adverse happens to the patient. 53.92% of PTs don't receive enough information, 33.33% sometimes receive such information.

Conclusions: There is insufficient communication between PTs and orthopedic surgeons, the frequency of communication is low and depends only when something adverse happens to the patient or when the progress is too slow, and the PTs don't receive enough information such as tissue quality, technique of the operation and shape of the tears from the surgeon.

FP.34.05

CUTIBACTERIUM ACNES SUTURE CONTAMINATION IN ARTHROSCOPIC ROTATOR CUFF REPAIR: INFLUENCE OF SUTURE COMPOSITION AND SHAPE, DISINFECTANTS, AND CLIMATE

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Background: During the arthroscopic rotator cuff repair procedure, sutures loaded on the suture anchors can be exposed to the skin; thus, the risk of contamination is high. The architecture of the UHMWPE suture is classified into two categories, the pure UHMWPE braid or the composite of UHMWPE fibers. As for the shape, there are two types: the conventional thread shape and the tape shape. Various agents are also used as skin disinfectants. Furthermore, the climate on the day of surgery may also play a role in suture contamination via perspiration. The aim of this study was to investigate the influence of suture composition and shape, and climate on suture contamination.

Methods: A retrospective study of 658 patients (66.0 yr, 420 males/238 females) who underwent arthroscopic rotator cuff repair was conducted. The sutures used were pure UHMWPE braid (Hifi suture), the composite of a polydioxanone, absorbable core (62%) with a sleeve (38%) of UHMWPE (Orthocord), and UHMWPE tape suture (SutureTape). Four different skin disinfection methods were used. Namely, 1% chlorhexidine-alcohol povidone-iodine, povidone-iodine-alcohol, and olanexidine hydrochloride hydrate. The first cut-tails of the anchor-suture after cuff fixation were submitted to aerobic and anaerobic cultures. No sutures exposed to the skin for more than 30 minutes were submitted. Logistic regression analysis using the forced entry method was performed with the positive culture results for *Cutibacterium acnes* as the target variable, and shape and brand of the suture, skin preparation procedure, age, BMI, sex, temperature, and humidity, and season as explanatory variables (significant level was set at .05).

Results: The overall contamination rate was 21.6%. In Orthocord, the contamination rate was significantly lower (Odd ratio (OR), 0.077, 95% confidence interval (CI) [0.01, 0.38], $p=0.0033$) in comparison to pure UHMWPE braid. For disinfectants, the contamination rate increased significantly for povidone-iodine (OR, 0.071, 95%CI [1.2, 4.4], $p=0.0085$) and decreased significantly for olanexidine (OR, 3.6 95%CI [2.1,6.1], $p<.00001$) in comparison to chlorhexidine-alcohol. An increase in the contamination rate was observed among males. Season, temperature, humidity, and BMI were not shown to be significant factors.

Conclusions: The current study showed a risk reduction with the use of Orthocord suture and olanexidine agent.

FP.34.06

WHAT FACTORS IMPACT PATIENTS' FEELING OF RECOVERY AFTER SHOULDER SURGERY?

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Background: The American Shoulder and Elbow Surgeons (ASES) score is a well-validated patient-reported outcome measure (PROM) used daily in orthopaedic practices. It is comprised of many components such as pain and activities of daily living (ADLs) but yet no prior study has evaluated the impact of these individual factors on patient's feeling of recovery. The ASES score lacks any assessment on driving, which is also a fundamental ADL that has not been properly assessed in this regard. Thus, the purpose of our study was to evaluate the influence of these factors on patients' feeling of recovery after shoulder surgery.

Methods: An anonymous survey was administered to participants above the age of 18 in Palm Beach County, Florida. Patients were asked to rank pain, shoulder function, sleep, driving, and self-care activities to assess the importance and impact of these factors on their assessment of recovery. Patients were also asked to predict the time to recovery of these activities. Descriptive statistics and Kruskal-Wallis analyses were conducted.

Results: The cohort consisted of 101 participants, with 51.4% identifying as male. The mean age of the cohort was 38.7 with the majority (68.2%) being Caucasian. Only 53.3% percent of participants said they would consider undergoing shoulder surgery. Pain relief was ranked as the most important factor for recovery. As for ADLs, the most important factor on their feeling of having recovered was sleeping on the affected side (73.8%), followed by toileting (67.3%), driving (60.7%) and ability to do usual work (32.1%). The time patients expected to return to sleeping on the affected side, ADLs, and driving after surgery was 5.3, 5.2, and 3.9 weeks respectively.

Conclusions: Pain was ranked as the most important factor but is not the only factor to consider for patient's feeling of recovery after shoulder surgery. The ability to perform ADLs, sleep without difficulty, and drive are also important factors to consider for patients to feel they have recovered from shoulder surgery. Shoulder specialists should take these patient perceptions into account in order to meet optimally patient expectations and personalize care when discussing recovery after shoulder surgery.

FP.34.07

IS VIRTUAL REALITY (VR) ARTHROSCOPIC SIMULATOR EFFECTIVE IN SHOULDER ARTHROSCOPY TRAINING? A SYSTEMATIC REVIEW AND META-ANALYSIS

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Background: While shoulder arthroscopy is one of the most widely performed surgeries, it is associated with a steep learning curve. Virtual reality (VR) arthroscopic simulator training has recently gained prominence as a promising training modality for shoulder arthroscopy over the past few years, but there remains a lack of high-quality evidence on its efficacy and role. Given the high cost of a VR simulator, this study aimed to investigate its effects in shoulder arthroscopy training.

Methods: A systematic search of four databases (PubMed, EMBASE, Scopus and Cochrane Library) was performed. Studies which compared outcomes pre- and post-training as well as outcomes between VR groups and Control (non-VR training) groups were included. Meta-analysis was performed to compare the following outcomes between VR and Control groups: (a) Time to completion of assessment tasks and (b) validated arthroscopic evaluation scores assessed via patients/cadavers (Arthroscopic Surgical Skill Evaluation Tool (ASSET) and Global Operative Assessment of Laparoscopic Skills (GOALS)). Further analysis was conducted to compare pre- and post-training arthroscopic evaluation scores. Finally, subgroup analysis was conducted for time to completion to determine if assessment modality (VR versus Diagnostic Arthroscopy) contributed to heterogeneity.

Results: Seven studies were included in this systematic review. Total cohort size was 143, with 93 in the VR group and 50 in the Control group. Pooled mean time to completion was 263s and 404s in the VR and Control group respectively. Meta-analysis showed a significantly shorter time to completion in the VR group ($p=0.05$). However, in terms of arthroscopic evaluation scores, there was no significant difference between the two groups ($p=0.48$). Moreover, post-training arthroscopic evaluation scores did not improve significantly from pre-training scores ($p=0.07$). Subgroup analysis showed that assessment modality did not contribute to differences in time to completion.

Conclusions: VR training is effective in reducing procedural time in arthroscopic shoulder surgery. Although this study did not demonstrate statistically significant improvement in arthroscopic evaluation scores, this could be attributed to small sample size, with our results tending towards significance favouring improvement after VR training. VR training for arthroscopic shoulder surgery is promising, although more high-quality evidence is required to verify this.

FP.35.01

THE FORGOTTEN LIGAMENT: THE POSTEROLATERAL LIGAMENT OF THE ELBOW - ANATOMY AND CLINICAL RELEVANCE

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Background: The posterolateral capsule was recognized in the past as an important structure for elbow stability but was later disregarded. Two recent biomechanical papers demonstrated its role preventing posterolateral instability, and thus it should be considered a ligament (PLL). This study includes two parts: anatomic study of the PLL's footprint; and 4 cases of pathological lesions of the PLL.

Methods: Six cadaveric upper limbs were assessed. The attachments of PLL were dissected, and the footprints were marked, photographed, and measured for the 2-dimensional area and length.

Results: Mean origin dimensions were length of 13 mm and an area of 102 mm², and mean insertion dimensions were 18 mm and 100 mm² respectively.

Cases: (a) two cases of clinical PLRI in young athletes following elbow trauma. On physical examination both had positive posterior drawer test but negative pivot shift test, and on MRI the LUCL was intact, but the PLL was torn. Both underwent elbow arthroscopy confirming these findings, and repair of the PLL with resolution of symptoms.

(b) Two cases of posterolateral elbow pain in professional cricket bowlers, diagnosed radiographically as enthesopathy of the PLL's origin on the posterior capitellum, probably due to repeated forced hyperextension of the elbow. Both were treated by debridement of the posterior capitellum and reattachment of the PLL, with complete resolution of symptoms.

Conclusions: The posterolateral ligament of the elbow has a significant role in the elbow's posterolateral stability. its footprints were described, and its clinical significance was demonstrated in cases of elbow instability caused by acute ligament tear, and elbow pain due to ligament enthesopathy. Surgeons should be aware of this structure and potential pathology related to injury.

FP.35.02

PREVALENCE AND CLINICAL SIGNIFICANCE OF CHRONIC INTEROSSEOUS MEMBRANE LESION FOLLOWING MASON II AND III RADIAL HEAD FRACTURES IN COMPLEX ELBOW INSTABILITY

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Background: The CB is an important stabilizer of the forearm that may be injured in complex elbow instability (CEI), especially in presence of type-III radial head (RH) fractures. In acute setting, a recent MRI study showed that this lesion occurs in 80% of type II/III RH fractures. This observation is particularly relevant considering that it is common opinion that CB lesions do not heal spontaneously. The primary aim of the present study was to assess the prevalence of chronic lesions of the central band of the interosseous membrane (cblOM) in a consecutive series of patients who had previously undergone surgical treatment for Mason II and III RH fractures in CEI. The secondary aim was to define its clinical significance.

Methods: 108 patients affected by CEI with type II or III RH fracture according to Mason's classification was analyzed in the chronic setting. All patients were treated according to the current surgical algorithms. At last follow-up, the muscular hernia sign was investigated by means of a bilateral ultrasonographic examination to assess any chronic cblOM lesions; the Mayo Elbow Performance Score (MEPS) was used to evaluate the clinical significance of these lesions.

Results: 93 of the 108 patients were assessed after a mean time of 7.3 years (range: 2-12). No positive hernia signs were found while 5 patients (5.4%) displayed an increased laxity of the cblOM when compared with the contralateral side, despite a negative hernia sign. The clinical outcome in all 5 patients was excellent (mean MEPS 96).

Conclusions: Chronic cblOM lesions are very rare in CEI with RH fractures. Considering that previous studies reported 1) a high prevalence of this lesion in patients with Mason II and III RH fractures and 2) the current expert opinion about the cblOM of a scarce healing potential, this study suggests that the IOM may heal better than previously believed when RH fractures are treated appropriately.

FP.35.03

NOVEL RADIOLOGICAL RISK FACTORS OF POSTERIOR ELBOW INSTABILITY: CT ANALYSIS OF HEALTHY AND UNSTABLE ELBOWS

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Background: Elbow stability depends on various bony, ligamentous and muscular factors. The most important bony factor of stability is the congruence of the humero-ulnar joint. There are no radiological parameters in the clinical practice to describe the contribution of the greater sigmoid cavity to intrinsic elbow stability. The goal of this study is to compare 3 radiological indexes that describe trochlear notch depth and ulnar coverage of humeral trochlea between a healthy population and patients with simple posterior elbow dislocation.

Methods: 50 CT scans were retrospectively selected and examined (25 healthy subjects vs 25 subjects with history of at least 1 episode of posterior elbow dislocation). The following indexes were measured: trochlear depth index (TDI), which evaluates trochlear depth in relation to coronoid-olecranon tips distance; Anterior Index of Coverage (AIC) and Posterior Index of Coverage (PIC), which evaluates coronoid and olecranon coverage of humeral trochlea.

Results: 25 healthy subjects (14 women and 11 men), with an average age of 46.0 ± 11.6 years (range 22-64), and 25 patients with simple elbow dislocation (14 women and 11 men), with an average age of 49.9 ± 15.9 (range 18-76), were included in the study.

Significant differences between the 2 groups were found for TDI (0.50 ± 0.05 in healthy subject vs 0.41 ± 0.06 in patients with posterior dislocation) and AIC (1.99 ± 0.10 vs 1.87 ± 0.12) ($p < 0.001$). The measured values for PIC were 1.38 ± 0.12 in healthy subjects and 1.37 ± 0.11 in the patients with dislocation, the difference for this index was not statistically significant. TDI value was higher in males vs females (0.48 ± 0.07 vs 0.44 ± 0.06) ($p = 0.038$). No correlation was found between the indexes and age or laterality.

Conclusions: The TDI index describes the depth of the olecranon trochlear notch and, consequently, the degree of joint congruence. The AIC index measures coronoid's height and its trochlear coverage. TDI and AIC values in our sample were lower in patients who suffered a posterior dislocation, therefore they may be considered as potential risk factors for posterior elbow instability. Since these indexes are simple to measure, they could be used in clinical practice as indicators of increased risk of dislocation.

FP.35.04

USEFULNESS OF DIAGNOSTIC ULTRASONOGRAPHY IN THORACIC OUTLET SYNDROME (TOS)

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Background: Although various physical findings have been reported for thoracic outlet syndrome (TOS), diagnosis is sometimes difficult due to lack of objective diagnosis. However there have been no reports that ultrasonography (US) is useful for diagnosing TOS, we have performed endoscopically assisted first rib resection in more than 700 cases of TOS and performed preoperative US. and compared intraoperative findings. As a result, it has become possible to objectively evaluate TOS by US. This study was to investigate whether TOS, which is intractable shoulder and elbow pain, can be evaluated by US.

Methods: The subjects were 292 TOS patients who underwent surgical treatment from 2017 to 2021. First, the DASH score was used to evaluate the severity of symptoms, and preoperative US was used to evaluate the following three points. 1) Evaluation of the position of the neurovascular bundle (subclavian artery and brachial plexus) (NVB classification), 2) measurement of interscalene distance (ISD) at the first rib stop, 3) Measurement of peak systolic velocity (PSV) of the subclavian artery in the lowered and elevated position of the limb. Next, we compared the intraoperative (1) NVB evaluation, (2) ISD measurement, and (3) postoperative PSV with the results of preoperative US. Finally, we investigated the correlation between the DASH score and (1)(2)(3).

Results: The NVB classification was almost the same (1 equal (1)), and the intraoperative ISD was significantly consistent with the US (1 nearly equal (1)). In PSV, the upper extremity elevation was 3)(0 cm/s) but improved to (3) normal value (80-120 cm/s) after surgery. The narrower the DASH score, the more severe the symptoms due to the stronger NVB strangulation.

Conclusions: US appears to be a useful diagnostic tool that can objectively evaluate the possibility of TOS by assessing NVB classification and ISD in the interscalene muscle space. We found that as the ISD narrowed, the NVB became more strangulated and the symptoms more severe. Whereas, when there is severe vascular stenosis in PSV, blood flow is interrupted, and the postoperative strangulation is relieved. From the above, it was suggested that US which allows objective evaluation, is useful for a reliable diagnosis of TOS.

FP.35.05

NEGLECTED POSTEROMEDIAL ROTATORY INSTABILITY OF THE ELBOW

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Background: Posteromedial rotatory instability of the elbow is a relatively recently established injury that has not been diagnosed or overlooked in the past. It is known that the prevalence of post-traumatic arthritis due to instability is high when not receiving appropriate treatment, but there are no clinical studies on the natural course or chronic changes. The investigated the clinical and radiographic characteristics of chronic posteromedial rotatory instability injury patients who were missed in diagnosis or did not receive appropriate treatment after the initial injury.

Methods: From 2005 to 2020, 16 patients with chronic posteromedial rotatory instability who were overlooked after an initial injury among the patients who visited our hospital were included in the study. Diagnosis was made using 3-dimensional computed tomography (3D CT) or magnetic resonance imaging (MRI). Analysis was performed using medical history, clinical symptoms, signs, and functional scores with Mayo Elbow Performance Score (MEPS) and quick Disabilities of Arm, Shoulder and Hand (qDASH) score. Radiologic measurement done for arthritis, coronoid fracture, and instability.

Results: 6 out of 16 patients did not remember any trauma history and 5 patients had a minor trauma history. Patient's chief complaint was pain in 12 cases (75%) and ulnar nerve symptoms in 4 cases (25%). A total of 7 patients (44%) had ulnar nerve symptoms. Instability confirmed through physical examination or imaging was in 11 patients. The patients' mean MEPS was 70.1 and mean qDASH score was 29.3. According to Broberg-Morrey classification, there were 1 case of stage 3, 8 cases of stage 2, 4 cases of stage 1, and 3 cases was no arthritis observed. Subtype of coronoid anteromedial facet fracture were classified according to the O'Driscoll classification. On CT, subtype 1 of anteromedial coronoid fracture in 3 patients, subtype 2 in 12 patients, and subtype 3 in one patient were observed.

Conclusions: Posteromedial rotatory instability of the elbow can be missed at the initial injury especially small fracture of anteromedial facet of coronoid. It results high incidence of ulnar neuropathy with various degree of arthritis and instability.

FP.35.06

INFLUENCE OF STRIDE LENGTH ON BIOMECHANICS AND PERFORMANCE FOR BASEBALL PITCHERS

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Background: Baseball pitching motion is dynamic with both high ball velocity and high rate of injury. An analysis of pitching biomechanics can help maximize performance and minimize risks of injury. Stride length is an important factor of the baseball pitching. The purpose of this study was to clarify differences in the kinematic and kinetic profiles of the upper extremities during baseball pitching, in relation to the stride length.

Methods: Participants were 143 baseball pitchers. Throwing motion was analyzed with a 3-dimensional motion capture system. Stride length was determined distance from the hind ankle marker of the drawing foot to the ankle marker of the planted foot and that was normalized to percent of height. For kinetic analysis, shoulder internal rotation moment, elbow valgus moment, shoulder joint reaction force, and elbow joint reaction force were analyzed. Moreover, the maximum velocity of hand, wrist, elbow, and shoulder were calculated. The relationship between these parameters and the stride length were evaluated.

Results: The mean ball velocity was 102 ± 10.1 km/h. There was significant correlation between the stride length and ball velocity ($P < 0.001$). Moreover, the maximum velocity of hand, wrist, elbow, and shoulder were significant associated with the stride length. ($P < 0.001$) On the other hand, there were no significant correlation between the stride length and shoulder internal rotation moment, elbow valgus moment, elbow joint reaction force, and shoulder joint reaction force. ($P = 0.8$, $P = 0.868$, $P = 0.02$, $P = 0.004$, respectively)

Conclusions: We found that values of the stride length varied and that related to the ball velocity, the maximum velocity of hand, wrist, elbow, and shoulder. On the other hand, there was no relationship between the stride length and shoulder internal rotation moment, elbow valgus moment, shoulder joint reaction force, and elbow joint reaction force. On the basis of these results, we suggest that the greater stride length might improve the pitching performance and not increase the risk of the throwing injury in baseball pitchers.

FP.35.07

CLINICAL RESULTS WITH THE USE OF BOX LOOP GRAFT IN CHRONIC UNREDUCED ELBOW DISLOCATIONS

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Background: Chronic unreduced elbow dislocation (longer than 3 weeks) are still frequent in emergent economies. Considering the high recurrence rate, a need for reconstruction of both medial and lateral ligamentous structures is needed. The box loop technique offers the possibility of reconstructing both medial and lateral ligamentous structures with a single graft and only two tunnels and need of minimal fixation hardware.

Methods: We included patients from January 2018 to December 2021 with chronic unreduced elbow dislocations without bone defects with one-year minimum follow-up. All patients were subject to the same technique with autologous gracilis autograft and fixation with two biocomposite interference screws (one humerus and one ulna). We recorded demographic variables and applied Mayo Elbow Performance Score (MEPS), Disabilities of the Arm, Shoulder and Hand, and EQ-5D scores pre and postoperatively.

Results: We included 12 patients in the final analysis. The average time of injury to surgery was 26 +/- 14 weeks. The average age at the time of surgery was 42.9 +/- 20.1 years, 50% were females and 50% males. In 50% of the cases the right side was involved and 50% the left side. The preop vs. postop MEPS score was 44 +/- 16 vs. 85 +/- 8 points. The preop vs. postop DASH score was 63 +/- 18 vs. 16 +/- 4. The preop vs postop eQ-5D scores was 57 +/- 16.1 vs. 87 +/- 9.6 points. According to all scores we achieved statistical significant difference and Minimal Clinical Important Difference. We had no redislocations. One patient had septic arthritis and secondary avascular necrosis, but received chemotherapy for an unrelated pathology.

Conclusions: Although technically demanding, the box loop technique offers predictable and reproducible results with very few complications in a complex pathology such as chronic unreduced elbow dislocations.

FP.35.08

ANCONEUS SPARING MINIMALLY INVASIVE APPROACH FOR LATERAL ULNAR COLLATERAL LIGAMENT RECONSTRUCTION IN POSTEROLATERAL ROTATORY ELBOW INSTABILITY - CLINICAL RESULTS

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Background: Surgical treatment helps restore stability to the elbow in patients with posterolateral rotatory instability (PLRI). The anconeus muscle is one of the most important active stabilizers against PLRI. A minimally invasive anconeus sparing approach for lateral ulnar collateral ligament (LUCL) reconstruction using a triceps tendon autograft has been previously described. The purpose of this study was to evaluate the outcome of this intervention and identify risk factors that influenced the clinical and patient reported outcomes.

Methods: 61 patients with chronic PLRI and no previous elbow surgery that underwent surgical reconstruction of the LUCL using a triceps tendon autograft in a minimally invasive anconeus sparing approach during 2012 and 2018 were assessed. Outcome measures included a clinical examination and the Oxford Elbow Score (OES), the Mayo Elbow Performance Score (MEPS), the Disability of the Arm and Shoulder and Hand (DASH) questionnaires and the Visual analogue scale (VAS) for pain. Patient satisfaction was assessed with the Subjective Elbow Value (SEV) and school grade. Clinical stability of the elbow was evaluated with the Push-up Test, the Pivot-shift test, Stand-up test and the pincer grip. Integrity of the common extensor tendons and centering of the radial head were assessed on standardized MRIs.

Results: The average age of the patients was 52 years with a mean follow up of 53 months (range 27-86). Clinical examination after surgery showed no clinical signs of instability ($P < .001$) and a non-significant improvement in range of motion. OES, MEPS, DASH and VAS averaged 40 out of 48 points (SD: 10), 92 out of 100 (SD:12), 9 out of 100 (SD: 14) and 1 (SD:2), respectively; all corresponding with good or excellent outcomes. Only one patient had to undergo revision surgery due to pain and there were no postoperative complications in this cohort. Superior functional results were observed in patients without radius subluxation on the MRI with a confirmed rupture of the LUCL.

Conclusions: The anconeus sparing minimally invasive technique for posterolateral stabilization of the elbow using a triceps tendon autograft is an effective and safe treatment for chronic posterolateral instability of the elbow with substantial improvements in elbow function and pain relief.

FP.36.01

PATIENTS WITH ROTATOR CUFF TENDONOPATHY HAVE IMPROVED CLINICAL OUTCOMES WHEN RANDOMISED TO AUTOLOGOUS TENOCYTE INJECTION COMPARED TO CORTICOSTEROID INJECTION

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Background: Preclinical and clinical studies of Autologous Tenocyte Injection (ATI) have shown cultured tenocytes can synthesise extracellular matrix in vivo and facilitate tendon healing. Our hypothesis is ATI is a safe and more effective treatment for partial thickness rotator cuff tears and impingement syndrome compared to corticosteroid injection (CSI).

Methods: Inclusion criteria were patients with impingement symptoms greater than six months with an MRI confirmed partial thickness predominantly interstitial supraspinatus tear that had been unsuccessfully treated with physiotherapy and a CSI. Eligible participants were randomised (2:1) to receive ATI to the tear, or a CSI to the subacromial bursa, under ultrasound guidance. Non blinded assessments of pain (VAS) and function (ASES) were performed at baseline, and 1, 3, 6, and 12 months post treatment. A 3T MRI was performed at baseline and 6 and 12 months post treatment.

Results: 30 participants were randomised (ATI:19, CSI:11), with mean age of 50.5 years (SD 8.5), with 10 females and 20 males. Mean duration of impingement symptoms was 21.8 months (SD 12.1). At baseline, there were no significant differences in VAS pain or ASES scores between groups. Post treatment, mean ASES scores in the ATI group were superior to the CSI group at 3 months ($p=0.026$), 6 months ($p=0.012$) and 12 months ($p=0.001$). The improvement from baseline in mean ASES scores in the ATI group at 6 months (14.4 points) and 12 months (19.1 points) exceeded the MCID (12.0 points). At 12 months post ATI, 95% of participants reported an ASES score above the PASS (patient acceptable symptom state). Mean VAS pain scores in the ATI group were superior to CSI at 6 months ($p=0.01$), and at 12 months ($p=0.001$). In the CSI group, clinical improvements were transient. 7 of 11 participants in the CSI group withdrew from the trial between 6 and 12 months due to worsening shoulder pain and function.

Conclusions: ATI is an emerging non operative treatment for tendonopathy. This randomised trial shows ATI results in significant and sustained reduction in pain and disability compared to CSI.

FP.36.02

LONG-TERM OUTCOMES OF ARTHROSCOPIC PARTIAL REPAIR FOR IRREPARABLE MASSIVE ROTATOR CUFF TEARS OVER 7 YEARS: A RETROSPECTIVE STUDY

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Background: Arthroscopic partial repair is a treatment option for irreparable massive rotator cuff tears. However, whether partial repair is sufficient to maintain the repair site and achieve better clinical outcomes to treat such patients for a more extended period remains unclear.

Methods: From May 2009 to September 2014, 24 patients (25 shoulders) who underwent arthroscopic partial repair for irreparable massive cuff tears were retrospectively evaluated. ASES shoulder score, Constant-Murley Shoulder Score, UCLA shoulder scale, VAS score, ROM, radiographic changes (acromiohumeral distance and degenerative change) and MRI (fatty infiltration and atrophy) were assessed preoperatively, at first follow-up (roughly 1 year postoperatively), and final follow-up (>7 years postoperatively).

Results: The average follow-up time of 24 patients (25 shoulders) was 8.4 ± 1.5 years. At the final follow-up, the patient's forward elevation, forward flexion strength, ASES score, CONSTANT score and VAS had a significant improvement compared to preoperative. At the last follow-up, compared with preoperative, the positive rate of tangent signs in the MRI was significantly increased. Compared with the preoperative MRI at the last follow-up, except for the supraspinatus muscle, there was no significant difference in the degree of fat infiltration in the other four parts of the muscle. The global fatty degeneration index of fatty infiltration of the rotator cuff tendon at the last follow-up was significantly higher than before the operation. The patients with Collin grade greater than or equal to 3, both ASES and acromiohumeral distance, were significantly worse than other patients. Compared with the first follow-up, the degree of fatty infiltration in the upper part of the subscapularis was significantly more severe in patients with reduced ASES at the last follow-up than in patients with increased ASES.

Conclusions: For most patients with irreparable MRCTs, at least 7 years of postoperative follow-up after arthroscopic partial repair can improve shoulder function, relieve pain, maintain the stability of the humeral head, and delay the degeneration of the joint. For patients with many tendons involved in severe fatty infiltration before the operation, especially those with poor repairable tendon quality, arthroscopic partial repair does not always achieve good results, and other treatment modalities may be considered.

FP.36.03

COMPARISON OF COST, SURGICAL TIME, AND CLINICAL RESULTS BETWEEN ARTHROSCOPIC TRANSOSSEOUS ROTATOR CUFF REPAIR WITH LATERAL CORTICAL AUGMENTATION AND ARTHROSCOPIC TRANSOSSEOUS EQUIVALENT SUTURE BRIDGE

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Background: To reduce the healthcare burden, the clinical results of arthroscopic rotator cuff repair and the cost of the implants used has recently been focused upon. This study compared implant cost, surgical time, short-term clinical results, and cuff repair integrity 2 years postoperatively between arthroscopic transosseous rotator cuff repair using lateral cortical augmentation (TOA) and arthroscopic transosseous-equivalent suture bridge (TOE).

Methods: This study included 220 patients with rotator cuff repairs performed by a single surgeon between December 2013 and December 2018. Overall, 70 TOA and 68 TOE cases met the inclusion criteria. The same surgeon performed the procedures at two different hospitals, and the techniques differed between the facilities. A total of 42 TOA patients were matched with 42 TOE patients. The patients were matched using a propensity score analysis by sex, age, and cuff tear size. The minimum follow-up period was 2 years. Implant cost and surgical time were compared between the two methods. The range of motion, clinical outcomes, and visual analog scale scores were evaluated. Magnetic resonance imaging was performed to examine cuff repair integrity 2 years postoperatively.

Results: The follow-up rate was 81% (112/138 patients). Implant cost was significantly lower with TOA (\$1,358 vs. \$2,104; $p < 0.001$) than with TOE. The average surgical time in the TOA method was significantly shorter than that in the TOE method (82 vs. 139 min; $p < 0.001$). At the final follow-up, the mean active elevation, abduction, and clinical outcomes improved with both methods, although no improvements in external and internal rotations were observed with either method. There were no significant differences in the postoperative variables and retear rate (TOA, 12%; TOE, 19%; $p = 0.548$) between the two methods.

Conclusions: TOA and TOE achieved comparable clinical results; however, TOA was more cost-effective and has shorter surgical time than TOE.

FP.36.04

STUDY ON MORPHOLOGY AND POSITION OF CORACOID PROCESS IN PATIENTS WITH SUBSCAPULAR TENDON TEAR BASED ON CT THREE-DIMENSIONAL MODEL

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Background: Subscapularis tendon tear (STT) is one of the leading causes of shoulder joint pain in middle-aged and older adults. Current studies on the mechanism of subscapularis tendon tear mainly include degeneration of the tendon itself, trauma, blood supply reduction, and subcoracoid impingement. The commonly used method for subcoracoid impingement measurement is to measure the shortest distance from the coracoid tip to the humeral head in the axial position of MRI, the coracoid-humeral distance (CH). This measurement method is greatly affected by the projection angle or the rotation angle of the humeral head and cannot accurately reflect the position of the coracoid tip. This study was to investigate the correlation between the shape and position of the coracoid process and subscapularis tendon tear (STT).

Methods: We retrospectively collected the imaging data of shoulder joint of patients with degenerative rotator cuff tear after arthroscopy and healthy people. They were divided into rotator cuff tears with STT group (group A, n=28), rotator cuff tear without STT group (group B, n=26), and healthy group (group C, n=22). The Mimics software was used to establish the three-dimensional modeling of the scapula and evaluate the positions of the coracoid process and scapular glenoid. The length of the coracoid (LC), the anteroposterior distance of the coracoid (ADC), the height of the coracoid (HC) the version angle of the glenoid (VAG), and the inclination angle of the glenoid (IAG) were measured, and the parameters of each group were analyzed and compared.

Results: There were significant differences in LC, HC, and IAG between group A and B ($P < 0.05$), but no significant differences in ADC and VAG ($P > 0.05$). There were significant differences in LC, HC, and IAG between group A and C ($P < 0.05$), but no significant differences in ADC and VAG between ($P > 0.05$). There were no significant differences in all the measured indexes between group B and C ($P > 0.05$).

Conclusions: The longer the coracoid process, the lower the position and the smaller the inclination angle of the glenoid, the more likely it to cause subscapular tendon tears. However, the ADC and VAG are not significantly related to the subscapular tendon tears.

FP.36.05

SUPRASPINATUS TEARS – PREDICTABILITY OF MRI FINDINGS BASED ON CLINICAL EXAMINATION

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Background: There is insufficient evidence upon which shoulder physical tests are efficient for shoulder impingements. The purposes of this study were: 1. to analyze the accuracy of eight clinical tests to diagnose supraspinatus tendon lesions; 2. to assess which is the best positivity criteria for shoulder maneuvers: pain and / or weakness; 3. to investigate the ability of these tests to distinguish between partial and full-thickness tears.

Methods: A total of 733 consecutive patients were prospectively evaluated by four shoulder surgeons in this multicenter diagnostic study from May 2017 to December 2018, and eight clinical tests (empty can, full can, drop arm, painful arc, Neer's sign, Hawkins', Patte's test and resisted external rotation) were compared with magnetic resonance imaging performed by blinded radiologists. We assessed the sensitivity, specificity, accuracy, positive and negative predictive values, and diagnostic odds ratio (DOR) for all tests.

Results: For overall supraspinatus tears, the empty can test showed the highest sensitivity (0.81), the Patte's test (positive for pain and weakness) and the drop arm, the highest specificity (0.99 and 0.98, respectively), and the best combination was the Neer's sign and the drop arm test (DOR = 12.92). The positivity criteria for pain associated with weakness showed the highest performance: Patte's (DOR = 16.94) and empty can test (DOR = 10.45). Patte's test and resisted external rotation, positive for pain and weakness, showed the highest ability to distinguish between full-thickness and partial tears (DOR = 5.69 and 5.35, respectively). The shoulder maneuvers showed low negative predictive values: the empty can the highest (0.58).

Conclusions: (1) The clinical tests demonstrated excellent diagnostic values, the empty can had the highest sensitivity, the drop arm and the Patte's test the highest specificity; and the best combination for detecting supraspinatus tears was the Neer's sign and the drop arm test. On the other hand, the physical examination showed limited values to rule out tears. (2) The best positivity criteria for shoulder maneuvers was pain associated with weakness. (3) Patte's test and resisted external rotation showed the highest ability to distinguish between full-thickness and partial tears.

FP36.06

THE ACROMIOHUMERAL CENTER EDGE ANGLE AND RISK OF ROTATOR CUFF TEAR: A PLAIN RADIOGRAPH AND MRI STUDY

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Background: The acromiohumeral center edge angle (ACEA) is a parameter that can be measured on plain shoulder radiographs and has been found to be associated with increased risk of sustaining a rotator cuff tear (RCT). The aim of this study was to confirm this association using the plain radiographs and to explore its applicability on shoulder MRI in the same patients.

Methods: This retrospective study included 45 patients who underwent rotator cuff repair between September 2021 and April 2022 and was compared to 41 patients with normal shoulders. The ACEA was measured by two independent observers on anterior-posterior radiographs and shoulder MRI. The collected data was analyzed and P values of <0.05 were considered statistically significant.

Results: The ACEA was found to be higher in patient with RCTs (23.48 DEGREE \pm 7.11 DEGREE) when compared to the normal shoulder group (15.54 DEGREE \pm 4.4 DEGREE), P value <0.002. On shoulder MRI assessment, a higher ACEA was also seen in the RCTs group (18.93 DEGREE \pm 6.7 DEGREE) when compared to the normal shoulder group (13.79 DEGREE \pm 4.9 DEGREE), P value <0.0001.

Conclusions: Our current study has confirmed an associated of increased ACEA with risk of RCTs when measured on plain radiographs. In addition, we have described a new technique for ACEA measurement on shoulder MRI and found that it is associated with risk of RCTs.

ICES ORAL POSTERS

Oral Poster Session 1: Shoulder Fracture

OP.01.01

ARTHROSCOPIC REDUCTION AND TRANSOSSEOUS SUTURE FIXATION OF 2 TO 4 PARTS PROXIMAL HUMERAL FRACTURES

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Background: Arthroscopic techniques have proven to be advantageous in the treatment of greater tuberosity and lesser tuberosity fractures (suture bridging technique) and subcapital humeral fractures (arthroscopic nailing). A new one day surgery method of arthroscopic reduction and transosseous suture fixation of 2 to 4 parts proximal humeral fractures and the results of the follow up of 28 cases will be presented.

It's based on reduction of the bony fragments and fixation with temporary K-wires, followed by placing sutures through the fragments using a new developed penetrating suture wire technique and Giant Needle technique to fix the fragments together after removal of the K-wires. An immobilization period of 3 to 4 weeks follows, then exercises will start.

Aim of the work: Describe the technique and evaluate the functional results in patients with acute posttraumatic two to four parts fracture of the proximal humerus.

Methods: Over a six-year period, a consecutive series of 33 patients with a specifically defined displaced fracture of the proximal part of the humerus underwent arthroscopic reduction and transosseous sutures fixation. All fractures were fixed with nonabsorbable, number-2 sutures. Four patients were lost to follow-up and one died before the time of follow-up.

Results: according to Neer classification excellent results were present in all cases of the two parts fracture, 8 (53%) of the 3 parts and 2 (29%) of the 4 parts fracture, satisfactory results were in 7 of the 3 parts (47%) and 3 (42%) of the 4 parts (29%) while unsatisfactory results were present in 2 of the 4 parts (29%). No complications of AVN were present. All fractures, united within four months, no nonunion, no heterotopic ossifications and no osteoarthritis or avascular osteonecrosis was detected. Malunion was found in 2 of the 4 parts fracture cases and 3 cases of three parts fracture. Two patients had signs of impingement syndrome.

Conclusions: The clinical and radiographic result strongly encourage using the arthroscopic techniques to treat proximal humerus fractures without disturbing the blood supply as open technique irrespective to age or osteoporosis without complications of osteonecrosis or nonunion.

OP.01.02

REHABILITATION PROTOCOLS IN PROXIMAL HUMERUS FRACTURE MANAGEMENT: A SYSTEMATIC REVIEW

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Background: Proximal humerus fractures (PHFs) are very common in adults, especially in the elderly population. Despite their frequency, the optimal postoperative rehabilitation is unknown. A portion of the equipoise regarding optimal management of PHFs may owe to rehabilitation heterogeneity. This study aims to characterize the published rehabilitation regimens utilized for operatively and nonoperatively treated PHFs.

Methods: A systematic review was performed according to PRISMA guidelines. The search was performed using PubMed, MEDLINE, Embase, and Cochrane databases to identify all articles on PHF rehabilitation protocols published between January 1, 2012, and January 1, 2022. All clinical PHF studies were reviewed and those that reported rehabilitation protocols for PHFs after either nonoperative management, open reduction internal fixation (ORIF) with a plate, or ORIF with an intramedullary nail were included. Characteristics of rehabilitation protocols from included studies were characterized descriptively and stratified by PHF management.

Results: We included 40 articles reporting on 3,507 patients (weighted mean age=63.5 years, 66% female). The . Substantial variability was present regardless of management. Key rehabilitation modalities were reported as follows: use of a sling was reported in 34 cohorts, most commonly for 3-weeks; use of pendulum exercises were reported in 21 cohorts, most commonly starting at post-intervention day-1; post-intervention passive ROM was reported for 30 cohorts, most commonly starting at 2-days; active ROM was reported in 8 cohorts, most commonly starting at 3-weeks; active-assist ROM was reported for 21 cohorts, most commonly starting at 3-weeks; full active or unlimited ROM was reported for 20 cohorts, most commonly at 4- or 6-weeks; non-weight bearing status was reported for 6-weeks, most commonly for 6-weeks; strengthening was reported for 16 cohorts, most commonly at 6-weeks; no restrictions was reported for 9 cohorts, most commonly at 6-weeks; use of home exercise programs with handouts was reported for 4 cohorts, all starting at different times; formal physical therapy was reported for 17 cohorts, most commonly starting at day-1.

Conclusions: Rehabilitation protocols for PHFs vary considerably regardless of the management. Future clinical outcome studies comparing methods of PHF management need to consider the influence of postoperative rehabilitation protocol heterogeneity when aggregating patient data from multiple sites.

OP.01.03

CORRECTIVE OSTEOTOMY FOR COMPLEX CLAVICLE MALUNION WITH VIRTUAL PLANNING AND PATIENT SPECIFIC GUIDE

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Background: Clavicle malunion may result in significant symptoms due to abnormal scapula positioning and altered muscular biomechanics. Freehand osteotomy is inaccurate for multiplanar deformities, often resulting in under-correction for fear of over tensioning soft tissues. This study assessed the accuracy of virtual surgical planning with bespoke guides using open-source software and reports clinical results in an initial cohort of patients.

Methods: Data from Computed tomographic (CT) images of both malunited and contralateral clavicles were imported into computer-aided design (CAD) software (using www.slicer.org and www.blender.org). The 2 fragmented ends of the malunited clavicle were 'corrected' by alignment to a mirror image of the contralateral clavicle. A model of the 'corrected' clavicle was 3D printed with fragments connected with virtual bone graft strut. A plate was contoured to match the corrected clavicle; 4 key drill holes were located on the model to perform the correction onto the plate once these 2 screws were inserted into each fragment. The plate was scanned into the CAD program and the 4 holes located on the virtual fragments. The correction was then reversed to locate the 4 holes on the malunited clavicle, and a jig was created to guide these drill holes and the osteotomy planes on the malunited clavicle. Postoperative CT scan assessed union and position. Patient reported outcome scores were measured pre- and post- operatively.

Results: Six osteotomies were performed, 4 with a structural bone graft to bridge the defect. Time to surgery was 5 - 98 months. Mean preoperative deformity was 18 mm shortening, 16° inferior angulation, 15 mm inferior translation and 13° axial rotation. Union was achieved in all patients (one after revision fixation adding a bone graft). 3 required plate removal. American Shoulder and Elbow scores improved from mean 79% to 99%, Subjective Shoulder Score from mean 59% to 91%. Correction in all cases was accurate to within 1.4 mm for length (mean < 1 mm) and angulation within 4° (mean 1.8°).

Conclusions: Virtual planning and patient specific guides simplify corrective osteotomy of complex clavicle malunions. Initial results demonstrate precise quantification of deformity and excellent correction in all planes.

OP.01.04

BIOMECHANICAL AND CLINICAL EVALUATION OF MINIMAL INVASIVE PLATE OSTEOSYNTHESIS FOR TWO-PART CLAVICLE SHAFT FRACTURES

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Background: Many surgical treatment methods exist for clavicle shaft fractures requiring surgical treatment. A locking compression plate (LCP) fixation with three screws per fracture side is commonly used. For certain fractures a stabilization with 2 cortical screws per side is potentially suitable, offering the advantage of reduced implant size and soft tissue approach, while avoiding the disadvantages of minimally-invasive nailing at the same time. This hypothesis was evaluated biomechanically and clinically.

Methods: Four treatment procedures were investigated biomechanically using composite human clavicle specimens. A load-to-failure test was performed using a three-point cantilever test. In group 1, a simple shaft fracture was simulated and stabilized with 2 screws per fracture side (5-hole LCP). In the second group 3 screws per fracture side (7-hole LCP) were used. In group 3, a non-reduced fracture zone was simulated and treated with 3 screws per fracture side (7-hole LCP). In group 4, an anatomically reduced multi-fragmentary diaphyseal fracture zone was simulated and treated with 3 screws per fracture side (7-hole LCP). Furthermore 27 patients were treated surgically with a short LCP with 2 screws per fracture side (similar to group 1) and assessed after a minimum follow-up of 12 months (Constant and DASH Score).

Results: The maximum load-to-failure of group 1 was 367 N. We observed the highest load-to-failure in group 2 with 497 N and the lowest in group 3 with 90 N. In group 4 a maximum load-to-failure of 298 N could be evaluated. There was no significant difference in load-to-failure between the treatment of a simple clavicle fracture using 5- or 7-hole LCP (group 1 vs. 2, $p=0.121$). However, we found a significant difference of load-to-failure between the simple and anatomical reduced fracture using a 7-hole plate (group 2 vs. 4, $p=0.014$).

The mean constant score of the surgically treated patients was 95 and the DASH score 3.0. Fracture consolidation was observed in 96.3%.

Conclusions: For non-fragmented 2-part fractures, a minimally invasive plate osteosynthesis fixed with only 2 screws per fracture side offers sufficient biomechanical stability, excellent soft tissue preservation and similar fusion rates compared to the common operative treatment with 3 screws per fracture side.

OP.01.05

DEVELOPMENT OF A NEW ANATOMICAL PLATE FOR GREATER TUBEROSITY FRACTURES OF THE PROXIMAL HUMERUS

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Background: Although various implants exist for the fixation of isolated greater tuberosity fractures, few implants are specifically designed for such fractures. Furthermore there is no specific plate for the type of fractures patterns (avulsion, split). The aim of this study was to develop a new low-profile anatomical locking plate for greater tuberosity fractures of the proximal humerus, analyzing the geometry of the proximal humerus

Methods: Proximal humerus parameters are key prerequisites for scientifically designing anatomical plates. First, from 20s to 70s, 30 people from each age group, 180 healthy east-asian subjects were included, who underwent computed tomography (CT). And Three dimensional (3D) humeral head models were reconstructed and geometric parameters were measured; GT height, width, angle in sagittal view. The finite element method in association with a two-level 24 full-factorial design model and its statistical products were used to develop this study. The anatomical plate validity was verified by matching the plate through thirty 3D printed humerus models and 6 human cadaveric models.

Results: The mean width of greater tuberosity in CT sagittal view was 23.5mm and height from the most proximal point of the GT to top was 34.2mm. The angle between line connecting point of GT top to most posterior part of GT and the line that goes down from top to distal shaft was 44.6°. The new anatomical plate could be applied universally to 3D printed proximal humerus models in various sizes. Furthermore, the new anatomical plate was applicable through the deltoid splitting approach without the violation of the axillary nerve.

Conclusions: The experimental plate fixation results using an anatomical new plate showed good results that could be applied to various sizes of proximal humerus. The new low-profile anatomical locking plate could be useful for the treatment of isolated greater tuberosity fractures especially in variable fracture type, but proper clinical studies must be undertaken

OP.01.06

NON-OPERATIVE VS OPERATIVE TREATMENT WITH, ORIF WITH LOCKING PLATE OR, HEMIARTHROPLASTY FOR DISPLACED 3-, 4-PART PROXIMAL HUMERAL FRACTURES IN THE ELDERLY. AN RCT OF 160 PATIENTS WITH 2-YEAR FOLLOW-UP

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Background: Introduction

The incidence of proximal humeral fractures has shown to be the highest in the 60-year and older female population. Operative treatment of proximal humeral fractures in the older patients is common. However, evidence of its efficacy is uncertain.

Aims and Objectives

To assess, whether operative treatment with locking plate or hemiarthroplasty yields better functional outcome than non-operative treatment of displaced three-, four-part proximal humeral fractures among patients aged 60 years or more.

Methods: We conducted a multinational, multicenter, randomized control trial (RCT) study of 160 patients, 60-year and older with a displaced (displacement of more than 1 cm or 45 degrees) three-, four-part proximal humerus fracture. Patients were randomized to non-operative or operative treatment with either a locking plate or hemiarthroplasty using a random number matrix in an age dependent block allocation fashion. A physiotherapist, blinded to the treatment, performed a research examination at 6 months, 1 year and 2 years. The primary outcome measure was the Disabilities of the Arm, Shoulder and Hand (DASH) score and the secondary outcome measures included the Oxford Shoulder Score (OSS), Visual Analog Scale (VAS), Constant-Murley Shoulder Score, EuroQol-5D (EQ-5D) value, and 15D quality of life questionnaire.

Our hypothesis was that operative treatment of displaced three- and four-part proximal humerus fractures with a locking plate or hemiarthroplasty would achieve better functional outcome and patient satisfaction compared to non-operative treatment in terms of the DASH.

Results: Recruitment was completed on December 2019 and all included patients completed two year follow-up by December 2021. A total of 160 patients were recruited with 106 patients randomized to operative treatments and 54 patients to non-operative treatment. Results will be analysed and the results are offered to be present in the 2023 ICSES congress.

Conclusions: Consensus on the optimal treatment method for three- and four-part proximal humerus fracture in the older patients has been weak and the debate is continued. This is the first trial to compare operative treatment with locking plate or hemiarthroplasty and non-operative treatment with early mobilization for displaced three-, four-part proximal humerus fractures in the patients aged 60 years or more.

OP.01.07

PREVIOUS CLAVICLE FRACTURE DOES NOT INCREASE THE INCIDENCE OF LATER DIAGNOSIS OF SUBACROMIAL IMPINGEMENT SYNDROME. A REGISTRY-BASED CASE-CONTROL STUDY WITH 15-25 YEARS FOLLOW-UP OF 131.838 PERSONS

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Background: A clavicle fracture changes the mechanical axes of the shoulder girdle, potentially leading to scapular protraction and decreased subacromial space. A previous clavicle fracture could therefore predispose to later development of subacromial impingement syndrome (SIS).

The purpose of this study was to investigate if a previous clavicle fracture was correlated with a higher incidence, or an earlier diagnosis, of SIS.

Methods: This was a retrospective case-control study with data from the Danish National Patient Register. All persons aged 18-60 years, with a hospital contact due to a clavicle fracture (DS420) between 1.1.1996 and 31.12.2005 were identified and included as cases. For each case, five controls matched on sex and age were identified. Primary outcome was the first hospital or out-patient clinic contact with an SIS diagnosis (DM751-755) registered >180 days following a clavicle fracture. Persons were followed until 01.11.2021.

Results: 21.973 cases and 109.865 controls were included. 23% were female. 1.640 (7.46%) cases and 8.072 (7.35%) controls later received an SIS diagnosis, demonstrating no significant difference in incidence of SIS diagnosis ($p=0.56$).

1614 cases underwent surgical fixation. This subgroup had a statistically significant higher incidence of receiving an SIS diagnosis later in life (205 cases, 13%, $p<0.001$).

Mean time from fracture to SIS diagnosis was shorter for cases compared to controls (4040 vs. 4442 days, $p<0.001$), and cases were slightly younger when receiving the diagnosis (51.3 vs 53.6 years, $p<0.001$)

Conclusions: Clavicle fracture patients did not have an increased incidence of a later SIS diagnosis, but were slightly younger at time of diagnosis. Surgical treatment was correlated with higher incidence of SIS diagnosis.

OP.01.08

PHYSIOTHERAPIST-SUPERVISED EXERCISES VERSUS UNSUPERVISED HOME-BASED EXERCISES AFTER NON-SURGICALLY TREATED PROXIMAL HUMERUS FRACTURE: A MULTICENTRE RANDOMIZED CONTROLLED TRIAL

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Background: Proximal humerus fracture (PHF) is a common fracture in older adults and can have a substantial impact on upper limb function. Most of the patients can be treated non-operatively, however, it has only been sparsely investigated if patients benefit from supervised exercise therapy after a PHF. The objective of this trial was to investigate if physiotherapist-supervised exercises was superior to daily home-based exercises in older adults with a non-operatively treated PHF.

Methods: The trial was a superiority, prospective, randomized controlled trial with blinded endpoint assessors which took place in three Nordic countries. Non-operatively treated 2-part PHF patients age 60 years or older were randomized to either 10 weeks of physiotherapist-supervised exercises or 10 weeks of unsupervised home-based exercises. Follow-up visits took place after 3 and 12 months. The primary outcome measure was the Disability of the Arm, Shoulder and Hand (DASH) and secondary outcomes were Constant-Murley Score, the 15D-instrument, the Visual Analog Scale, General Self-Efficacy scale and Pain Catastrophizing Scale. Non-union of the fracture was counted as complication.

Results: 72 patients with a non-operatively treated PHF were enrolled, with a mean age of 73 years. After 3 months the mean DASH score in the supervised group was 25.9 (SD 16.0) compared to 22.4 (18.9) in the unsupervised group. The mean difference was 3.5 (95% CI -5.0;12.5) and did not meet the minimal clinical important difference of 10 points (DASH). Nor did we find any clinical relevant between-group differences on any of the secondary outcome scores at 3 months follow-up. At 12 months follow-up the between-group difference on DASH was 3.7 (95% CI -5.2;12.6) in favor of the unsupervised group. Similarly, there were no between-group differences in the secondary outcome measures. One patient in the supervised group and three in the unsupervised group had non-union.

Conclusions: This trial provides no evidence that supervised exercises are superior to non-supervised home-based exercises in improving shoulder function or quality of life in patients aged 60 or older with a non-surgically treated 2-part PHF. Our results suggest that most older adults with a non-surgically treated 2-part PHF can perform a standardized exercise program without supervision from a physiotherapist.

OP.01.09

SINGLE-CENTRE COMPARISON BETWEEN THE USE OF A TENDON ALLOGRAFT WITH DOUBLE BUTTON OR SUTURE ANCHOR FIXATION AND THE CLASSIC WEAVER AND DUNN PROCEDURE FOR SUBACUTE ACJ DISLOCATIONS.

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Background: In the Weaver and Dunn technique (WD) for AC joint dislocations, the CA ligament is transferred to the distal clavicle to repair the coracoclavicular (CC) ligament injury. The purpose of this prospective, observational cohort study is to compare the clinical and radiographic outcomes of this standard technique with the newer double-button plus tendon allograft technique (DB), and suture anchor repair plus tendon allograft plus ACJ capsule repair (SA).

Methods: The study cohort includes 53 patients between 18 and 70 years old, who underwent surgery for a subacute (between 2 weeks and 3 months) ACJ dislocation Rockwood type 3, 4 and 5. Patient-reported outcome scores and clinical results as well as loss of reduction rates on plain radiographs were compared. The following questionnaires were administered: Disabilities of the Arm, Shoulder and Hand (DASH), the Subjective Shoulder Value (SSV), the Visual Analogue Scale (VAS) and the Constant score. Between-group comparisons were performed using the Kruskal-Wallis test. All reported values are median (Q1-Q3) unless otherwise specified.

Results: Nineteen patients in the DB group, 19 patients in the SA group and 15 patients in the WD group, completed the clinical and radiological follow-up. The median age was 44[29-58] and 48 patients out of 53 were men. The mean VAS scores were 0,33[0-1], 0,47[0-1] and 1,21[0-2] in the WD, DB and SA groups, respectively ($p=0.06$). There were no significant differences in DASH, SSV and Constant scores between groups, although the DASH and SSV scores were slightly better in the DB and WD groups (DASH score, WD 2.2[0-5.4], DB 1.1[0.8-4.2], SA 5.0[0.1-11.8], $p=0.22$; SSV score, WD 95[90-100], DB 95[95-100], SA 90[90-100], $p=0.16$; Constant score, WD 100[95-100], DB 98[95-100], SA 96[89-100], $p=0.48$)
Loss of reduction on plain radiographs occurred in 4 patients in total (1 WD, 1 DB, 2 SA).

Conclusions: The use of newer techniques with tendon allograft and additional button or suture anchors fixation techniques, with or without repair of the posterior ACJ capsule, does not affect the clinical and radiographical outcomes compared to the classic Weaver and Dunn procedure for subacute ACJ stabilisation. The overall surgical effect of all three techniques shows excellent clinical results.

OP.01.10

MORTALITY FOLLOWING PROXIMAL HUMERUS FRACTURE—A NATIONWIDE REGISTER STUDY OF 147,692 FRACTURE PATIENTS IN SWEDEN

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Background: Proximal humerus fractures (PHF) are common and occur mostly after the 6th decade of life. While mortality following PHF has been reported previously, mortality data after longer follow-up on a national level is lacking

Methods: We obtained data from the Swedish Hospital Discharge Register, on all adult patients (18 years or older) with a diagnosis of PHF (S42.2, S42.20, or S42.21) for the period between 2001 and 2016. We used the Swedish Cause of Death Register to investigate mortality in the fracture cohort. We compared the mortality of fracture patients with age- and sex-matched population-based mortality data obtained from Statistics Sweden

Results: A total of 147 692 PHF patients were identified, with a male to female ratio of 1:3. The mean age was 69 years (range, 18 to 111). Most patients were treated non-surgically (n=126,487, 86%). The crude mortality rate was 2.2% at 1 month, 4.1% at 3 months, 8.5% at 12 months, and 24% at 48 months after sustaining a PHF. Mortality increased with age; however, the standardized mortality rate (SMR) was highest among young patients. SMR was 5.4 (CI: 4.5–6.2) in the 18- to 39-year age group, 3.9 (CI: 3.8–4.0) in the 40- to 64-year age group, 1.8 (CI: 1.8–1.8) in the 65–79-year age group, and 1.2 (CI: 1.2–1.2) in the 80-years and older population. The age-adjusted SMR was 3.9 (CI: 3.9–3.9) in the whole adult PHF population

Conclusions: The mortality rate and SMR suggest that PHF patients are heterogeneous. Some older PHF patients may benefit from specialized care (e.g., orthogeriatric), and this should be evaluated in future studies. What's more, PHFs seem be associated with a high mortality rate even in the younger age groups which calls for additional research on the younger subpopulations. The high mortality rate and the evidence supporting conservative treatment in the majority of these fractures should lead to a critical assessment of current operative treatment policies, when considering the finite resources of health care systems

OP.01.11

THE INFLUENCE OF ADHERENCE TO ORTHOSIS AND PHYSIOTHERAPY PROTOCOL ON FUNCTIONAL OUTCOME AFTER PROXIMAL HUMERAL FRACTURE IN ELDERLY

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Background: Proximal humeral fracture is the third most common fracture in elderly. Compliance is crucial for successful treatment. In terms of orthosis wearing compliance is up to now a topic. Physiotherapy aftercare is also of great importance. It was hypothesized that neither compliance of orthosis nor of physiotherapy protocol have influence on functional outcome, complications, and revision rates in elderly.

Methods: Patients >60 years with proximal humeral fractures were prospective included. Four groups were defined: Sling under conservative treatment [A], sling after plate osteosynthesis [B], abduction brace under conservative treatment [C], abduction brace after plate osteosynthesis [D]. Rehabilitation protocol followed an evidence-based guideline. Participants presented after 6 weeks and 12 months. Constant Score (CS), protocol deviations, complications and revisions were evaluated.

Results: N=149 participants were included. Mean age: 76.4±8.4 years. In [AB] n=33 (53.2%) completed orthosis and physiotherapy orderly (CS: 57±10), n=10 (16.1%) terminated one of both earlier (CS:64±7), n=19 (30.6%) terminated both earlier (CS: 59±10) (Distribution: p<0.001, CS: p=0.9). In [CD] n=39 (44.8%) completed orthosis and physiotherapy orderly (CS: 58±8), n=23 (26.4%) terminated one of both earlier (CS: 58±10), n=25 (28.7%) terminated both earlier (CS: 60±11) (Distribution: p<0.001, CS:0.2)). In [AB] neither regular termination of sling protocol (p=0.8) nor completion of physiotherapy protocol (p=1) influenced CS significant. The same result in [CD]: sling protocol (p=0.1), physiotherapy protocol (p=0.7). Overall 36.9% terminated orthosis earlier due to complications, some of them serious, one life-threatening. Secondary fracture dislocations were not significant over all groups (p=1). Surgical revisions were not conducted in any group. Moreover CS after 12 months was not significant in any group (p=0.4).

Conclusions: Several factors prevent the elderly from properly implementing both orthotics and physical therapy. This collective has difficulties to organize and keep physiotherapy, orthosis-protocols can lead to relevant restrictions in daily life and even dangerous situations. The present study was able to show severe deviations of the protocols in elderly that were simultaneously accompanied without significant deterioration in functional outcome, complications or revisions. The assume a cut-off age at which strict adherence becomes significantly relative, and attempted implementation entails significant losses in life quality with no increase in functional outcome.

OP.01.12

CLINICAL AND RADIOLOGICAL OUTCOMES OF GLENOID FRACTURES

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Background: Isolated glenoid fractures are rare and their management is poorly understood. Our study analyses clinical and radiological outcomes of all glenoid fractures at a single trauma unit over a 10-year period.

Methods: A retrospective study examining outcomes of patients with isolated intra-articular glenoid fractures. Imaging was examined noting fragment size and degree of displacement (step and/or gap). Patients were assessed for range of movement (ROM), Oxford Shoulder Scores (OSS), quick DASH (QDASH) and Subjective Shoulder value (SSV). Functional outcomes in operative vs non-operative groups and different displacement groups were analysed using independent sample, 2-tailed t-test, $P < 0.05$ denotes statistical significance.

Results: 40 patients met criteria, 17 (42.5%) males and 23 (57.5%) females. Mean age of 59.7 years (range 29-87). 64% of fractures were on dominant side. 28 non-operatively managed and 12 managed operatively (6 Latarjet - 1 revised to arthroplasty, 2 arthroplasty, 1 McLoughlin, 3 arthroscopic procedures). Mean follow-up was 36 months (range 5-136). Mean ROM was elevation 138° (range 10°-170°), ER 50° (range 10°-80°), IR in constant points 6.88 (range 2-10). Mean OSS 38.2 (range 5-48), QDASH 21.2 (range 0-86) and SSV 76.3 (range 20-100). Mean OSS in the operative and non-operative groups were 32.8 and 40.8 ($p=0.05$). 7 patients had recurrent dislocations (4 displaced, 2 minimally displaced), all 4 displaced were managed operatively. Comparing displaced >5mm fracture outcomes (OSS 35.8, elevation 124°, IR 5.57, ER 43°) to minimally-displaced/undisplaced fractures (OSS 41.8, elevation 156°, IR 8.6, ER 59°); $p=0.11$, $p=0.025$, $p=0.007$, $p=0.044$, respectively. 19 patients had both a step and a gap radiographically; 10 managed non-operatively (OSS 38.0, elevation 146°, IR 8.0, ER 49°), 9 managed operatively (OSS 36.6, flexion 113°, IR 4.33, ER 38°). Patients with a step had poorer function than gaps (OSS 27.2 vs 43.7; $p=0.1$). Overall complication rate was 45% (adhesive capsulitis 22.5%, rotator cuff tendinopathy 20%).

Conclusions: This is one of the largest case series evaluating function of patients with isolated intra-articular glenoid fractures. Patients with recurrent dislocations, fracture displacement >5mm, with both radiographic gap and step, were more likely to have operative intervention. Worse functional outcomes and higher complication rates were associated with operatively managed patients.

OP.02.01

ULTRASOUND SEEMS A VALUABLE TOOL FOR ASSESSMENT OF SOFT TISSUE INJURIES IN THE ELBOW!

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Background: Ultrasound (US) has been suggested a valuable complement to clinical and radiological examinations in elbow trauma. Magnetic resonance imaging (MRI) is considered the gold standard despite reported fair to moderate interrater reliability (IRR). The primary aim was to investigate if US was feasible in the acute setting following an elbow trauma. Secondly to investigate IRR between 2 investigators using US in acutely injured elbows and agreement between US and MRI for the same injuries.

Methods: 101 patients, 45 men, mean age 49 (range 18-86) suffering an elbow trauma with dislocation and/or fracture were included. Exclusion criteria were prior injury or examinations not possible within 14 days. During US the condition of muscles and ligaments was recorded in a protocol, with alternatives intact, partial or complete tear. 72 patients had two US assessments independently by upper extremity surgeons. 58 patients had an MRI evaluated by 2 experienced radiologists using the same protocol. Agreement between assessment modalities was analysed with kappa statistics and interpreted according to Landis and Koch.

Results: US examination was feasible in all within 2 weeks with tolerable discomfort. Describing the structures as intact or injured the IRR was moderate or substantial as follows: extensors 0,50, lateral ligaments 0,45, annular ligament 0,70, flexors 0,40, medial anterior ligament 0,70, medial posterior ligament 0,62. When separating the findings further and differentiating between intact, partial or complete the IRR ranged from fair to substantial. The agreement between MRI and US ranged from fair to substantial (extensors 0,64, lateral ligaments 0,28, annular ligament 0,31, flexors 0,62, MCL anterior 0,29, MCL posterior 0,45). When categorizing the same structures as intact, partial or complete the agreement ranged from fair to moderate.

Conclusions: Ultrasound was found feasible. IRR varied depending on examined structures. With MRI as gold standard, agreement with US was good, ranging from moderate to substantial when injuries were separated into injured or not. For lesions considered as partial agreement was slightly less good, ranging from fair to substantial. The different modalities had varying precision in different anatomical structures. Overall, ultrasound seems like a useful tool for identifying soft tissue lesions in injured elbows.

OP.02.02

IS IT TIME FOR A CHANGE IN SIMPLE OLECRANON FRACTURES FIXATION OPERATIVE TECHNIQUE?

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Background: Olecranon fracture is a common upper limb fracture accounting for approximately 10% of all fractures of the upper extremity and 40% of all fractures around the elbow joint. Seventy percent of fractures are simple transverse fractures. Treatment with sutures, tension band wiring, screw or plate fixation depending on patient factors, fracture configuration, and surgeon preference. The most common mode of fixation is to use tension band wiring. Even though there are many implants on the market, no ideal solutions are currently available. Using the existing methods as a motive, and intending to solve the most common complications of current operative techniques, we have developed a novel technique utilizing a high-strength suture without any metallic implants.

Methods: The study enrolled ten patients, aged 26-76 years, treated with the tension-band tape fixation technique. All patients included sustained a Mayo IIA olecranon fracture during a fall on the same level, without associated injuries to other bones. During the monitoring, five outpatient controls were held, distributed over the period of six months. The main goal was to evaluate the range of motion of the operated arm. On the last follow-up, patients were given a questionnaire with series of questions considering the current condition using the Mayo Elbow Performance Score and the Oxford Elbow Score. X-rays were performed on each visit to monitor fracture healing and the position of fracture fragments. Our technique involves passing of two FiberTape sutures through the parallel bone tunnels created in the fracture fragments, and forming a figure "X" at the level of the fracture.

Results: Healed fracture in proper position was observed in all patients, eight weeks post-operatively. By the 12th week, 8/10 patients achieved full range of active motion. During the six months of follow-up, there were no postoperative complications. During the final follow-up visit, the average results of the Mayo Elbow Performance Score and Oxford Elbow Score were 97.5/100, and 47.33/48

Conclusions: Suture tension-band tape fixation may be a viable alternative to the traditional methods of managing simple olecranon fractures. All patients treated with this operative technique had satisfactory clinical results, without the presence of postoperative complications.

OP.02.03

TERRIBLE TRIAD OF THE ELBOW: OPTIMIZING SURGICAL OUTCOMES WITH INTERNAL BRACE

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Background: The association between elbow dislocation with fractures of the radial head and coronoid process is known as the terrible triad of the elbow (TTE). It has been a concerning disorder, due to notorious unsatisfactory results. Traditional approach includes radial head fixation or replacement, coronoid fixation and lateral ligament repair. Although surgical steps are well established, TTE is still considered an orthopedic challenge. For this reason, we have routinely included the 'internal brace' technique (IB) at the surgical approach for TTE. This lateral collateral ligament reinforcement consists of fixing a strong suture to both ligament insertion points, ensuring for a greater joint stability.

Methods: Inclusion criteria were TTE patients operated by the same surgeon, augmentation with IB, and at least 12-month follow-up. Operative reports were assessed, and patients were reviewed for radiographic analysis and clinical results, including range of motion (ROM) and functional scores. The operated elbow was also compared to contralateral unaffected side.

Results: Inclusion criteria were met by 26 individuals. Simple radial head fractures were fixed with headless screws in 8 patients, and all other were replaced due to comminution. Coronoid were plated in one, fixed with screws in 4 and grafted due to comminution in two patients. All other coronoid injuries were classified as tip fractures and were not fixed. Lateral collateral ligament was repaired and augmented with IB in all patients. Mean ROM for operated elbows were: $136^{\circ} \pm 2$ (flexion), $10^{\circ} \pm 8$ (extension), $86^{\circ} \pm 6$ (pronation) and $84^{\circ} \pm 11$ (supination). Mean functional scores were 96 ± 6 points for MEPS and 5 ± 6 for DASH. Although statistically different for flexion ($p=0,0000$) and extension ($p=0,0000$), comparison with contralateral unaffected elbow did not reach the minimal important clinical difference for any outcome parameter. Clinical scores and ROM were not influenced by different radial head or coronoid approaches, since no statical difference were found. There was no significant complications or reoperations within our series.

Conclusions: TTE treatment including ligament reinforcement with IB techniques results in satisfactory outcomes. Reinforcement with the IB adds security to lateral ligament repair, increasing stability and providing more confidence for early rehabilitation.

OP.02.04

A HOLOGRAPHIC MIXED REALITY SYSTEM TO LEAPFROG CURRENT TECHNOLOGY IN REMOTE ORTHOPEDIC UPPER EXTREMITY TRAUMA CARE

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Background: Introduction: Operating rooms in remote and developing countries often do not have access to advanced medical technologies. Trauma care presents additional challenges, due to the emergent nature of trauma and the uniqueness of each injury. Some hospitals have invested in on-site 3D printing workflows based on imaging to facilitate better understanding of fractures, but these workflows require expensive equipment, workflows, and replenishment of printing materials. This study investigated the use of a holographic mixed reality system in a remote location to facilitate trauma care with no disposable resources.

Methods: Methods: A head-mounted holographic mixed reality system that allows the surgeon to intraoperatively view, manipulate, position, and reduce fractures in augmented reality was developed (RSQ HOLO, RSQ Technologies, Poznan, Poland). The system was utilized in an orthopedic trauma hospital in Ethiopia. After obtaining 3D imaging of a trauma patient, 3D models of upper extremity fractures were uploaded to the mixed reality system that allowed the surgeons to both manipulate the fracture components and template each case ahead of the procedure. Intraoperatively, while maintaining sterility, the mixed reality system was used by the surgical staff to reference and manipulate the anatomy in real time as if they were physical objects in the surgical field.

Results: Results: The workflow from imaging to uploading 3D models to the mixed reality system took less than 5 minutes to complete. The surgeons were able to preoperatively plan each case in 3D as well as visualize the virtual objects intraoperatively for anatomical referencing. All surgeons quickly acquired the skills to manipulate their virtual field. Complex upper extremity fractures were successfully reconstructed utilizing the system for reference.

Conclusions: Discussion: The form factor, zero-waste, and intraoperative advantages of using a head-mounted mixed reality system in upper extremity trauma care facilitates an increased understanding of complex fracture anatomy as well as streamlining the workflow from imaging to the procedure. Such systems can be deployed to remote areas thereby "leapfrogging" current standard imaging, viewing, and intraoperative assistance systems.

OP.02.05

ELBOW ARTHROSCOPY "INJECTION - FLEXION" SIGN

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Background: A lack of elbow extension is a frequent indication for arthroscopy; however, the loss of extension can be caused by a tight anterior capsule, or alternatively bone or scar obstruction posteriorly. A common positioning for elbow arthroscopy is with the patient was placed in a lateral position with the arm over a bar, with the elbow flexed at 90 degrees. It was observed that while most elbows extended on injection of saline, a proportion flexed. This study assessed the correlation between the direction of the elbow motion following injection of saline, and the presence of an anterior capsular contracture.

Methods: Because of the observation of variable motion with 20ml saline injection, the direction of initial motion, as well as routine documentation of pathology and treatment was recorded for all elbow arthroscopy. This data was then retrospectively reviewed to assess for a possible correlation of elbow flexion on saline injection with anterior contracture as a cause of loss of elbow extension.

Results: Of the consecutive series of 49 patients who underwent elbow arthroscopy, 12 were noted to flex, and 37 to extend following injection of 20ml of saline. 3 of the 31 who extended were also noted to have volar capsular contracture, but extended less than those without a volar capsular contracture. There was a significant association with elbow flexion and volar capsular contracture ($p < .00001$) and with extension and no contracture ($p < .00001$). Of the 3 patients who extended but were noted to have an anterior capsular contracture, 2 had large anterior loose bodies, and the other patient responded well to anterior capsular release. Overall sensitivity of "injection flexion" for predicting the presence of an anterior contracture as the cause of elbow extension lack was 0.8, and the specificity 1.0.

Conclusions: A significant association between elbow flexion on injection of saline and the presence of an anterior capsular contracture has been demonstrated. This provides a useful guide as to the cause of the lack of elbow extension, prior to arthroscope insertion, and is consistent with the work by Gallay, Richards and O'Driscoll (Arthroscopy, 1993) on the compliance of the stiff elbow.

OP.02.06

LINKING THE DISTAL HUMERUS COLUMNS IN ARTICULAR FRACTURE FIXATION

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Background: High rates of nonunion in articular distal humerus fractures indicate an unsolved problem. The fixation principles of O'Driscoll describe linking the fractured articular segment to the distal humerus columns with compression screws which creates a stable fixed angle construct. A novel device has been introduced which utilizes an interlocking beam through the articular segment to connect the distal aspect of the medial and lateral plates, creating a linked construct. We sought to evaluate the stability of this linked construct using an articular model of distal humerus fracture.

Methods: Ten matched pair specimens of 65 years of age or older were randomized to the use (LB group) or non-use (NLB group) of an interlocking beam to link the medial and lateral locking plates in fixation of an AO Type C3 fracture model. Outside of the linking beam, fixation between the matched pairs was consistent using 2.7mm locking screws with fixed trajectories and uniform lengths.

Results: Mean stiffness was 273 Newtons/mm in the LB group and 225 Newtons/mm in the NLB group ($p=0.001$). Mean maximum displacement was 0.28 in the LB group and 0.93mm in the NLB group ($p=0.006$). Mean load to failure was 277 pounds in the LB group and 280 pounds in the NLB group ($p=0.94$).

Conclusions: Success of the distal humerus fixation construct is predicated on 2 conditions - 1) rigid fixation of the articular segment and 2) compression of the articular segments to the humeral shaft. These fixation principles have been applied to a novel fixation construct which links the medial and lateral columns via an interlocking beam. In structural engineering, a beam is a horizontal element which resists loads that are perpendicular to its axis. Our results indicate that an interlocking beam which links the medial and lateral plates provides greater stability compared to a similar fixation construct which does not utilize an interlocking beam. We attribute this finding to the beam's double supported design which resists cantilever bending and provides robust compression of the fractured fragments.

OP.02.07

MONTREAL NOVEL FRAGMENT SPECIFIC CLASSIFICATION OF COMPLEX OLECRANON FRACTURES: CREATION OF A 3D MODEL, RADIOLOGICAL VALIDATION AND PROPOSED SURGICAL ALGORITHM

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Background: Current classifications for proximal ulna fractures patterns come from qualitative observations and are not guiding surgical decision making. They are not impartial enough for understanding the deforming forces on the fracture fragments. We propose a new classification system based on a biologic and anatomic stresses analysis. Our hypothesis is that fragments in complex fractures can be predicted by the tendinous and ligamentous insertions on the proximal ulna. A surgical algorithm based on fractured fragments will be proposed.

Methods: A literature review was conducted, followed by modeling of the proximal ulna soft tissue insertions. Selected articles included location of these insertions. A 3D model of the ulna anatomy has been designed using data from the literature review with SliceOMatic and Catia V5R20 software. Proposed fragments and fracture lines were derived from the literature review. A retrospective radiological study was conducted. The radiological database was used to identify CT scans of multi-fragment olecranon fractures from 2009 to 2021. These have been reviewed and classified according to the novel "fragment specific" classification, the Mayo and the Schatzker classifications.

Results: The literature review targeting quantitative values for the elbow soft tissue identified 1152 scientific articles. 198 articles were filtered as directly relevant and 41 met the inclusions criteria. 12 papers presented quantitative data for an equivalent of 134 quantified elbows. consensus was obtained, and the bony attachments of ligaments and tendons were mapped on a 3D olecranon model. Seven potential fracture fragments were identified. The radiological study was a cohort of 67 cases. A substantial interrater reliability (Cohen kappa, >0.6) was obtained. The seven specific fragments were identified in the 67 cases of complex olecranon fractures based on pre-operative CT scans: dorsal (40%), intermediate (42%), tricritical (100%), supinator crest (25%), coronoid (18%), sublime tubercle (12%) and anteromedial facet (18%). 18 cases (27%) were classified as Schatzker D (comminutive) and 21 (31%) Mayo 2B (stable comminutive).

Conclusions: This proposed classification system is anatomically based and considers the deforming forces from ligaments and tendons. By offering a more precise comprehension of complex proximal ulna fractures, it would lead to more accurate fracture evaluation in order to plan fixation.

OP.02.09

OLECRANON FRACTURE DISLOCATION. OPERATIVE TREATMENT AND IMPORTANCE OF RECOGNISING LESSER SIGMOID NOTCH FRACTURES

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Background: Olecranon fracture dislocations (OFD) are complex elbow injuries with certain characteristics. The lesser sigmoid notch of the ulna has received limited attention in the setting of these injuries. The purpose is to present the lesions, surgical technique and outcomes of patients that were operated for OFD with radial head (RH) and coronoid fractures. Secondary purpose is to describe the fracture of lesser sigmoid notch (LSN) in these cases.

Methods: Sixteen patients (8 male, mean age 58years, range 24-70) were operated for OFD with concomitant RH and coronoid fractures. All patients had a preoperative CT examination.

Seven patients had LSN fracture (undisplaced n=1, displaced but not comminuted n=4, comminuted n=2). All patients were operated through transolecranon fracture approach. Coronoid fracture fixation was performed with sutures, screws or plate depending on fracture pattern. Identification and anatomical restoration of LSN fracture allowed for proximal radioulnar joint (PRUJ) congruity and provided a landmark for RH arthroplasty height.

Results: At mean 39 months follow-up (range 27-60) the patients had mean (range) elbow ROM flexion/extension 120° (110-120)/-10° (-20 - -5) and pronation/supination 70° (60-80)/60° (60-70). Fracture union was achieved, and none had new dislocation or needed revision. Mean (range) MEPS and DASH scores were 100 (0) and 7.5 (2.5-20) respectively. Four patients presented with ulnar neuritis that resolved spontaneously.

Conclusions: Patients of this series that were operated for olecranon fracture dislocation with concomitant radial head and coronoid fracture displayed successful functional outcome. The lesser sigmoid notch fracture should be recognized and anatomically restored to achieve stability and congruity of PRUJ and to serve as landmark for RH arthroplasty in olecranon fracture dislocation with associated RH and coronoid fractures. According to the findings LSN may present as: I. intact; II. undisplaced fracture; III. displaced without comminution; IV. comminuted fracture. Further studies are needed to confirm these findings regarding lesser sigmoid notch involvement and fracture pattern in OFD injuries.

OP.02.10

PREDICTIVE FACTORS FOR HUMERO-ULNAR OSTEOARTHRITIS IN FRACTURES OF THE PROXIMAL ULNA

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Background: Olecranon fractures are the most common fractures in elbow trauma. Double plate osteosynthesis is now the gold standard when they are comminuted or complex. Our study evaluates the incidence of osteoarthritis in patients who have undergone double plate osteosynthesis following a complex fracture of the proximal ulna.

Methods: Between January 2004 and June 2019, 74 patients who underwent plate osteosynthesis of the upper end of the ulna and were free of humero-ulnar osteoarthritis were included. Radiographic analysis was conducted on the initial, postoperative and longest follow-up radiographs of these patients to determine what radiological predictors of post-traumatic humeroulnar osteoarthritis might be.

Results: The mean follow-up time was 37.3 months (1 - 169). The mean age of the patients was 56 years (15 - 85), with 55% female. The incidence rate of humero-ulnar osteoarthritis on radiography at longest follow-up was 46% (34 patients). Risk factors associated with a higher rate of osteoarthritic lesions were Schatzker F, Mayo 3 fractures, presence of metaphyseal extension of the fracture line, associated Regan and Morrey stage 2 or 3 coronoid fracture or Mason stage 2 or 3 radial head fracture, and poor joint reduction.

Conclusions: Proximal ulna fractures are often associated with complex injuries involving the stabilising anatomical elements of the elbow. There is a significant influence of the severity of the type of fracture and these associated lesions in the development of humero-ulnar osteoarthritis. The quality of joint reduction can help to correct this unfavourable progression.

OP.02.11

LONG TERM RESULTS FOR TREATMENT OF POST INFECTION NON UNION OF SUPRACONDYLAR HUMERUS WITH A RING FIXATOR

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Background: Nonunion of the supracondylar area of the humerus is a very difficult area to treat. The Ilizarov method has been shown to be effective in the treatment of nonunion of the humeral diaphysis. However, there is little in the literature regarding the treatment of nonunion of the supracondylar area especially in post-infection cases. In this study long term results of using this technique are demonstrated .

Methods: Eighteen patients with a mean age of 45.73 years were treated for post-infection nonunion of the supracondylar area of the humerus with the Ilizarov method and followed up for 7 years. All had undergone at least 2 previous failed operations. The patients were evaluated radiologically and clinically with an outcome survey using the Disabilities of the Arm, Shoulder and Hand (DASH) score.

Results: Solid union was achieved in all patients in a mean time of 6.87 months. All patients had improvement in shoulder and elbow motion after treatment. The mean DASH score before surgery was 90.66 , whereas that after surgery was 24.62 . There was a significant improvement in the DASH score after surgery; the mean difference was 66.04 , with a t value of 35.88 ($P < .001$). All patients were satisfied with the treatment and returned to a more normal lifestyle with no pain, as well as complete soft-tissue recovery. None had recurrence of infection.

Conclusions: Ilizarov treatment for post-infection nonunion of the supracondylar humerus was shown to be effective, reliable, and tolerated by the patients

OP.02.12

CLINICAL OUTCOMES IN PATIENTS UNDERGOING DISTAL HUMERAL HEMIARTHROPLASTY FOR COMPLEX INTRA-ARTICULAR DISTAL HUMERAL FRACTURES

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Background: Distal humeral hemiarthroplasty (DHH) is a treatment option for complex intra-articular distal humerus fractures not amenable to open reduction internal fixation (ORIF). ORIF has a reported high complication rate and Total elbow arthroplasty (TEA) places significant limitations on patient functionality, in addition to its own complications. The literature on clinical outcomes from DHH is limited.

The aim of the study is to present the clinical outcomes in patients undergoing hemiarthroplasty for distal humeral fracture with early to mid-term follow up.

Methods: Prospectively collected data from departmental database was reviewed retrospectively. All patients undergoing elbow hemiarthroplasty for trauma with minimum 2 year follow up at a Major Trauma Centre were reviewed. The implant used was Tornier Latitude elbow hemiarthroplasty. Outcome measures constituted Oxford Elbow Score (OES), Disabilities of the Arm Shoulder and Hand Score (DASH) and Range of motion (ROM).

Results: 22 patients were reviewed with 1 lost to follow up and 2 deaths. 19 elbow hemiarthroplasties in 19 patients (male:female of 1:18) were identified with mean follow up of 55 months (26 to 111), over a 7 year period from 2012 to 2019. The mean age was 67 years (49 to 77) with 88% ASA grade 2 and 12% ASA grade 3. The reported mean OES was 32 (9 to 47) and mean DASH score was 37.4 (2.3 to 79.6). The mean post-operative ROM was flexion 122.4 degrees (90 to 150), extension 14.7 degrees (0 to 45), pronation 88.4 degrees (80 to 90) and supination 85.6 degrees (40 to 90). The complication rate was 16% (n=3) and included permanent ulnar neuropathy, complete ankyloses and olecranon erosion requiring revision to total elbow replacement at 48 months.

Conclusions: Our study supports DHH as a good option for complex un-reconstructable distal humerus fractures. The functional outcomes in our cohort were satisfactory with a lower complication rate than reported in the literature.

OP.03.01

FUNCTIONAL AND IMAGING EVALUATION OF SUBSCAPULARIS MUSCLE IN PATIENTS UNDERGOING LATARJET SURGERY WITH PRESERVATION OF TENDON INSERTION

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Background: In bone block surgery described by Latarjet, surgical desinsertion of the subscapularis muscle often results in alterations in its function and structure, which may be definitive. Thus, the split of subscapularis muscle fibers was described as an alternative to disinsertion. In order to verify the impact of this preservative approach, both on the structure and function of the subscapularis muscle, we evaluated a group of patients who underwent Latarjet surgery in which muscle split approach was performed.

Methods: Participants with a minimum postoperative follow-up of one year who had undergone computed tomography of the affected shoulder, as part of the preoperative routine, were selected. Participants underwent physical examination to assess range of motion and subscapularis function. Through the analysis of computed tomography images, we evaluated thickness of the subscapularis and infraspinatus and the stage of subscapularis fatty infiltration. For strength evaluation, bilateral muscle torque analyzes of the medial and lateral rotators were performed using an isokinetic dynamometer.

Results: The study included 32 individuals of both genders, with a mean age of 33.9 ± 9.2 years. Regarding the physical examination, we did not clinically observe subscapularis dysfunction. Postoperative computed tomography images, using the contralateral side as a control, revealed reduced thickness of both subscapularis (2.28 ± 0.46 cm and 2.10 ± 0.46 cm, respectively) and infraspinatus (2.84 ± 0.33 cm and 2.76 ± 0.30 cm, respectively) muscles on the affected side. There was also a significant difference in the strength of the medial and lateral rotators between the shoulders, with lower values of both peak torque and total work on the affected shoulder, with a symmetry index between 76.3 and 89.4%. There were significant but small correlations between postoperative subscapularis muscle thickness and peak torque values and total work of the medial rotators of the affected shoulder.

Conclusions: The results suggest that the approach with preservation of the subscapularis humeral insertion results in decreased subscapularis muscle thickness as well as in reduced peak torque and total work of medial rotators. These changes, however, did not manifest on physical examination, with the maneuvers performed to evaluate the subscapularis function being negative.

OP.03.02

NOVEL TECHNIQUE TO TREAT STERNO-CLAVICULAR JOINT INSTABILITY WITH JOINT FIXATION AND MID-CLAVICLE OSTEOTOMY, LONG TERM FOLLOW UP OF MORE THAN 10 YEARS

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Background: The Sternoclavicular (SC) joint dislocations are rare injuries. Surgical management is indicated for patients who failed conservative management and have persistent pain and instability.

Methods: Between December 2003 and May 2020, 8 patients who were diagnosed with recurrent SC Joint instability were included in the study. All these patients underwent the surgical technique that consists of two stages. The first stage consists of medial clavicle fixation and mid-clavicular osteotomy and a second stage to remove the tension band wire and fixation of the mid-clavicular osteotomy with a plate. Patients reported outcome scores used including the disabilities of the arm, shoulder and hand (DASH) questionnaire, Constant score and Oxford shoulder score. Data was analysed statistically using simple descriptive statistics.

Results: There were total of 8 Patients diagnosed with recurrent SC joint dislocation. The mean age was 48 years. The average follow up was 10,61 years (range 2.5-19 years). The average of DASH Function, work module and sports/performing arts module was 2.7, 0 and 0,78 respectively. The average constant score was 99.75 and Oxford shoulder score was 47.5. There was no wound or neurological complications or hardware migration occurred in this series.

Conclusions: There is no evidence in the literature that supports one surgical technique over another technique for the sternoclavicular (SC) joint dislocations. The novel two-stage approach has shown constant satisfactory long-term functional outcomes.

OP.03.03

OPEN LATARJET OUTPERFORMS OPEN BANKART REPAIR IN CONTACT SPORTS

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Background: Because Rugby is a contact and collision sport, it exposes to a higher risk of recurrence after anterior shoulder stabilization. Therefore, the choice of the surgical procedure warrants specific attention to optimize the stability of the shoulder throughout the career of the player. The goal of this study was to compare clinical and radiological outcomes of open Bankart and open Latarjet at mild to long term follow-up in a high-risk sport.

Methods: 66 rugby players were retrospectively enrolled in a single center study after a surgical treatment for anterior shoulder instability procedure with a minimum follow-up of 5 years. 33 players (35 shoulders) treated with an open Bankart repair (Group Bk) were compared to 33 players treated with an open Latarjet (Group Lt). Rowe score, Walch-Duplay score and rate of recurrence (dislocation or subluxation) were analyzed. Degenerative arthritis was explored on plain X-rays at follow-up.

Results: Both groups were comparable in term of preoperative glenoid bone loss and ISIS.

At mean follow-up of 6 years, the rate of recurrence was 17% for group Bk and 0% for group Lt ($p=0.01$). Postoperatively, no complication occurred in group Bk, whereas 2 infections required a reoperation and washout in group Lt ($p=0.23$). 93% was able to return to rugby at the same level or higher in group Bk and 85% in group Lt ($p=0.26$), at mean time of 6 months and 5 months respectively ($p=0.30$). The mean Rowe and Walch-Duplay were of 91 vs 94 points ($p=0.34$), 87 vs 89 points ($p=0.78$) for Bk and Lt group respectively.

The rate of moderate or mild arthritis was 68% in group Bk and 39% in group Lt ($p=0.01$).

Conclusions: Open Latarjet procedure provided satisfactory clinical and radiological outcomes at long term follow-up in rugby player population. It outperformed open Bankart repair in term of rate of recurrence and degenerative arthritis.

OP.03.04

CLAVICULAR TUNNEL WIDENING IN CHRONIC ACROMIOCLAVICULAR JOINT INSTABILITIES AFTER PRIMARY AND REVISION ARTHROSCOPICALLY-ASSISTED ACROMIO- AND CORACOCALVICULAR STABILIZATION

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Background: The treatment of chronic bidirectional acromioclavicular joint (ACJ) dislocations can be challenging. Loss of reduction (LOR), recurrent dynamic posterior translation (DPT) and clavicular tunnel widening (cTW) are common postoperative phenomena.

We aimed to evaluate coracoacromial malalignment (LOR, DPT) and cTW in patients with chronic ACJ dislocations treated with arthroscopically-assisted ACJ stabilization after previously failed non-operative or surgical treatment.

Methods: 27 patients (20 male, 7 female, mean age 46.1 years) with chronic bidirectional ACJ dislocations and failed previous treatment (15 patients non-operatively, 12 patients surgically) were operated with an arthroscopically-assisted ACJ stabilization by use of a coracoclavicular and acromioclavicular tendon allograft passage augmented with a single low-profile TightRope device.

Bilateral anteroposterior stress views served for evaluation of LOR and cTW at 6 weeks and 6 months postoperatively and for evaluating the filling ratio (FR, device insertion depth divided by clavicle height) at 6 weeks postoperatively. Bilateral Alexander views were used to assess the degree of DPT 6 months postoperatively.

Results: There were no postoperative differences in LOR, DPT or cTW between groups.

After joint reduction at 6 weeks postoperatively [16.6mm with 95% CI 14.9-18.3mm to 8.3mm (6.7-9.9mm); $p < 0.001$], LOR was observed 6 months postoperatively [-3,5mm (-5.2- -1.9mm); $p < 0.001$].

cTW area increased between Follow-Ups (FUs) [28.5 mm² (24.2-32.8 mm²) to 39.1 mm² (34.4-43.8 mm²); $p < 0.001$]. Diametral cTW was most pronounced at the inferior cortex [7.3mm (7.0-7.7mm) vs. superior cortex: 6.0mm (5.8-6.1mm) and vs. intermediate level: 6.2mm (6.0-6.4mm); $p < 0.001$, respectively].

Larger cTW at the inferior cortex was related to a smaller FR ($r = -0.432$; $p = 0.032$) and showed a correlation with LOR ($r = -0.449$; $p = 0.024$) and DPT ($r = 0.421$; $p = 0.036$).

Conclusions: In chronic ACJ dislocations treated with arthroscopically-assisted ACJ stabilization after failed prior treatment, cTW is associated with malalignment of the ACJ. Consequently, reduced cTW (e.g., by means of a more filling device) could improve ACJ reduction.

OP.03.05

COST-EFFECTIVENESS ANALYSIS OF ARTHROSCOPIC BANKART REPAIR VERSUS OPEN LATARJET IN PATIENTS WITH INSTABILITY SEVERITY INDEX SCORE (ISIS) BETWEEN 4 AND 6

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Background: The ideal surgical treatment for anterior shoulder instability is still under debate. Both clinical and economic factors must be considered for optimal resource allocation. From the clinical perspective, the Instability Severity Index Score (ISIS) is a helpful and validated tool for surgeons, although a gray area between 4 and 6 exists. In fact, patients with an ISIS <4 and >6 can be treated effectively with arthroscopic Bankart repair and open Latarjet, respectively. The purpose of this study was to conduct a cost-effectiveness analysis of arthroscopic Bankart repair versus open Latarjet in patients with an ISIS between 4 and 6

Methods: A decision-tree model was constructed to simulate the clinical scenario of an anterior shoulder dislocation patients with an ISIS between 4 and 6. Outcome probabilities and utility values in the form Western Ontario Instability Score (WOSI) were assigned to each branch of the tree, alongside institutional cost. The primary outcome assessed was an Incremental Cost-Effectiveness Ratio (ICER) of the two procedures. Eden-Hybbinette was also considered in the model as a salvage procedure for failed Latarjet. A two-way sensitivity analysis was performed to identify the most impactful parameters on the ICER upon their variation within a pre-determined interval.

Results: Base case cost was 1.245,57 € (1220,48 - 1270,65 €) for arthroscopic Bankart repair, 1.623,10 € (1580,82 - 1665,39 €) for open Latarjet and 2.373,95 € (1940,81- 2807,10 €) for Eden-Hybbinette. Base-case ICER was 9,570,23 €/WOSI. Most impactful parameters were the utility of arthroscopic Bankart repair, the probability of success of open Latarjet, the probability of undergoing surgery after post-operative recurrence of instability and the utility of Latarjet. Of these, utility of arthroscopic Bankart repair and Latarjet had the most significant impact on the ICER.

Conclusions: from a hospital perspective, open Latarjet was more cost-effective than arthroscopic Bankart repair in preventing further shoulder instability in patients with an ISIS between 4 and 6. Despite its several limitations, this is the first study to analyze this subgroup of patients from a European hospital setting from both an economic and clinical perspective. This study can help surgeons and administrations in the decision-making process.

OP.03.06

ARTHROSCOPIC TREATMENT OF ACUTE BONY BANKART LESION WITH A PRE-CONTOURED XENOGRAFT IMPLANT: A CASE SERIES

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Background: The management of acute Bony Bankart Lesion (aBBL) is matter of dispute. We evaluated objective and subjective outcomes in a case series of unreparable aBBL treated arthroscopically implanting pre-contoured xenograft.

Methods: Between September 2019 and January 2022, 6 patients with traumatic instability and associated glenoid fracture were treated using a pre-contoured bone xeno-graft. At follow-up, a clinical assessment was performed including Rowe Score, WOSI, Quick-Dash, ROM and VAS scale; radiographic assessment of joint centering and osteoarthritis was documented; computed tomographic images were used to evaluate glenoid reconstruction morphology, graft position and modification in surrounding native bone.

Results: Six patients were postoperatively examined at medium follow-up of 23 months (range, 12-39 m). Two patients had up to 5 previous gleno-humeral dislocation events. Positive preoperative apprehension and relocation test resulted for 5 patients in the healthy side, but for all were negative at follow-up in the treated shoulder. No neurologic lesion observed both before and after surgery. The clinical tests performed had very high scores, with patients rating "good" and "excellent" at follow-up. ROM was fully restored with minimum loss of external rotation in ER1 position in 5 patients compared with the contralateral shoulder.

Conclusions: Arthroscopic stabilization using xenograft is a safe, feasible, and reproducible technique. In our cases, good shoulder stability could be achieved with high patient satisfaction.

OP.03.07

CLINICAL OUTCOMES AND RECURRENCE RATE OF FOUR PROCEDURES FOR RECURRENT ANTERIOR SHOULDER INSTABILITY: ASA, REMPLISSAGE, OPEN AND ARTHROSCOPIC LATARJET. A RETROSPECTIVE MULTICENTER STUDY.

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Background: The optimal surgical technique for treatment of chronic anterior shoulder dislocation is still controversial due to the different clinical conditions and functional demands of these patients. The aim of the present study was to compare clinical outcomes of four surgical techniques in patients with recurrent anterior shoulder dislocation, Glenoid Bone Loss < 15% and Instability Severity Index Score >3.

Methods: A retrospective multicenter study was conducted on 226 patients who underwent one of four different techniques (Bankart plus Arthroscopic-Subscapularis-Augmentation, Bankart plus Remplissage, Latarjet, Arthro-Latarjet). Inclusion criteria were: recurrent dislocation, Glenoid Bone Loss <15%, Instability Severity Index Score >3. Exclusion criteria were: glenoid bone loss >15%, voluntary instability, multidirectional instability, pre-existing osteoarthritis, throwing athletes and first dislocation, Instability Severity Index Score <3. Minimum follow-up was 24 months with a maximum of 6 years. Hyperlaxity was clinically evaluated according to Neer and Coudane-Walch tests.

Clinical outcomes were assessed using the Rowe score and the Western Ontario Shoulder Instability Index for each technique. Before surgery, the Pico area method was used to assess the percentage of glenoid bone loss.

Results: 226 patients were included in the present series. Arthroscopic Subscapularis Augmentation group patients at final follow-up scored as excellent in 89.2% according to Rowe score, and Western Ontario Shoulder Instability Index improved from 838 to 235 points. Remplissage group patients scored as excellent in 76,9% according to Rowe score, and Western Ontario Shoulder Instability Index improved from 1146 to 465 points. Latarjet group scored as excellent in 98.5% according to Rowe score, and Western Ontario Shoulder Instability Index scale improved from 1456 to 319 points. Arthro-Latarjet group scored as excellent in 81.6% according to Rowe score, and Western Ontario Shoulder Instability Index improved from 1250 to 221 points. Recurrence rate: Arthroscopic-Subscapularis-Augmentation group (7%), Remplissage group (6,1%), Latarjet group (1.5%), Arthro-Latarjet group (0%).

Conclusions: Arthroscopic-Subscapularis-Augmentation and Remplissage procedures demonstrated to be effective to restore joint stability with good clinical outcomes similarly to the Latarjet procedure in patients with glenoid bone loss <15% and Instability Severity Index Score >3. Soft tissues augmentations of the Bankart repair demonstrated to be effective in addressing anterior capsule deficiencies and critical Hill-Sachs lesions.

OP.03.08

CORACOID BONE GRAFT RESORPTION AFTER LATARJET PROCEDURE AT A MINIMUM 5-YEAR FOLLOW-UP

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Background: There is no consensus among shoulder physicians regarding the clinical impact and progression of coracoid bone graft resorption after Latarjet procedure. This study aims to investigate the coracoid bone graft resorption after Latarjet procedure at a minimum 5-year follow-up.

Methods: Between January 2011 and October 2017, 50 patients underwent an Latarjet procedure and were included. All patients had a minimum 5-year follow-up. Clinical outcomes measures included the pain visual analog scale (VAS), American Shoulder and Elbow Surgeons (ASES) function score, Constant-Murley score, Rowe score and range of motion (ROM). Radiographic outcomes measures included the graft position, graft resorption, screw orientation, and glenohumeral joint osteoarthritis. The incidence, classification, region, risk factors, clinical impact and progression of graft resorption were analyzed.

Results: After a mean follow-up of 7.5 years (range, 5-9 years), the incidence of coracoid graft resorption was 88% based on the computed tomography evaluation, while 84% at 1-year follow-up, and no significant difference was found between these 2 follow-up period. The graft resorption at the final follow-up was classified as grade 0 in 6 patients, grade I in 28, grade II in 14, and grade III in 2. Compared with the classification at 1-year follow-up, 2 patients was classified from grade 0 to grade I, and other cases showed no progression during the follow-up. Graft resorption mainly occurred on the superficial part of the proximal coracoid bone graft. No correlation was found between the incidence, classification of graft resorption and the preoperative glenoid bone defect, gender, age, smoking status, graft position, screw orientation, postoperative ROM, pain, or Rowe score. There was no significant difference between the minor resorption group (grade 0, I) and the major resorption group (grade II, III) in clinical outcome scores and ROM. No recurrent dislocation and progression of glenohumeral joint osteoarthritis occurred in all cases during the follow-up.

Conclusions: Coracoid bone graft resorption was present in at least 80% of the patients after Latarjet procedure at a minimum 5-year follow-up, and most of the cases were classified as minor graft resorption. However, the graft resorption seems to remain stable without progression after 1 year postoperatively and has no prominent negative impact on clinical outcome.

OP.03.09

RECURRENT SHOULDER DISLOCATIONS PRIOR TO LABRAL REPAIR IS ASSOCIATED WITH INCREASED RISK OF REOPERATION FOR INSTABILITY: A LARGE MATCHED COHORT INSURANCE DATABASE ANALYSIS

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Background: Shoulder instability is known to lead to increased recurrence with each dislocation prior to stabilization procedures. The extent to which multiple shoulder dislocations increase the risk of recurrent instability following surgery in a large population is not known.

Methods: A large insurance database was queried for patients with shoulder stabilization for surgery between 2010-2018. The study population was stratified by single dislocation versus multiple dislocations before surgery. Groups were matched by surgery type, Charlson Comorbidity Index, age, and gender. The primary outcome was revision shoulder instability surgery; other outcomes included postoperative closed reduction of the shoulder, ED visits, readmissions, and medical complications.

Results: Baseline demographics were similar between groups (N=161 per group). Overall, 21 patients (13.0%) with a single dislocation and 47 patients (29.2%) with multiple dislocations had subsequent revision surgery (OR=2.75, P=0.0006). Twelve patients (7.5%) with a single dislocation and 42 patients (26.1%) with multiple dislocations required a closed reduction postoperatively (OR = 4.38, P<0.0001). An increasing number of dislocations was associated with greater risk of postoperative dislocation requiring closed reduction (OR = 1.05, 95% CI 1.04-1.07, P<0.0001) and increased risk of revision (OR = 1.03, 95% CI 1.02-1.05, P<0.0001). There were no differences in rates of manipulation under anesthesia (P=0.62), readmission (P=0.80), or complications (P>0.99). Significant predictors of revision for instability included open Latarjet procedure (adj-OR=10.39, P=0.03), arthroscopic capsulorrhaphy (adj-OR=7.53, P=0.03), and history of multiple shoulder dislocations (adj-OR=2.92, P=0.0003).

Conclusions: Compared to patients with a single shoulder dislocation, those with multiple dislocations are twice as likely to require revision surgery and 3 times as likely to require a postoperative closed reduction. An increasing number of dislocations prior to a stabilization procedure is associated with a greater risk of postoperative instability requiring closed reduction or revision. Overall, patients undergoing labral repair may benefit from earlier surgical intervention.

OP.03.10

POSTERIOR OPEN WEDGE GLENOID OSTEOTOMY FOR THE TREATMENT OF POSTERIOR SHOULDER INSTABILITY WITH INCREASED GLENOID RETROVERSION: CLINICAL AND RADIOLOGICAL OUTCOMES AT MID-TERM FOLLOW-UP

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Background: The purpose of this study was to evaluate the clinical and radiological outcomes following posterior open wedge glenoid osteotomy (PGO) as a treatment for patients with posterior shoulder instability (PSI) with increased glenoid retroversion.

Methods: Of 8 consecutive patients (9 shoulders), 6 patients (7 shoulders) at a mean age of $24.0 \pm SD 5.7$ years that underwent PGO between 02/2009 and 11/2016 for PSI and increased glenoid retroversion (equal or higher than 15°) were included. Outcome measures included Oxford Shoulder Instability Score (OSIS), Rowe-Score and Visual Analog Scale (VAS) for pain. Shoulder Range of motion and posterior instability testing was documented at a minimum of 6 years postoperatively. Magnetic resonance imaging (MRI) was obtained to evaluate the progression of osteoarthritis and posterior subluxation of the humeral head (PSH) compared to preoperative images. \pm

Results: At a mean follow-up of 102.1 ± 25.9 months, no significant changes in OSIS (40.5 [interquartile range $31.0-41.3$] vs. 39.5 [$25.5-44.0$]; $p=0.46$) and Rowe-Score (83.0 ± 12.8 vs. 76 ± 14.8) were observed. Patients' abduction (180° [$147.5-180.0$] vs. 180.0° [$155.0-180.0$]; $p=0.32$), flexion (170° [$145.0-180.0$] vs. 170° [$170.0-180.0$]; $p=0.18$) and external rotation ($75.8^\circ \pm 12,8$ vs. $76,7^\circ \pm 13,7$; $p=0,36$) were not significantly altered, when compared to the contralateral side. 4 of 7 patients (57.1%) demonstrated persisting posterior instability, including one patient with recurrent posterior dislocation. MRI revealed no progression of osteoarthritis (0 [$0-2$] vs. 0 [$0-1$]; $p=0,32$) and no change in pre- to postoperative humeral head subluxation index ($67 \pm 7,1\%$ vs. $62,6 \pm 9,8\%$; $p=0,48$).

Conclusions: At mid-term follow-up, PGO for PSI with increased glenoid retroversion did not reliably restore shoulder stability, however, no progression of osteoarthritis and humeral head subluxation was observed.

OP.03.11

CORRELATION OF THE DISTAL CLAVICLE AND THE GLENOID CAVITY FOR ANTERIOR SHOULDER INSTABILITY TREATMENT

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Background: In anterior shoulder instability, biomechanics is compromised when a bone loss of 21% or over is present in the glenoid cavity. The coracoid process is still the most used autologous graft option even though a high complication rate has been shown. Other graft sites, especially with osteochondral characteristics, are being studied to treat the bony defects of the glenoid.

Methods: we have dissected twenty shoulders, bilaterally from ten fresh cadavers, with an age range between 30 and 88 years, of which 8 were men and 2 women. An extended deltopectoral approach was chosen to access the glenoid and the ipsilateral acromioclavicular (AC) joint. We classified the morphology of the distal clavicle as flat, curved, or oblique, and afterward performed an osteotomy 1 cm medially to the extremity and measured its anteroposterior (ApCl) and superoinferior (SiCl) dimensions. The anteroposterior dimension of the glenoid (ApG) was measured after the resection of all labral attachments. We performed a vertical osteotomy on the anterior glenoid rim corresponding to 25% of its anteroposterior diameter, simulating the bony lesions that occur in recurrent anterior shoulder instability. The distal clavicle was then manually attached to the created glenoid lesion so we could assess its positioning and the relationship between their radii of curvature. The distal clavicle was then osteotomized and we measured its cartilage thickness as well as that of the glenoid.

Results: The mean ApG dimension was 29.52 mm and the mean SiCl dimension was 13.9 mm. It represents a 47.08% ratio between the AP glenoid and the Si clavicle dimensions. The mean cartilage thickness of the glenoid was 2.61 mm in the total sample, 3.03 mm in those without degenerative osteoarthritis, and 2.04 mm in the group with arthritis. The mean cartilage thickness of the distal clavicle was 2.2 mm in the total sample, 2.49 mm in those without degenerative osteoarthritis, and 1.8 mm in the group with arthritis

Conclusions: The distal clavicle can cover up to 47.08% of the anterior glenoid bone loss. However, due to its morphological variation, this must be previously analyzed for its use as an autologous bone graft.

OP.03.12

LONG-TERM OUTCOMES OF THE OPEN LATARJET PROCEDURE FOR SURGICAL MANAGEMENT OF HUMERAL AVULSION OF GLENOHUMERAL LIGAMENT (HAGL)

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Background: Limited long-term evidence is available for the management of recurrent anterior glenohumeral instability caused by humeral avulsion of the glenohumeral ligament (HAGL). We present a retrospective review with long-term follow-up of patients treated with an open Latarjet procedure for recurrent anterior shoulder instability due to a humeral avulsion of the glenohumeral ligament (HAGL).

Methods: 19 patients were operated on by a single surgeon at a single centre, undergoing standardised assessment, rehabilitation and follow-up. 16 patients with complete clinical and radiological data and minimum 2yr follow-up were available for review. Outcomes assessed included range of motion (ROM), joint stability, Visual Analogue Score (VAS) for pain, Walch-Duplay score (WDS), Rowe score (RS), Constant-Murley score (CMS), Subjective Shoulder Value (SSV), satisfaction rating, return to sport and identification of clinical and radiological complications.

Results: Patients were all male with no hyperlaxity, had a median age at surgery of 28yrs (18-42) and median follow-up of 10yrs (2.8-15). After surgery, the median movements showed recovered elevation of 175°, external rotation of 62° and internal rotation to T12 level. Post-operative VAS was 0.5, WDS 86, RS 95, CMS 77 and SSV 88%. 87% returned to sport, 68% got back to the same pre-injury level and 93% were satisfied. There were no recurrent dislocations or subluxations but 2 patients who had subjective apprehension were associated with a significant Hill-Sachs and medial-seated graft, although SSV was 80%. Other complications included a superficial infection (successfully treated), a delayed bone-graft union (healed at 1yr), a patient with mild long-term pain and another with persistent stiffness. 56% had mild post-operative arthritis but 13% already had pre-operative degenerative changes. None required further surgery.

Conclusions: The open Latarjet procedure provides good outcomes with acceptable complication rates in the long-term, for symptomatic HAGL lesions. It is an effective treatment option and a safe alternative to arthroscopic or open HAGL repair.

OP.04.01

DYNAMIC MEASUREMENT OF SHOULDER RANGE OF MOTION USING THE INTEL REALSENSE D435 CAMERA

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Background: Shoulder range of movement assessment is important for evaluating shoulder pathologies. However, goniometric measurement of only peak range misses out dynamic assessment of complex shoulder movements which could aid in differential diagnosis. The Intel Realsense 3D camera (D345), like other infrared depth sensors, can digitally detect movement in space without the need for markers to detect position. We aimed to determine whether this camera can dynamically assess shoulder movement smoothness, velocity and acceleration, in addition to quantifying peak range of motion.

Methods: 26 healthy subjects without any history of shoulder pathology or pain participated in this study and were instructed to perform maximum shoulder abduction as naturally as possible. Measurement of the whole upper limb motion in the coronal plane was recorded for both right and left sides using the Intel Realsense D435 camera and data output postprocessed using Microsoft SDK to acquire shoulder range, velocity and smoothness of motion. Processed video outputs of movements demonstrated the change in acceleration through the different phases of movement by displaying red or green segments of the movement arc corresponding to increasing or decreasing acceleration.

Results: The mean age of subjects was 39 years (+/-SD 11.6) with female: male ratio of 21:5. There was good agreement of peak ROM measurement using pictorial goniometer and video dynamic assessment with mean abduction angle of 151.9 degrees (+/-SD 8.4) and 153 (+/- SD 8.7) for right and left arms respectively. The mean area of abduction curve used to measure the total capacity of abduction was similar in both upper limbs. ($P < 0.49$). There was a distinct difference in velocity in the first half of shoulder abduction compared to second half with mean acceleration (metres/second) in the 1st half of the total range of movement being 4.65 and 2.8 compared to 3.87 and 2.3 in the 2nd half for right and left arms respectively.

Conclusions: Infrared depth cameras like Intel Realsense D435 camera are capable of dynamically assessing shoulder movement in addition to quantifying shoulder range, velocity and smoothness of motion. This technology could be used to differentiate between shoulder pathologies in order to provide targeted treatment.

OP.04.02

COMPARISON OF THE EFFICACY OF ROTATOR INTERVAL VERSUS POSTERIOR APPROACH FOR INTRA-ARTICULAR CORTICOSTEROID INJECTIONS FOR PRIMARY FROZEN SHOULDER: A RANDOMIZED CONTROLLED TRIAL

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Background: Intra-articular (IA) corticosteroid injection is commonly performed in patients with primary frozen shoulder (PFS). However, the best administration site remains controversial. The aim of this study was to compare the efficacy of rotator interval versus posterior approach for ultrasound-guided corticosteroid injections into the glenohumeral (GH) joint in patients with PFS.

Methods: Ninety PFS patients were randomly assigned to either rotator interval approach (RI group, n = 43) or posterior capsule approach (PC group, n = 45) for ultrasound-guided IA corticosteroid injection. Fluoroscopic images to assess the accuracy of the injection were obtained immediately after injection by a shoulder specialist. Visual analog scale (VAS) for pain, the American Shoulder and Elbow Surgeons (ASES) score, the subjective shoulder value (SSV), and range of motion (ROM) were used for assessment of clinical outcomes for all patients at the time of presentation, 3, 6, and 12 weeks after injection.

Results: The accuracy of injection was 76.7% (33/43) and 93.3% (42/45) in the RI and PC groups, respectively; the between-group difference was statistically significant ($P = .028$). Significant improvements were observed in both groups in terms of all clinical scores and ROMs throughout follow-up until 12 weeks after the injection (all $P < .001$). At 12 weeks, better improvements in forward flexion and abduction ($P = .049$ and $.044$) were observed in the RI group than in the PC group. No adverse effect related to injection was observed in either group.

Conclusions: Both groups showed significant pain reduction and functional improvement until 12 weeks after injection. Although no significant differences were observed in pain and functional scores between the two groups, the RI group showed better improvement of ROM than the PC group. These results indicate that the rotator interval and anterior structures are a major site in the pathogenesis and treatment target of PFS.

OP.04.03

SCAPULA-TO-SCAPULA TETHERING FOR TREATMENT OF SCAPULOTHORACIC ABNORMAL MOTION (STAM): A CASE SERIES AND TECHNIQUE

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Background: Scapulothoracic abnormal motion (STAM) contributes to restricted motion and pain and has both neurogenic and non-neurogenic causes. The purpose of this study is to describe a novel, scapula-to-scapula tethering technique to treat patients with STAM. Our hypothesis is that scapula-to-scapula tethering improves outcomes of patients with STAM.

Methods: A retrospective review was performed for patients receiving scapula-to-scapula tethering between 2020 and 2022 at a single institution. Patient demographics and clinical outcomes were recorded. Univariate statistics were performed to compare pre- and post-operative values.

Results: Ten patients with an average age of 35 +/- 15 years (range 18-57) and follow-up of 6.9 +/- 6.7 months (range 2-22 months) were included. Surgical indications included facioscapulohumeral dystrophy (FSHD) (n=2;20%) and non-neurogenic severe STAM (n=8;80%). All patients had symptom improvement with scapular retraction testing. Visual analog pain (VAS) scores improved (7.2 +/- 1.9 versus 1.7 +/- 2.9; p=0.16) as well as subjective shoulder value (SSV) (36.1 +/- 24.7% versus 50 +/- 40%; p=0.58). Forward elevation (pre-operative 113 +/- 41 degrees vs post-operative 150 +/- 6 degrees; p=0.02), abduction (pre-operative 106 +/- 40 degrees vs post-operative 126 +/- 34 degrees; p=0.26), and IR (pre-operative 6.3 +/- 4.7 (L3-L2) vs post-operative 8.3 +/- 5.5 (L1-T12); p=0.63) all improved after scapula-to-scapula tethering, with ER remaining unchanged (pre-operative 53 +/- 7 degrees vs post-operative 48 +/- 3 degrees; p=0.22). Two patients (n=20%) had late complications of ongoing restricted motion and pain resulting in reoperation at 10 and 18 months post-operatively. Overall, patient satisfaction was 80%.

Conclusions: Scapula-to-scapula tethering can provide improved function and reduced pain for patients with severe STAM. Correct diagnosis of STAM through focused physical examination is important and provides insight into surgical indication for this procedure. Further study is required to determine the efficacy of this procedure in long-term follow-up.

OP.04.04

DIAGNOSTIC ACCURACY OF NON-CONTRAST MRI IN FROZEN SHOULDER

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Background: Despite being the most used exam today, few studies have evaluated the accuracy of findings on non-contrast magnetic resonance imaging (MRI).

The primary objective of the study was to evaluate the sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of non-contrast MRI findings in frozen shoulder, isolated and in combination. Secondary objectives were to define the interobserver and intraobserver agreement of the assessments and to define the odds ratio for the presence of frozen shoulder in view of the various findings of magnetic resonance imaging.

Methods: A diagnostic accuracy study comparing non-contrast MRI findings between two groups of patients, 50 with frozen shoulder and 50 controls. Sensitivity, specificity, positive predictive value, negative predictive value, accuracy, odds ratio, interobserver and intraobserver agreement were calculated for each finding and their possible associations.

Results: The hyperintensity on capsule in the axillary recess presented 84% sensitivity, 94% specificity and 89% accuracy. The obliteration of the subcoracoid fat triangle in the rotator interval had a sensitivity 34%, specificity 82% and accuracy 58%. For coracohumeral ligament thickness equal or greater than 2 mm had specificity 66%, 48% specificity and 57% accuracy. Capsule thickness in the axillary recess equal or greater than 4 mm resulted in 54% sensitivity, 82% specificity, and 68% accuracy. Regarding interobserver agreement, only the posteroinferior and posterosuperior quadrants showed moderate results, and all the others showed strong reliability. The odds ratio found for hyperintensity in the axillary recess was 82

Conclusions: The accuracy of non-contrast magnetic resonance imaging is high for the diagnosis of frozen shoulder, especially when evaluating the hyperintensity of the axillary recess. The exam has high reliability and reproducibility. The presence of an association of signs increases the specificity of the test.

OP.04.05

SEAGULL WING SIGN. A NEW VALIDATED PHYSICAL SIGN FOR PECTORALIS MAJOR TEAR

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Background: Pectoralis major tears reports are on a rise. Early diagnosis leads to acute treatment. The diagnosis of pectoralis major tears is clinical, and several clinical signs have been described. However, none of these signs has been validated. The purpose of this study was to describe, evaluate and validate the diagnostic performance of a new clinical sign, the seagull wing sign for the diagnosis of pectoralis major tears.

Methods: Single-center series included patients with pectoralis major tears from 2017-2018. All were preoperatively assessed clinically, an MRI and treated surgically. Tietjen's classification and Schepsis criteria were used accordingly. This study was performed according to STARD (standards for reporting of diagnostic accuracy) guidelines, and the reference test was a preoperative diagnosis of a complete pectoralis major tear. On the preoperative appointment the seagull wing sign was assessed independently by two orthopedic surgeons. To identify the sign: The examiner must stand at the patients' feet, while the patient was in supine decubitus position and with arms resting on the side. A positive sign was considered an elevated pectoralis major when compared to the non-injured side.

Results: Twelve patients were included. Mean age was 37 years (range, 19-51); all males. According to Tietjen's classification eight cases were considered complete. Seven patients presented on a chronic stage according to Schepsis criteria. The seagull wing sign presented a interrater agreement of 100% and was present in 100% of the acute cases. The overall sensitivity for acute and chronic cases was of 75%. Furthermore, the sign presented 100% sensitivity and 42% specificity to detect complete pectoralis major tears. After surgery the seagull wing sign disappeared in all patients.

Conclusions: The seagull wing sign is a new, valid, highly sensitive for acute and complete pectoralis major tears. Is a simple physical sign to assess as it doesn't need of active or passive movement or require painful counter resistance maneuvers. And it disappears after pectoralis major is repair.

OP.04.06

IMPACTS OF SPINAL CHARACTERISTICS ON SHOULDER FUNCTION IN MIDDLE-AGED TO ELDERLY POPULATION

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Background: Shoulder joint is loosely connected to the rib cage which originates from thoracic spine. Shoulder pathologies, such as subacromial impingement and rotator cuff tears have been reported to be associated with spinal alignment and posture. However, how shoulder elevation function itself is affected by the spine, especially among those who are vulnerable to shoulder pathologies, has not been fully investigated. Therefore, the purpose of the study was to evaluate the impacts of spinal characteristics on active shoulder elevation in middle-aged to elderly people.

Methods: A total of 211 subjects aged over 40 years (92 males, 119 females, mean 64 years old) were evaluated during a public health checkup. Alignment of thoracic and lumbar spine was measured using Spinal-Mouse® in multiple positions, from which range of motion (ROM) of spine specifically for shoulder elevation was calculated. In standing position, sagittal posture type was determined using Kendall's classification, and maximum active shoulder elevation angle against trunk was measured. Univariate and multivariate analyses were performed to determine correlations. A t-test was used for categorical measures.

Results: Shoulder elevation angle was greater in females than males (155° vs 150°, $p < 0.001$), and was correlated negatively with age ($r = -0.2$, $p = 0.0016$) and thoracic kyphosis ($r = -0.3$, $p < 0.0001$) and positively with lumbar lordosis ($r = 0.3$, $p < 0.0001$) and thoracic and lumbar ROM ($r = 0.35$, $p < 0.0001$). The effects of these spinal measures on shoulder elevation remained significant even after adjusted with age and gender. Compared to "ideal" posture, "flat-back" and "sway-back" demonstrated lower shoulder elevation angle (156° vs 150° ($p = 0.0342$) and 150° ($p = 0.0004$), respectively).

Conclusions: Spinal alignment and mobility, and sagittal posture have impacts on active shoulder elevation. When assessing and treating shoulder disorders, considering not only shoulder joint itself but also spinal characteristics and posture types is important.

OP.04.07

MEASURING THE CRITICAL SHOULDER ANGLE ON RADIOGRAPHS: AN ACCURATE AND REPEATABLE DEEP LEARNING MODEL

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Background: The critical shoulder angle (CSA) is defined as the angle formed between the line connecting the inferior and superior bone margin of the glenoid and the line connecting the glenoid inferior bone margin to the most lateral border of the acromion process, measured on a true anteroposterior radiograph of the shoulder. Biomechanical research showed that shoulder abduction, glenoid compression, and joint shear forces depend on CSA. A greater-than-normal CSA ($> 35^\circ$) has been found to be associated with rotator cuff pathology, while a smaller-than-normal CSA ($< 30^\circ$) is associated with higher OA prevalence. Due to the non-negligible inter- and intra-rater variability in CSA calculation, we developed a deep learning model that calculates it automatically and accurately.

Methods: We used a dataset of 8467 anteroposterior shoulder radiographs annotated with the 3 landmarks of interest. A Convolutional Neural Network model coupled with a spatial to numerical transform (DSNT) layer was used to predict the landmark coordinates from which the CSA was calculated. The performances were evaluated by calculating the Euclidean distance between the ground truth coordinates and the predicted ones normalized with respect to the distance between the first and the second points, and the error between the CSA measured by a human observer and the predicted one.

Results: Regarding the normalized point distances, we obtained a median error of 2.9%, 2.5%, and 2% for the three points among the entire set. Considering CSA calculations, the median errors were 1° (standard deviation 1.2°), 0.88° (standard deviation 0.87°), and 0.99° (standard deviation 1°) for angles below 30° , between 30° and 35° , and above 35° , respectively.

Conclusions: The model is user-independent, automated, and deterministic: it always provides the same result given the same image, allowing to repeat an analysis multiple times with a fixed output. Moreover, the model is very fast, allowing to process large amounts of data in a short time: it could process on average 2000 images in 20 minutes. Reported standard error in CSA measurements is greater than 2° , above the median absolute error of the model, indicating a potential accuracy sufficient to be used in clinical and research settings, wherever reproducibility is needed.

OP.04.08

ANATOMICAL AND CLINICAL CHARACTERISTICS OF THE ROTATOR CUFF IN FROZEN SHOULDER: A CROSS-SECTIONAL PRELIMINARY STUDY

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Background: Frozen shoulder has a negative impact on activities of daily living, producing pain and disability. Frozen shoulder people have arm mobility deficits. Although passive structures are the main ones involved in this condition, active components could have an essential contribution in reducing the movement of these patients. In previous studies, the evaluation of the pennation angle (PA) and the muscle thickness (MT) is proposed to evaluate the active components. Both assessments give information about muscle function. The main objective of this study is to explore and compare the PA and the MT of supraspinatus, infraspinatus, and teres minor between people with and without frozen shoulder.

Methods: An observational and cross-sectional study has conducted in a hospital in Buenos Aires, Argentina. Adults with loss of 50 % of external rotation and at least loss of 10 % of the other shoulder movements, history of shoulder pain and disability, Rx normal, and without antecedents of bone fracture, shoulder surgery, systemic diseases sling use were included in the frozen shoulder group. People without these characteristics were considered in the healthy group. PA and MT were assessed by ultrasound with and without muscle contraction in the shoulder affected in frozen shoulder participants and in the shoulder of the dominant arm in people without frozen shoulder. Shoulder function, range of motion, quality of life, pain intensity during the movement, pain catastrophizing, and kinesiophobia were assessed in all participants.

Results: This preliminary study was conducted between December 2021 and May 2022 and included 30 participants, 14 with frozen shoulder and 16 without this condition. No statistically significant differences were founded in the PA and MT of supraspinatus, infraspinatus, and teres minor in both conditions. Clinical and statistical differences were founded between both groups in Shoulder function, range of motion, quality of life, pain intensity during the movement, pain catastrophizing, and kinesiophobia.

Conclusions: The PA and MT were not different between individuals with and without frozen shoulder. The findings of this preliminary study lead to continuing the effort of research to promote a better understanding of the rotator cuff in frozen shoulder patients and the possible clinical impact.

OP.04.09

VALIDITY AND RELIABILITY OF POLISH VERSIONS OF THE SIMPLE SHOULDER TEST, THE ASES SCORE, AND THE UCLA SHOULDER SCALE

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Background: The SST, ASES, and UCLA are widely used shoulder outcome measures in clinical work and scientific studies. The purpose of this study was to translate and culturally adapt into Polish and determine psychometric properties of the Polish versions of SST-PL, ASES-PL, and UCLA-PL.

Methods: The original versions of the SST, ASES, and UCLA were translated into Polish following international recommendations. The two groups of patients completed the SST-PL, ASES-PL, UCLA-PL, Disability of Arm, Shoulder and Hand assessment (DASH) and Short-Form 36 (SF-36): group I of 64 patients (average age: $52,6 \pm 12,9$) with painful shoulder disorders and group II of 63 patients (average age: $30,1 \pm 9,6$) with anterior shoulder instability. 38 patients from group I and 30 patients from group II repeated the SST-PL, ASES-PL, and UCLA-PL in 2-14 days intervals. The internal consistency (Cronbach α), test-retest reliability (intraclass correlation coefficient) and construct validity were assessed.

Results: The internal consistency of Polish translations was good: the SST-PL group I ($\alpha = 0,85$), group II ($\alpha = 0,81$), ASES-PL group I ($\alpha = 0,89$), group II ($\alpha = 0,88$); UCLA-PL group I ($\alpha = 0,73$), group II ($\alpha = 0,55$). The intraclass correlation coefficient for Polish versions of questionnaires was very high: SST-PL group I (0,99), group II (0,99); ASES-PL group I (0,92), group II (0,98); UCLA-PL group I (0,96), group II (0,97). The construct validity was determined by comparison between Polish versions of shoulder outcome measures, DASH and SF-36. There were strong and statistically significant correlations between DASH and: SST-PL group I ($r = -0,81$, $p < 0,0001$), group II ($r = -0,7$, $r < 0,0001$); ASES-PL group I ($r = -0,75$, $p < 0,0001$), group II ($r = -0,82$, $p < 0,0001$); UCLA-PL ($r = -0,64$, $p < 0,0001$), group II ($r = -0,67$, $p < 0,0001$). The correlations with SF-36 were weaker. The highest and significant correlations ($p < 0,001$) were observed between SF-36 bodily pain vs. SST-PL $r = 0,55$, $r = 0,44$; ASES-PL $r = 0,62$, $r = 0,66$; UCLA-PL $r = 0,64$, $r = 0,56$; and SF-36 physical functioning vs. SST-PL $r = 0,70$, $r = 0,62$; ASES-PL $r = 0,71$, $r = 0,71$; UCLA-PL $r = 0,62$, $r = 0,58$ (group I and group II respectively).

Conclusions: The Polish versions of SST, ASES, and UCLA were found to be reliable and valid questionnaires for shoulder assessment of painful disorders and anterior shoulder instability as well.

OP.04.10

TREATMENT OF ACROMIOCLAVICULAR JOINT SEPARATIONS IN JAPAN: A SURVEY

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Background: Treatment options for acromioclavicular joint (ACJ) separations are highly dependent on severity as well as patient background. Furthermore, some patients can be switched from conservative to surgical treatment. In this study, we conducted a mail-based questionnaire survey for members of the Japan Shoulder Society on administering treatments for ACJ separations.

Methods: A questionnaire survey was mailed to all 1655 members of the Japan Shoulder Society (including 59 councilors) in five categories: initial treatment, whether surgery was performed, indications for surgery based on severity, switch from conservative to surgical treatments, and surgical methods.

Results: Altogether 183 members, including 56 councilors, responded. The initial treatment included 17 cases without immobilization and 166 otherwise. Eleven members opted for conservative treatment only, and 172 chose surgery depending on the case-of the latter, nine considered it for patients with a Rockwood classification of type 2 or higher; 120, for type 3 or higher, and 172; for types 4, 5, and 6. Furthermore, 75 of 172 members had experience switching to surgical treatment during conservative treatment. For 64 out of 172 members, the modified Cadenat method was the most common surgical method.

Conclusions: Only 11 members opted for conservative treatment for ACJ separations, and approximately 95% of physicians chose surgery. Furthermore, over 70% of physicians considered surgery for type 3 or higher, and 37% of members performed the modified Cadenat method. However, the spread of arthroscopic surgery may affect the selection of surgical method in future.

OP.04.11

PATIENT RECALL OF INFORMED CONSENT AT 4 WEEKS FOLLOWING ARTHROSCOPIC SHOULDER SURGERY WITH STANDARDISED VERSUS THE SURGERY-SPECIFIC CONSENT

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Background: The aim of this study was to evaluate whether the use of a Surgery-Specific consent form would affect patient's recall at four weeks after shoulder arthroscopy.

Providing patients with sufficient and appropriate information to enable shared decision-making plays a pivotal part in the Informed consent elements of the legal and ethical obligations on surgeons. However poor patient recall of the surgical consent process has been frequently noted in studies

Methods: This study, a prospective randomized control trial, assigned forty adult patients undergoing shoulder arthroscopy to either a control group, who received the standard consent form, or to the intervention group who received a procedure specific consent form. All patients recall of the surgical details and risks was assessed on the morning of surgery, and at follow up 4 weeks later.

Results: Demographic and educational characteristics of patient participants were similar in both groups. There were poor recall rates seen in both groups on Day of Surgery, but with intervention group showing a statically significant increase in the mean number of risks recalled at 3.45 compared with 2.55 in the control group ($P = .0464$). At follow-up, the recall rates had deteriorated in both groups, with the Intervention group again having increased recall rates, although without statistical significance.

Conclusions: Obtaining informed consent is a complex and challenging process. Patient's recall improves with the use of a procedure-specific consent form, and we would therefore advocate their use. However even with these forms, patient's recall remains poor, and deteriorates over time, and therefore further methods may be worth exploring to provide further improvements, with longer recall.

OP.04.12

CLINICAL OUTCOMES OF ARTHROSCOPIC BRACHIAL PLEXUS NEUROLYSIS FOR NEUROGENIC THORACIC OUTLET SYNDROME

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Background: Thoracic outlet syndrome (TOS) poses a difficult challenge to physicians largely due its non-specific and variable nature of symptoms. Conservative management is the first line of treatment. Unfortunately, there remain many patients who have had multiple visits to different specialists as these current treatment options have failed to provide adequate and reliable outcomes. Surgical management is reserved for those who have failed conservative management. This study aims to present the outcomes of arthroscopic brachial plexus neurolysis in patients who had failed conservative management for neurogenic TOS.

Methods: Consecutive patients who underwent arthroscopic brachial plexus neurolysis performed by a senior fellowship-trained shoulder surgeon from February 2017 to September 2022 were included in the study. Clinical and functional outcomes including range of motion, Visual Analogue Score (VAS), Constant Score, American Shoulder Elbow Society (ASES) Score, and UCLA score were collected preoperatively and postoperatively at 6 months, 12 months, and 2 years.

Results: 17 patients (21 shoulders) were included in the study, with mean age of 34 (range 19-45). 76% of the cohort were female, and 24% had bilateral involvement. At a mean follow-up of 12 months, there was 50% reduction in pain (VAS 6+3 to 3+3). Range of motion also improved (forward flexion 136+60 to 167+31, lateral elevation 122+53 to 147+40, external rotation 54+23 to 64+18, internal rotation 52+28 to 67+16), as well as Constant score (40+25 to 64+11), ASES score (54+27 to 73+21), and UCLA score (15+8 to 26+7). Satisfaction post arthroscopic neurolysis was 81%. Those who were not satisfied and presented with persistent pain had associated secondary pathologies such as subclavian thrombosis, rudimentary rib, glenohumeral arthritis, multidirectional instability, and in one patient, development of postoperative frozen shoulder. No neurovascular complications were noted.

Conclusions: Arthroscopic brachial plexus neurolysis is an effective procedure to address neurogenic thoracic outlet syndrome after failed conservative management. There is excellent satisfaction rate after arthroscopic neurolysis. Those with associated secondary pathologies may be expected to present with persistent symptoms postoperatively and need to be appropriately counselled preoperatively. Overall, it is a safe procedure; however, it requires advanced arthroscopic skills and has a high learning curve.

OP.05.01

DISTAL BICEPS TEARS: PRE OPERATIVE ULTRASOUND LANDMARK AND RESULTS EVALUATION USING A DYNAMOMETER

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Background: Distal biceps ruptures are common. Different fixation techniques are described and all of them appear to have sufficient strength to secure the tendon. More than six different skin incisions are described each of them had its own advantage and disadvantage. Objective of our study is 1) demonstrate that the pre-operative ultrasound examination helps in the choice of skin incision and 2) to evaluate results in terms supination strength using a dynamometer.

Methods: From 2020 to 2022 we prospective treated 20 pt for acute or subacute distal biceps tear (16 total tear and 4 partial tear). All patients were studied with FABS-MRI. Timing from trauma to surgery was 16 days (4-56). In all cases pre-operative ultrasound landmark were performed. We used single incision in all cases (16 transverse and 4 longitudinal). Anatomical reinsertion with endobutton was obtained in all cases. We used an early rehabilitation protocol beginning from the second week after surgery. Results were evaluated using MEPS, Q-DASH and MRC scale. Muscle strength recovery was assessed using a dynamometer.

Results: Full range of motion was obtained within 3 months in all cases. According to MEPS, Q-DASH and MRC scale all patients obtained excellent results within 4 months after surgery. No major complications were observed. Four patients had transient paresthesia of LACN and Median nerve, spontaneously resolved within 3 months.

Conclusions: Pre-operative ultrasound exam allows to identify bone and soft tissue landmark and so it helps to accurately plan skin incision. In all cases, even after 56 days, the correct planning allowed us to obtain an anatomical reinsertion into radial tuberosity without any additional incisions. Functional elbow score appears inadequate to evaluate results because they pay attention mainly in recovery of ROM and pain during daily activity life. Evaluation of muscle strength with the MRC scale is not very useful, in fact all patients after 4-6 months easily reach the value of 5_5. Moreover none of this score or scale allow a quantification of muscular strength. We introduced a dynamometer as a tool to quantify muscle strength, it represents an innovative technique not yet described. This tool allows to quantify exactly

OP.05.02

SYSTEMATIC REVIEW OF ELBOW INSTABILITY IN ASSOCIATION WITH REFRACTORY LATERAL EPICONDYLITIS : MYTH OR FACT?

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Background: Elbow instability, particularly posterolateral rotatory instability (PLRI), has been reported in patients with refractory lateral epicondylitis (LE). However, evidence of diagnostic approach and surgical outcomes are lacking. This review aimed to identify (1) the risk factors, clinical and radiology-diagnostic characteristics, and (2) the treatment options and clinical outcome of LE with PLRI.

Methods: We searched PubMed, Ovid/MEDLINE, Cochrane, Google Scholar, and EMBASE databases using keywords as well as Medical Subject Headings terms and Emtree using "(lateral epicondylitis OR tennis elbow) AND (instability OR posterolateral rotatory instability)" for English-language studies. We conducted a systematic review using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.

Results: In total, eight articles comprising six level-4 and two level-3 studies were identified, including 249 patients (254 elbows). The main triggering factor was heavy labor activity (43%, 74/172). A total of 184 patients (73.9%) received either single (2.2%, 4/184) or multiple (97.8%, 180/184) steroid injection shots. Clinically, instability was always accompanied by pain. Magnetic resonance imaging (MRI) revealed that radial collateral ligament (RCL) and lateral ulnar collateral ligament (LUCL) lesions were most common (23%, 18/79). The most common surgical procedure performed was arthroscopic RCL plication (52%, 62/120) followed by LUCL reconstruction (25%, 30/120). Ligament patho-laxity sign was shown intraoperatively for 64% (44/69). Clinical outcomes ranged from good to excellent in all studies. The most common residual symptom was limited range of motion (61%, 11/18).

Conclusions: Instability can coexist and may be associated with refractory LE. The risk factors of instability associated with refractory LE are heavy labor and multiple steroid injections. A systematic approach to identify the clinical and MRI presentation of the condition followed by examination under anesthesia (EUA) are necessary for affirmative diagnosis, as independent presentations may be misleading.

OP.05.03

ANTEROLATERAL ROTATORY INSTABILITY (ALRI) OF THE ELBOW: A POSSIBLE ETIOLOGY OF PRIMARY OSTEOARTHRITIS

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Background: The purpose of this study is to describe anterolateral rotatory instability (ALRI) as a possible etiology of primary osteoarthritis (OA) of the elbow.

Methods: 76 fresh frozen cadaveric elbows (M:F = 56:20, Mean age = 81) were examined for patterns of cartilage erosion that could be due to ALRI: These included erosions on the lateral trochlear ridge (LTR lesion), the crescent rim of the radial head (RC lesion) or the ventral capitellum (VC lesion). The extent and location of the lesions were mapped by image processing of photographs of the humeral and radial articular surfaces, and the degeneration of the articular surface was graded.

Results: 10 of 76 specimens (13%) had one or more lesions consistent with ALRI. LTR lesions were the most common, followed by RH, then VC lesions. LTR lesions were most common and were seen in 10 of 10 specimens (100%), typically involving the distal 30% of the LTR. RC lesions were seen in 9/10 and were located on the anteromedial crescent of the radial head ranging from 6 to 10 o'clock. VC lesions were seen in 8/10 specimens.

Conclusions: ALRI is a possible mechanism initiating primary osteoarthritis of the elbow. It has a characteristic pattern of triple lesions involving the lateral trochlear ridge (LTR), the crescent rim of the radial head (RC), and the ventral capitellum (VC).

OP.05.04

WHAT ARE THE LIMITS FOR ARTHROSCOPIC SYNOVECTOMY IN RHEUMATOID ELBOWS?

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Background: Elbow is frequently involved in rheumatoid arthritis patients. Radiographic classification ranges from types 1 to 5 (T-1 to T-5) and helps defining best treatment indication. Arthroscopic synovectomy is a well established treatment for early stages but is not recommended for severe cases. Indication is controversial for intermediate stages (T-3A and T-3B) and limits for arthroscopy are still unclear in this clinical scenario.

Methods: Inclusion criteria were arthroscopic synovectomy for rheumatoid elbows with at least 12-month follow-up, and availability of clinical and radiographic data, from both pre and post-operative evaluation. Patient evaluation included range of motion (ROM), visual analogic pain scale (VAS) and functional scores (MEPS and DASH). Clinical and radiographic comparison was made between preoperative and postoperative periods. We also compared results between patients according to their radiographic classification.

Results: Inclusion criteria was met by 19 elbows from 18 patients. Only one patient was male and mean age was 41 ± 8 years. Mean follow up was 83 months (13 to 115). According to pre-operative radiographic classification, we found the following distribution: 10 (T-2), 5 (T-3A) and 4 (T-3B). All patients showed pain reduction after procedure, with VAS improvement from $4,3 \pm 1$ to $0,6 \pm 0,7$ ($p=0,0000$). All patients showed superior functional scores after the procedure, with mean improvement from 49 ± 13 to 90 ± 8 ($p=0,0000$) for MEPS and from 50 ± 9 to 11 ± 8 ($p=0,0000$) for DASH. Despite not reaching statistical significance, we found ROM improvement for flexion: $16^\circ \pm 11$ ($p= 0,1751$), extension: $20,2^\circ \pm 22$ ($p= 0,3481$), pronation: $14,7^\circ \pm 13$ ($p= 0,0549$) and supination: $16,8^\circ \pm 18$ ($p=0,7801$). We found no statistical differences comparing patients separated by classification grades. One patient had a persistent synovial fistula without signs of infection, that took 8 weeks to resolve. Only one patient needed an additional procedure, with conversion to total elbow arthroplasty after 3 years of arthroscopic synovectomy. No other complications were found.

Conclusions: Arthroscopic synovectomy is a safe and effective treatment option for rheumatoid elbow in the young and active patients, even those with intermediate joint involvement.

OP.05.05

EXTENSIVE DEBRIDEMENT ARTHROPLASTY FOR PRIMARY OSTEOARTHRITIS OF THE ELBOW: LONG-TERM RESULTS

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Background: Although open or arthroscopic arthroplasty are major surgical treatment for primary osteoarthritis of the elbow, the long-term results were less frequently studied. The purpose of this study was to evaluate the long-term clinical and radiologic results after extensive debridement arthroplasty (EDA) for primary osteoarthritis of the elbow.

Methods: Eleven patients with primary osteoarthritis treated with EDA were retrospectively evaluated.

The mean age of the seven male patients and four female patients was fifty-six years (forty-seven to seventy-four years). The surgical procedure involved fenestration of the olecranon fossa and excision of all osteophytes, anterior and posterior capsule, and the posterior band of the medial collateral ligament through a medial approach (in some cases with a lateral approach). At a mean follow-up of fifteen years (ten to twenty years) clinical and radiographic outcomes were assessed.

Results: The mean flexion increased significantly ($P < 0.005$) from 110° to 130° postoperatively in short-term and was generally maintained at the final follow-up. On the other hand, although the extension lag improved significantly ($P < 0.005$) from 26.4° to 11.4° postoperatively in short-term, at the latest examination it decreased to 25.5° . No postoperative complications were observed. Five (45%) of the elbows were seen to have recurrence of olecranon osteophytes and the fenestration of the olecranon fossa was partially refilled in four elbows and completely in two elbows at the time of latest follow-up. According to the Mayo Elbow Performance Score, the result was excellent for five elbows, good for five, fair for one. Univariate analysis revealed that among preoperative variables, only extension was found to be the prognostic factor that affected the postoperative extension in long-term ($P < 0.05$).

Conclusions: The data from the present study indicate that EDA provides marked long-term relief of pain and improvement in flexion despite the recurrence of a limitation of extension. Patients with preoperative large limitation of elbow extension are at risk of the deterioration of extension in long-term.

OP.05.06

EXPERIENCE WITH THE LATERAL RESURFACING ELBOW ARTHROPLASTY USED FOR PATIENTS WITH RADIAL HEAD DEFICIENCY DUE TO FAILED (SYMPTOMATIC) EXCISION ARTHROPLASTY OR FAILED (SYMPTOMATIC) RADIAL HEAD ARTHROPLA

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Background: The Lateral Resurfacing Elbow (LRE) arthroplasty initially designed to treat patients with symptomatic arthritis confined radiologically to the radiocapitellar joint was subsequently used for patients with more severe radiological changes extending into the ulnohumeral joint. The LRE arthroplasty has also been used for patients with disabling pain following either resection of the radial head (excision arthroplasty) or pain following radial head replacement due to capitellar erosion and/or implant loosening but radiologically well-preserved ulnohumeral joints. The purpose of this presentation is to present the lessons we have learned from our experience in this 'challenging' group of patients.

Methods: We have treated a group of 7 patients (2 male: 5 female) age range (38-75) with LRE arthroplasty for elbow pain following either excision arthroplasty (3 patients) or revision for failed radial head arthroplasty (4 patients) between 2008-2022. In 6 patients LRE primary components were used. All the capitellum components were inserted press-fit, the radial head components were either inserted press-fit (3 patients) or 'augmented' with cement (4 patients). In 1 patient a primary capitellum component was used together with a custom (press-fit) radial head component.

Results: The severe intrusive rest pain experienced pre-operatively was relieved in all these patients. No significant complications were encountered.

The mean pre-operative Mayo score was <60. The post-op Mayo score was >90. To date no further revision procedures have been required.

Conclusions: Resurfacing the capitellum together with radial head replacement provides effective pain relief for 'radial head deficient' elbows following excision arthroplasty or following 'failed' radial head replacement arthroplasty. Advancing the radiocapitellar joint line distally does not compromise the range of elbow movement.

A radial head replacement arthroplasty effectively replaces only the 'socket' of a ball-and-socket joint. This has not proved to be an effective solution in either shoulder or hip arthroplasty. Should we therefore consider capitellum resurfacing for every patient requiring radial head replacement?

OP.05.07

RESULTS OF UNCEMENTED DISCOVERY TOTAL ELBOW REPLACEMENT WITH MINIMUM 5 YEAR FOLLOW UP - SINGLE SURGEON CASE SERIES

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Background: This study evaluates the results, complications, and revision rates of the discovery uncemented total elbow replacement at a minimum 5 years follow up.

Methods: 28 elbows in 27 patients were treated with a Discovery total elbow replacement uniquely modified for use as an uncemented implant between 2003 and 2015. Prospectively collected follow up data alongside hospital records and radiology records were reviewed to determine patient demographics, outcomes, complications, radiological failures, and revision rates following surgery.

Results: Of the 27 patients treated 4 were lost to follow up and have been excluded from the study. Of the remaining 23 patients (24 elbows) two patients died due to unrelated causes after 2 and 5 year follow up and have been included in the study. The remaining elbows all had follow-up for a minimum of five years. The average time to follow up was 9 years (5-17). There were 21 males and 2 females with an average age of 46 years (22-75). At last follow up the average Mayo Elbow performance Score was 76 (15-100) with 18 patients achieving a good to excellent result. The average DASH score was 36.7 (2-72). Average pre surgery arc of motion was 29-109 degrees and post-surgery was 26 - 117 degrees.

Four patients experienced mild ulna nerve sensory symptoms. One patient had revision due to infection at 2 years and a second patient with infection remains with a discharging sinus but no evidence of loosening at 8 years. No patient has experienced implant loosening indicating reliable primary stability and bone ingrowth. However, two patients have a broken hinge screw but no loosening at 8 and 10 years. A further two patients have progressive osteolysis around the articulation without loosening of the stem at 10 and 12 years

Conclusions: Uncemented total elbow arthroplasty with a semi constrained hinge has demonstrated excellent short to medium term results despite being utilised in a challenging group of patients with young average age. We are beginning to see failures associated with the articulating hinge at around 10 years indicating this will be the modality of long term failure in this group of patients.

OP.05.08

THE ANATOMY THAT PREDISPOSES TOWARDS TENNIS ELBOW TENDINOPATHY

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Background: the label of Tennis elbow remains a poor descriptor of a well known tendinopathy affecting the lateral side of the elbow. The purpose of this study was to study the anatomy of the lateral elbow and to gain a better understanding of how the tendon becomes torn ; and why it becomes chronic.

Methods: We have dissected cadavers at the university of Melbourne Australia to determine the exact macro and micro anatomy of each tendon and ligament relevant to the pathology of a tennis elbow lesion. We also looked at the histology of these tendons and ligaments. The anatomical findings are in keeping with previous .The relevance to the physical forces that are unique to this anatomical locating will be discussed.

Results: We will present our original unpublished diagrams and professional art work that simplifies our understanding of this very complex micro anatomy.

Conclusions: The lateral human elbow anatomy is unique. The annular ligament allows the radius to pronate and supinate through an enormous range of motion, creating unique forces. Secondly, none of the ligaments or tendons attach themselves to the radius bone. Instead the LCL and the LUCL attach indirectly via the annular ligament .The combination of pronation (tightening ECRB tendon) and extension (tightening LCL) causes a unique shear force between the layers of fibres creating the well described tennis elbow lesion. Once the tear is initiated it is then also perpetuated by this same pair of opposing shearing forces. Understanding this concept allows us to create improved solutions for the treatment and repair of these tendon lesions.

OP.05.09

ARTHROSCOPIC TENDON REPAIR COMBINED WITH PLATELET-RICH PLASMA (PRP) BENEFITS PATIENTS IN REFRACTORY LATERAL HUMERAL EPICONDYLITIS AT THE EARLY-TERM FOLLOW UP.

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Background: Refractory lateral epicondylitis (rLE) of the humerus often requires surgical treatment, which arthroscopic tendon repair provides better clinical outcomes comparing with tendon debridement alone. Platelet rich plasma (PRP), which is widely reported satisfied results in LE treatment. But till now, there is no clinical study on tendon repair combined with PRP for rLE. The aim of this study was to investigate the efficacy of arthroscopic tendon repair combined with PRP for refractory LE and the risk factors affecting the torn tendon healing.

Methods: This was a prospective study including 21 rLE patients (mean age= 48.3) who underwent arthroscopic tendon repair combined with PRP injection from July 2020 to June 2022. The symptom duration was 16.95 months on average. VAS, DASH, PETEE, muscle strength and clinical physical examination were recorded preoperatively and 3, 6, 12, 24 weeks postoperatively and paired t-tests was performed between each follow up time with baseline. MRI was also evaluated preoperatively and 24 weeks postoperatively. The clinical results were analyzed by linear regression to determine the high risk factors affecting tendon healing.

Results: All patients were followed up with satisfied results without any complications at the early term follow up. VAS, wrist extension and grip strength improved significantly from 6 to 24 weeks postoperatively. DASH and PRTEE improved significantly from 12 to 24 weeks postoperatively. MRI showed complete tendon healing in all patients 24 weeks after surgery. Risk factors on tendon healing involved the times of steroid injections, symptom duration and positive preoperative pronation pull test (Mill's test).

Conclusions: Arthroscopic tendon repair combined with PRP injection is effective in rLE patients. The times of steroid injections, duration of disease and positive pronation pull test are risk factors for tendon healing.

OP.05.10

LONG TERM FOLLOW UP IN COONRAD-MORREY TOTAL ELBOW ARTHROPLASTY: OUTCOMES COMPARISON AND SURVIVAL ANALYSIS FOR DIFFERENT SURGICAL INDICATIONS

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Background: Total Elbow Arthroplasty (TEA) has broadened its indications in elbow joint pathologies over the years. The semi-linked TEA Coonrad - Morrey (CM) has shown good results in restoring the function of the elbow, nevertheless despite the increasing use, there are still controversies in literature. Aim of this retrospective study with long term follow up is to compare clinical results and survival of CM prosthesis in relations to its different indications. The second endpoint was to analyze how percentage of different indications has changed along the years.

Methods: Between October 2002 and September 2016 in Orthopaedic department of Modena, we performed 122 Total Elbow Arthroplasty (TEA) with the semi-linked CM implant. Inclusion criteria were: reumathoid arthritis, RA; osteoarthritis, OA; ankylosis, ANK; acute fracture, FR; severe instability, INS. Forty-eight patients (a total of 51 TEA) were enrolled in the study. Radiographical and clinical evaluation were performed with multiple parameters and scores (MEPS, QuickDash, range of motion, VAS, assesment of nerve empairment, subjective patient's satisfaction after the procedure).

Results: Survival rate reported is 90% at 5 years and 85% at 10 years (FR: 97%; INS and ANK 91% , RA: 82%, OA: 79%). We recorded 12 implant revisions (9,8%): 1 bushing wear, 1 heterotopic ossification, 6 aseptic mobilizations, 1 periprosthetic fracture and 4 septic mobilizations. The average time of follow up resulted in 9.8 years. Avarage MEPS score was $79,7 \pm 18,3$, QuickDASH score was 33,1 , mean ROM was 95°; mean VAS (1,2), satisfaction score (4,0) and evaluation of ulnar nerve empairment (1,9) were satisfactory, without significant differences within subgroups. 82 CM implants were performed between late 2002 - 2009 (FR: 22,0%; INS 19,5%; ANK: 15,9%; RA: 19,5%; OA: 23,2%), 40 in the period 2010 - 2016 (FR: 65,0%; INS 5,0%; ANK: 10,0%; RA: 5,0%; OA: 15,0%).

Conclusions: CM prosthesis has shown promising clinical results and survival rates over time. The best clinical results have been recorded in elderly population, guaranteeing a good pain-free quality of life. Different techniques and implants, as weel as changing in therapeutic protocols has changed indications and results in the last decade.

OP.05.11

DOES CONSTITUTIONAL HYPERLAXITY AFFECT CORONOID FRACTURE PATTERN IN CASE OF ELBOW DISLOCATION?

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Background: The elbow is a very congruent joint and its stability is guaranteed by both bony and soft tissues constraints. Coronoid process is clearly the most important primary stabilizer of the elbow joint. Nevertheless, the role of capsuloligamentous structures should not be forgotten.

Elbow dislocation is a frequent traumatic injury, and it often occurs in male young active patients after a fall on an outstretched hand. Posterolateral rotatory instability is the most frequent type of elbow acute dislocation, and its mechanisms are well known in literature.

What is not yet known is how constitutional hyperlaxity could determinate simple elbow dislocation (SED) or complex elbow dislocation (CED). Our hypothesis is that higher Beighton scores correspond to SED or lower grade of coronoid fractures.

The aim of this study is to assess and analyze Beighton score in patients who underwent SED and CED with isolated coronoid fractures (ICF). The secondary goal is to evaluate the association between the coronoid fracture pattern and Beighton score.

Methods: 62 CT scans of elbow dislocations were retrospectively analyzed. Patients were divided in 2 groups: simple and complex elbow dislocations. In CED group were considered only patients with ICF; presence of other fractures was an exclusion criterion. Skeletally immature or previously operated patients were excluded. CT were classified accordingly to Regan-Morrey and O'Driscoll classifications. Grade 0 were assigned to SED.

All patients were then tested with Beighton score by the same orthopedic surgeon. Trauma energy was classified in low, medium, and high energy. Firstly, it was analyzed if Beighton score was different in SED and CED group considering the same trauma energy. Secondly, it was evaluated if exists an association between Beighton score and coronoid fracture pattern.

Results: Preliminary data assess the association between high Beighton score and SED.

Conclusions: This study is the first work evaluating the impact of constitutional hyperlaxity in elbow instability. There are no similar studies in the literature that correlate the fracture pattern to individual predisposition factors considering the same trauma energy.

In the light of these results, the fundamental role played by the capsule-ligament structures in elbow stability is confirmed.

OP.05.12

COMPLEX FRACTURES OF THE DISTAL HUMERUS TREATED WITH ELBOW HEMIARTHROPLASTY: SHORT-MEDIUM-TERM RESULTS

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Background: Plurifragmentary articular fractures of distal humerus represent a challenge even for an expert elbow surgeon. Open reduction and internal fixation (ORIF) remains the first choice of treatment; however, the results are extremely variable and uncertain. Total elbow replacement is been often used in cases of non-constructible fractures, however the rate of mechanical complications is high especially in young and active patients. Distal humerus hemiarthroplasty (DHH) may prevent this kind of complications and avoid restrictions related to load. The goal of this prospective study is to evaluate the clinical and radiographic medium-term results in patients with articular pluryfragmentary distal humerus fractures treated with DHH.

Methods: Ten patients (1 M and 9 F, mean age 76 years, range 63-85), were subjected to DHH during the period between 2017 and 2021. 8 patients were affected by a multi-fragmentary fractures of distal humerus and 2 cases had a shear fracture of the capitulum humeri and trochlea. In one case, it was associated with a radial head fracture that was treated by osteosynthesis with screws. All patients were allowed to perform active and passive mobilization from the second postoperative day. The postoperative functional evaluation was performed with the Mayo Elbow Performance Index (MEPI) and radiological exams.

Results: The mean follow-up was 21.3 months (Range 4- 48). Based on the MEPI, in 5 cases were rated as excellent, 4 good, 1 poor. The complications observed were: 2 cases of mild stiffness and 1 delayed wound healing. Radiographically it was highlighted one cases of nonunion of both the lateral and medial column resulting asymptomatic and one case of heterotopic ossification located anteriorly to the flange of the implant. No patient underwent revision surgery.

Conclusions: DHH represent a viable option in the treatment of unreconstructable intra-articular fractures of the distal humerus, especially in active patients. However, long term studies are necessary to evaluate the real effectiveness of this treatment and to verify the effect of the direct contact of the implant with the cartilage surface of the proximal ulna.

OP.06.01

EVALUATION OF SPIN IN REVIEWS OF BIODEGRADABLE BALLOON SPACERS FOR MASSIVE, IRREPARABLE ROTATOR CUFF TEARS

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Background: Clinical studies are at risk of spin, a form of bias where beneficial claims are overstated while negative findings are minimized. Spin is more problematic in abstracts given their brevity and can result in the misrepresenting of a study's actual findings. The goal of this study is to aggregate primary and secondary studies reporting the clinical outcomes of sub-acromial balloon spacers' use in the treatment of massive irreparable rotator cuff tears (mIRCT) to identify the incidence of spin and find any association with study characteristics.

Methods: This study was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Searches were completed on two databases (PubMed and Embase). Two independently screened the studies using a predetermined inclusion criteria. Study characteristics such as s, , study design, etc. Each study was independently assessed for the presence of 15 different types of spin. Statistical analysis was conducted to identify associations between study design and spin.

Results: 29 Studies met inclusion criteria for our analysis, of which 10 were reviews or meta-analyses and the remaining 19 being primary studies. Spin was identified in every study except for 2 (27/29, 93.1%). Type 3 spin, "Selective reporting of or overemphasis on efficacy outcomes or analysis favoring the beneficial effect of the experimental intervention" and type 9 spin, "Conclusion claims the beneficial effect of the experimental treatment despite reporting bias" were the most frequently noted spin seen in our study, both being observed in 12/29 studies (41.4%).

Conclusions: Spin is highly prevalent in the abstracts of primary studies, systematic reviews, and meta-analyses discussing the use of subacromial balloon spacer technology in the treatment of mIRCT. In most cases, spin in the abstract favored the balloon spacer. In our assessment of 29 studies, type 3 spin and type 9 spin were the most prevalent forms of spin. Scopus CiteScores, date of publication, adherence to PRISMA or PROSPERO were study characteristics associated with a higher rate of certain types of spin. Further efforts are required in the future to mitigate spin within the abstracts of published manuscripts.

OP.06.02

ASSOCIATION BETWEEN BASELINE FACTORS AND PREOPERATIVE QUALITY OF LIFE USING THE EQ-5D-5L FOR PATIENTS UNDERGOING ARTHROSCOPIC ROTATOR CUFF REPAIR

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Background: The EuroQol-5 Dimensions questionnaire (EQ-5D) is a widely used generic instrument and commonly applied in the field of upper extremity surgery to assess preoperative health-related quality of life (HRQoL) status. However, associations between baseline factors and preoperative HRQoL scores have been poorly reported. The aim of this study was to identify associations between baseline factors and the preoperative EQ-5D index and EQ-VAS score in patients undergoing arthroscopic rotator cuff repair (ARCR).

Methods: For this study, 5 sociodemographic, 7 patient-related and 9 injury-related factors were retrieved as part of a multicenter prospective Swiss cohort study (ARCR_Pred). Univariable and multivariable ordinary least-square linear regression models were designed to assess the associations between these 21 factors and preoperative HRQoL. Final models were selected using stepwise backwards regression using the coefficient of determination (R²) and Akaike information criterion (AIC) for model comparison.

Results: A total of 973 patients (male: 611; 63%) with a mean age of 57.3 (SD: 9.4) were included in the analysis. The mean EQ-5D index value score was 0.7 (SD: 0.2) and mean EQ-VAS score 68.7 (SD: 19.8).

In the multivariable regression analysis, male gender (regression coefficient (β) = 0.05; p = .001) and higher education such as apprenticeship or high school (β = 0.07; p = .003) and university or college (β = 0.11; p < .001) were associated with a higher EQ-Index; mass index (β = -0.01; p = .002) and affected sleep-quality (β = -0.03; p < .001) were associated with lower EQ-Index. The described model resulted in a R² = 0.194 and an AIC = -0.265.

Factors negatively associated with overall health measured with EQ-VAS score were mild (β = -9.39; p < .001), moderate (β = -12.7; p < .001) and severe (β = -40.79; p < .001) depression, presence of comorbidities (β = -3.71; p = .001) and pain (β = -1.81; p < .001). The model shows a goodness of fit with R² of 0.243 and AIC of 8.542.

Conclusions: Our results highlight the importance of a holistic approach to orthopedic care and the importance of sociodemographic and patient-related factors on the multidimensional construct of HRQoL.

OP.06.03

DEVELOPMENT AND VALIDATION OF A DIAGNOSTIC PREDICTION MODEL FOR THE ACTIVE SHOULDER FLEXION IN PATIENTS UNDERGOING AN ARTHROSCOPIC ROTATOR CUFF REPAIR IN THE CONTEXT OF THE ARCR_PRED COHORT STUDY

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Background: Associations between preoperative active shoulder flexion and potential factors by patients undergoing an arthroscopic rotator cuff repair are still poorly understood. Our objective is to develop a diagnostic model predicting preoperative active shoulder flexion by patients undergoing an arthroscopic rotator cuff repair.

Methods: Patients of the Swiss nationwide arthroscopic rotator cuff repair (ARCR) cohort study (ARCR_Pred) were included. Patients with pre-operative shoulder stiffness, single infraspinatus full-thickness tears or tears involving the teres minor muscle, moderate to severe osteoarthritis (Samilson/Prieto >1) were excluded from the study. Our primary outcome was the presence or the absence of pseudoparalysis, defined as active flexion of less than 90 degrees, assessed using a goniometer. A set of 33 baseline variables was analyzed. Multivariable logistic regression models were used. Models were internally validated using bootstrap resampling.

Results: Of 973 patients enrolled in the ARCR_Pred cohort study, 746 patients met inclusion criteria for a complete case analysis, 169 (23%) patients had a pseudoparalysis. Ten factors were retained in the final model: age, mass index, longer symptom duration, traumatic onset, tear severity, diabetes, fatty infiltration of the infraspinatus and subscapularis muscles, the critical shoulder angle and the pre-operative level of pain. After correction for optimism, R squared was 22.7% and calibration slope was 0.89. The model was discriminatory with an apparent AUC = 0.79 [0.76; 0.82].

Conclusions: In patients undergoing ARCR, severe restrictions in preoperative active shoulder flexion were accurately predicted with a set of ten factors. Traumatic onset, diabetes, higher degree of fatty infiltration for the infraspinatus and subscapularis muscles, increasing age, BMI and critical shoulder angle were associated with a higher risk of pseudoparalysis. Interestingly, longer symptom duration was associated with a reduced risk of pseudoparalysis. Pre-treatment variables, such as the number of steroid infiltrations were not retained in the final model. Further studies are needed in order to evaluate the model.

OP.06.04

COMPARISON OF NON-AUGMENTED VERSUS AUGMENTED DOUBLE-ROW ROTATOR CUFF REPAIR WITH A BIOINDUCTIVE COLLAGEN IMPLANT VERSUS ACELLULAR DERMAL ALLOGRAFT

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Background: Failure of healing after primary rotator cuff repair has been associated with poor functional results and higher likelihood of reoperation. Various products have been used to augment primary rotator cuff repair using an onlay technique and have demonstrated improved healing rates and outcomes compared to conventional repairs. However, most studies lack a control group and few have compared performance of different augmentation options. The aim of this study was to examine healing rates of rotator cuff tears treated with primary double-row repair with and without augmentation using a bioinductive collagen implant (CI) or acellular dermal allograft (DA).

Methods: Patients with primary complete arthroscopic rotator cuff repair were prospectively enrolled starting in April 2020 at a single institution. The control group consisted of double-row repairs without augmentation and the augmentation groups were determined at the time of surgery by the surgeon and were employed using onlay technique. Patients received an MRI at 6-12 months postoperatively to assess healing. Patient reported outcomes (PROs) were collected at 3-month, 6-month, and 1 year follow-up.

Results: 94 patients were enrolled (36 control, 34 CI, 24 DA). Groups were similar in cuff tear chronicity. Overall, healing rate was significantly greater for CI (79.4%) as compared to the control (58.3%) and DA (50%) ($p=0.049$). When stratifying by tear size, healing of small tears was significantly greater for CI (100%) as compared to the control (91.7%) and DA (33.3%) ($p=0.005$). No differences were found for medium, large, or massive tears by treatment group. In patients with a preoperative Goutallier stage <1 ($n=83$), healing was significantly greater for CI (86.7%) as compared to the control (61.8%) and DA (57.9%) ($p=0.04$). No significant differences were found by treatment group for those with a Goutallier stage >1 ($p=0.75$). There were no differences in PROs between groups at 6-month and 1 year follow-up.

Conclusions: Augmentation of a double-row rotator cuff repair with the CI implant led to a better healing rate over non-augmented repairs and DA augmentation in small tears and those minimal fatty infiltration. Healing of larger tears and those with fatty infiltration remain a challenge despite advances in repair technology.

OP.06.05

THE CLINICAL TESTS FOR THE LONG HEAD OF THE BICEPS TENDON SHOW HIGH SENSITIVITY IN DIAGNOSIS OF SUBSCAPULARIS TEARS

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Background: Subscapularis tears have been reported to cause refractive anterior shoulder pain and affect the clinical outcomes of rotator cuff repair if left untreated. However, subscapularis tears are often difficult to be diagnosed preoperatively because their common clinical tests demonstrate the low sensitivity. The common subscapularis tests evaluate strength of shoulder internal rotation. Since pathologies of the long head of the biceps tendon (LHBT) have close relationship with subscapularis tears, we supposed that pain provocation tests for LHBT lesions may have a potential to diagnose subscapularis tears. The purpose of this study was to assess the ability of LHBT tests in the diagnosis of subscapularis tears and to compare it with that of subscapularis tests.

Methods: The subjects were patients who underwent arthroscopic rotator cuff repair by one of two senior surgeons between August 2021 and October 2022. Before surgery, the senior surgeons assessed the patients with six clinical examinations including both LHBT (O'Brien test, bicipital groove tenderness, and speed test) and subscapularis (Napoleon, bear hug, and lift off tests) tests. The sensitivity and specificity of each test were evaluated based on surgical findings of the subscapularis tendon. One of two fellow shoulder surgeons also examined each subject preoperatively, and the inter-rater reliability of each test were assessed as a kappa value.

Results: The subjects were 100 shoulders including 50 males and 50 females with a mean age of 65 years (range, 36-83). Subscapularis tears were found in 57 shoulders. The sensitivity and specificity of each test were as follows: O'Brien, 58%, 33%; bicipital groove tenderness, 68%, 37%; speed, 72%, 33%; Napoleon, 39%, 70%; bear hug, 39%, 63%; lift off, 37%, 72%. The inter-rater reliability of each test was 0.52, 0.46, 0.44, 0.50, 0.48, and 0.34, respectively.

Conclusions: The LHBT tests demonstrated higher sensitivity for the diagnosis of subscapularis tears than the subscapularis tests; however, the specificity was low in the LHBT tests. In contrast, the subscapularis tests showed higher specificity. The intra-rater reliability was fair to moderate in all tests. The use of the LHBT tests in combination with the subscapularis tests may improve the accuracy of the preoperative diagnosis of subscapularis tears.

OP.06.06

AETIOPATHOGENESIS OF ROTATOR CUFF TEAR IN PATIENTS YOUNGER THAN 50 YEARS: MEDICAL DISEASES HAVE A RELEVANT ROLE

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Background: Studies on rotator cuff tear in patients younger than 50 years have focused their attention on the results obtainable after surgical repair. Little attention has been focused on cuff tear etiopathogenesis; although it is common belief that most lesions are due to trauma. We have retrospectively verified the prevalence of comorbidity whose role in determining the cuff tissue degeneration and tear has been widely demonstrated in a considerable group of patients younger than 50 years who underwent surgical repair of the postero-superior cuff.

Methods: 32 patients represent the studied group. Personal data, BMI, smoking habit, comorbidities (diabetes, arterial hypertension, hypercholesterolaemia, thyroid diseases, copd) were registered. Finally, the possible triggering cause, the affected side and tear size were noted. Statistical analysis was performed.

Results: Of our patients 75%, had one or more comorbidities and/or they smoked for more than 10 years. In the remaining 25%, only 4 patients sustained a rotator cuff tear due to a traumatic event while in the other 4 patients no comorbidities were registered, and no trauma occurred. The presence of two or more comorbidities did not affect the cuff tear size.

Conclusions: In three quarters of cases the young patients with cuff tear smoke or has comorbidities predisposing to tear; therefore, the role of trauma in the genesis of cuff tear in patient younger than 50 years is markedly resized. It is plausible that in the remaining 25%, cuff tear may be due to trauma or to genetic or acquired degeneration.

OP.06.07

ALLOGRAFT-ENHANCED LATISSIMUS DORSI TRANSFER IS BETTER THAN THE CONVENTIONAL TECHNIQUE FOR IRREPARABLE POSTEROSUPERIOR ROTATOR CUFF TEARS. A RETROSPECTIVE MATCHED COHORT.

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Background: Latissimus dorsi tendon (LDT) transfer (LDTT) to the greater tuberosity to treat irreparable posterosuperior rotator cuff tears (RCTs) in young active patients has been shown to have up to 36% of clinical failures, most of them happening because of either deltoid origin disruption or post-operative transfer rupture from the greater tuberosity. In an attempt to simultaneously prevent both complications, a modified technique includes the following adaptations to the original technique: reinforcement and augmentation of the LDT with a tendinous allograft, enabling the use of a single deltopectoral approach. The aim of this study is to compare mid-term outcomes of the traditional LDTT technique with this modified transfer.

Methods: Retrospective cohort study comparing two groups who underwent either the traditional (group 1; n=19) or the modified technique (group 2; n=27). Group homogenization was assured by statistical comparison of 24 baseline independent variables. The outcome variables were the gains to active shoulder range of motions (ROM) and UCLA scores (and all its subscores, independently), at a minimum follow-up of two years. A p value <.05 was considered to be statistically significant.

Results: At a mean follow-up of 25 months, both groups have shown improvements to most variables, with 84% of patients achieving MCID in group 1 and 89% in group 2. However, group 2 (modified technique) achieved greater improvements than group 1 to UCLA score (p=.009), active external rotation (p=.006), internal rotation (p=.008) and forward flexion strength (p=.003).

Conclusions: At mid-term follow-up, both the traditional and the modified techniques provided improvements to shoulder ROM and function. However, outcomes of the modified (single approach, allograft-enhanced) latissimus dorsi tendon transfer were better than those of the original technique.

OP.06.08

ROTATOR CUFF REPAIR PROTECTED WITH SUBACROMIAL BALLOON SPACER SHOWS A LOW RATE OF NON-HEALING

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Background: The purpose of this study was to evaluate clinical outcomes and tendon integrity on magnetic resonance imaging (MRI) of chronic posterosuperior rotator cuff tears treated with single-row tensionless repair and subacromial balloon spacer as protection with a minimum follow-up of 2 years. The hypothesis of this study was that this procedure would have acceptable clinical outcomes and tendon-healing rate without increased complications.

Methods: This is a retrospective study of patients with chronic posterosuperior rotator cuff tears repaired with a single-row technique protected with a subacromial balloon device. Patients were followed up for a minimum of 2 years. Clinical outcomes were evaluated with American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES) and Numerical Rating Scale (NRS) for pain. MRI study was obtained likewise after at least 2 years to assess tendon-healing rate. Statistical comparison was performed between pre-operative and at least 2-year clinical and imaging follow-up.

Results: Thirty-two patients were included in the study with a mean follow-up of 27 ± 7 (range 24-48). The tear size was on average 2.3 cm (range 2-4) and a mean of 2.1 triple-loaded anchors were used (range 2-3). The ASES score significantly increased from a mean of 39 ± 12 points to a mean of 89 ± 12 at the final follow-up ($P < 0.001$). Similarly, pain significantly reduced from a mean pre-operative NRS of 6.8 ± 1.4 to 0.8 ± 1.5 at the final follow-up ($P < 0.001$). MRI scans showed that repair occurred in 26 patients (81.3%). Significant higher ASES score was reached at final follow-up in patients with a healed (Sugaya I-III) tendon when compared to patients with an evidence of tendon discontinuity on MRI study (Sugaya IV-V), 93 ± 9 and 74 ± 13 , respectively ($P < 0.001$).

Conclusions: Arthroscopic repair of chronic posterosuperior rotator cuff tears using a single-row tensionless repair and subacromial spacer as protection resulted in an 81.3% of tendon integrity at a mean follow-up of 27 months. Clinical outcomes and pain scores significantly improved without severe complications reported after a minimum follow-up of 2 years.

OP.06.09

LONG TERM OUTCOMES OF ARTHROSCOPIC ROTATOR CUFF REPAIR - A SYSTEMATIC REVIEW AT 10-YEARS MINIMUM FOLLOW-UP

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Background: The purpose of this study was to perform a systematic review of the literature to evaluate the functional outcomes, radiological outcomes and revision rates following arthroscopic rotator cuff repair (ARCR) at a minimum of 10-years follow-up.

Methods: Two independent reviewers performed a literature search using the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines using Pubmed, Embase and Scopus databases. Only studies reporting on outcomes of ARCR with a minimum of 10-years follow up were considered for inclusion.

Results: Our search found 9 studies which met our inclusion criteria, including 455 shoulders in 448 patients (51.6% males), with average age of 70.7 ± 3.7 years (45-90) and mean follow-up of 146.9 ± 21.8 months (120-216). At final follow-up, the ranges of American Shoulder & Elbow Surgeons (ASES), age & sex adjusted Constant-Morley (CM) and University of California Los Angeles (UCLA) scores were reported in 5, 6 and 3 studies respectively as 79.4 - 93.2, 73.2 - 94 and 26.5 - 33 respectively. Of the included studies, satisfaction rates varied in 6 studies from 85.7% to 100% in the long-term. Furthermore, the ranges of forward flexion, abduction and external rotation were 142.4 - 170 deg, 116.2 - 166 deg and 22.9 - 64 deg as reported in 3, 2 and 3 studies respectively. Additionally, the overall radiological re-tear rate ranged from 9.5% to 63.2%. At final follow up, 3 studies reported re-tear rates detected on magnetic resonance imaging (MRI) as 46.5% to 63.5%, whilst 2 studies reported re-tear rates of 9.5% to 27.3% using ultrasound. The overall surgical reoperation rates ranged in 6 studies from 3.8% - 15.4%; with 0% - 6.7% requiring revision-ARCR and from 1.0% - 3.6% requiring revision sub-acromial decompression in 6 and 2 studies respectively at minimum 10-years follow-up.

Conclusions: Our systematic review established that ARCR results in very high satisfaction rates, excellent clinical outcomes, as well as low revision rates at minimum 10-years follow-up, despite modest evidence of re-tears rates in asymptomatic patients.

OP.06.10

ARTHROSCOPIC TRANSOSSEOUS REPAIR TREATMENT OF MASSIVE ROTATOR CUFF TEARS LONG TERM FOLLOW UP

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Background: Controversies in the results of long term follow up of massive rotator cuff tear are present in the literature. the purpose of this study is to evaluate outcomes of arthroscopically repaired massive rotator cuff tears and to identify prognostic factors affecting rotator cuff healing and functional outcome, especially in patients with failed rotator cuff healing.

Methods: Among 97 patients who underwent arthroscopic repair of a massive rotator cuff tear, 55 patients with a mean age of 54 years were included. Outcome evaluation was completed both anatomically (CT arthrography or ultrasonography) and functionally at a mean follow-up period of 14.5 years Various factors affecting cuff healing were analyzed, and factors affecting functional outcome were evaluated in patients with failed repairs using both univariate and multivariate analyses.

Results: The anatomic failure rate was 31% in arthroscopically repaired massive rotator cuff tears; however, functional status significantly improved regardless of cuff healing. Several factors were associated with failure of cuff healing in the univariate analysis, but only fatty infiltration . Among patients with failed rotator cuff healing.

Conclusions: Despite a high rate of healing failures, arthroscopic repair can be recommended in patients with massive rotator cuff tears because of the functional gain at late follow-up. No preoperative factor was able to predict poor functional outcome; reduced postoperative AHD was the only relevant functional determinant in the patients' eventual functional outcome and should be considered when ascertaining a prognosis and planning further treatment strategies.

OP.06.11

DOES THE SUPERIOR CAPSULAR RECONSTRUCTION WITH ACHILLES TENDON-BONE ALLOGRAFT USING KEY HOLE FOR FITTING BONE TO BONE HAVE GOOD OUTCOMES OF THE PATIENTS WITH PSEUDOPARALYSIS?

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Background: The purpose of this study was to compare the clinical and radiologic outcomes of superior capsular reconstruction (SCR) with Achilles tendon-bone allograft using key hole for fitting bone to bone for irreparable massive rotator cuff tear (RCT) with or without the pseudoparalysis.

Methods: This retrospective study was conducted on the patient who underwent SCR for irreparable massive RCT from November 2018 to November 2021. In this study, patients who could be evaluated with pre- and postoperative American Shoulder and Elbow Surgeon (ASES) score, Constant Score (CS), range of motion (ROM) such as forward elevation (FE), internal rotation (IR) and external rotation (ER), isokinetic muscle strength test and magnetic resonance image (MRI), who had posterior marginal convergence (PMC) with thick and low tension broad coverage of infraspinatus foot print and were included. 52 cases could be enrolled in this retrospective study with the inclusion criteria and were divided into 2 groups (patients with pseudoparalysis as group A; 13 cases, patients without pseudoparalysis as group B; 39 cases).

Results: Preoperatively, clinical score, ROM and muscle strength were significantly inferior and fatty degeneration of infraspinatus was also more severe in group A compared to group B. However, compared to preoperatively, two groups had clinical improvement significantly after surgery (ASES - group A; 35.14 to 84.16, group B; 54.62 to 82.58, isokinetic muscle strength - group A; 8.45/5.83/16.86 to 17.77/14.49/27.91 (FE/ER/IR), group B; 11.9/8.92/19.32 to 20.87/14.46/22.69, $p < 0.05$). Pseudoparalysis were restored in all patients of group A improving from mean $35 \pm 3^\circ$ to $148 \pm 18^\circ$ of active FE, postoperatively. However, in 3 cases that could not have PMC or needed high tension foot print coverage of the posterior rotator cuff due to the lack of allograft size, graft failure was diagnosed in all and pseudoparalysis persisted.

Conclusions: For the stable incorporation with the posterior cuff of the Achilles allograft in the pseudoparalysis patients, it is considered that the thick and broad coverage of the allograft enough to cover the defect of the posterior cuff with low tension is needed and the clinical outcomes was not inferior to that of the patient without pseudoparalysis.

OP.06.12

THE RESULTS OF ARTHROSCOPIC REPAIR OF PARTIAL THICKNESS OF ROTATOR CUFF TEAR: LATE RESULTS OF TRANSOSSEOUR REPAIR TECHNIQUE

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Background: Repeated elevation of the arm more than 80 degrees of abduction produces repeated micro-trauma to the critical hypo-vascular area of the cuff tendon and the head of the humerus is no longer secured in the inferior glenoid fossa. Thus, upward migration of the head occurred by the over pull of the deltoid leading in presence of subacromial narrowing lead to partial tear of the supraspinatus. To establish a sound strong supraspinatus for superior stability and function a transosseous repair was done to all cases.

Methods: This work was done on 30 patients 22 males and 8 females, were diagnosed arthroscopy during larger work arthroscopically treating chronic impingement patients that they had partial thickness rotator cuff tear. All the 30 cases were treated by arthroscopic subacromial decompression and transosseous Giant Needle suture rotator cuff repair. The repair was carried out by the use of giant needle technique. The average follow up period was ten years post operative. We used the UCLA scale for the pre and post-operative assessment of the results.

Results: The improvement in the score of pain and score of function were dramatically obvious progressing with time at 6w, 3m, 6m and one year. They achieved improvement in the score of 4.7 for the score of pain and 3.9 for the score of function preoperative to be 9.8 for the score of pain and 10 for the score of function ten years post operative.

Conclusions: We concluded that the giant needle technique for the partial rotator cuff tear, with subacromial decompression is an excellent method for the treatment of partial thickness cuff tear.

OP.07.01

RANGE OF MOTION IN REVERSE SHOULDER ARTHROPLASTY AT 2 YEARS FOLLOW-UP: A PROSPECTIVE COMPARISON BETWEEN STATIC SCAPULA 3D PLANNING SOFTWARE TOOL AND CLINICAL OUTCOMES

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Background: Preoperative planning software has become a popular tool in reverse shoulder arthroplasty (RSA). Commercially available planning software help determine humeral and glenoid component type, size and position for restoring optimal range of motion (ROM). However, simulated ROM feature does not take into consideration any soft tissue parameters or scapulothoracic movement. This study aims to compare simulated software generated ROM obtained with clinical measurements obtained postoperatively.

Methods: Pre- and post-operative shoulder Computed Tomography (CT) scans of 50 patients who underwent primary RSA (Tornier Aequalis™ Adjustable Reversed) between 2018 and 2021 were prospectively evaluated. Each patient clinical ROM at two years follow-up and implant sizes were collected. Accurate positions of humeral and glenoid components were determined from post-op CT images of each patient using Mimics 25.0 (Materialise NV, Leuven, Belgium). Pre-op CT images were uploaded into Blueprint™ 3D planning software and implant positioning ascertained from post operative CT scans was used to set parameters for planning to replicate the performed surgery. Abduction, flexion and external rotation motions were simulated, and values were recorded. Simulated ROMs were compared to clinical ROM using linear regression analysis and Pearson correlation coefficient.

Results: Predicted ROM by software were abduction: $76^\circ \pm 14^\circ$ (range, 54° to 105°), flexion: $109^\circ \pm 27^\circ$ (range, 60° to 180°), and external rotation: $11^\circ \pm 15^\circ$ (range, 0 to 59). Whereas abduction of $154^\circ \pm 18^\circ$ (range, 100° to 180°), flexion of $159^\circ \pm 14^\circ$ (range, 100° to 180°), and external rotation of $52^\circ \pm 13^\circ$ (range, 30° to 80°) was noted clinically. Weak linear correlation was found between simulated and clinical ROM (abduction: $R^2=0.01$; flexion: $R^2=0.01$; external rotation: $R^2=0.14$). Pearson's correlation coefficients were -0.01, -0.13 and 0.37 for abduction, flexion and external rotation, respectively, indicating a very low correlation between these measurements.

Conclusions: Our study demonstrates a weak agreement between the simulated ROM using a static scapula 3D-preoperative planning software and the clinical ROM. Multiple factors soft tissue impingement and scapulothoracic movement play a critical role in post op clinical ROM. Further research and development is needed to make the ROM simulation feature a more clinically reliable tool that can guide the surgical decision making.

OP.07.02

TUBerosITY RECONSTRUCTION BASEPLATE FOR SHOULDER HEMIARTHROPLASTY: MORPHOLOGICAL DESIGN AND BIOMATERIAL APPLICATION

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Background: Shoulder hemiarthroplasty is prone to tuberosity malposition and migration, reducing the rate of tuberosity healing. We proposed to design a tuberosity reconstruction baseplate to assist in tuberosity integration and to evaluate the mechanical properties of baseplate made from the novel biomaterial carbon fiber reinforced polymer (CFRP) composites

Methods: The three-dimensional model of native proximal humerus was constructed by computed tomography (CT) data. The morphological design of baseplate was based on the tuberosity contour and rotator cuff footprint.

Finite element models were created for different thicknesses of CFRP composites, poly (ether-ether-ketone) (PEEK) and titanium-nickel (TiNi) alloy. The permissible load and suture hole displacements were applied to evaluate the mechanical properties.

Results: The structurally optimized model made of CFRP composites provided superior strength and deformability, compared to the PEEK material and TiNi alloy. Its permissible load was above 200 N and the suture hole displacement was between 0.9 and 1.4 mm.

Conclusions: This study proposed a method for designing tuberosity reconstruction baseplate based on morphological data and extended the application of biomaterial CFRP composites in the orthopedics field. The optimized model made of CFRP composites allowed a certain extent of elastic deformation and showed the possibility for dynamic compression of tuberosity bone blocks.

OP.07.03

CLINICAL AND RADIOGRAPHIC OUTCOMES OF REVERSE TOTAL SHOULDER ARTHROPLASTY WITH AN AUGMENTED BASEPLATE COMPARED TO THOSE WITHOUT AN AUGMENT

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Background: Introduction: The incidence of reverse total shoulder arthroplasty (rTSA) is continuing to increase and is now greater than anatomic total shoulder arthroplasty. This increase is associated with expanding indications, improved surgical techniques and implants. The introduction of augmented glenoid baseplates for rTSA provides a solution for optimizing biomechanics and managing glenoid wear with the added benefit of glenoid preservation. The purpose of this study was to compare clinical and radiographic outcomes in patients treated with rTSA and an augmented baseplate versus a non-augmented baseplate.

Methods: Material and Methods: A retrospective chart review was conducted for 204 patients who underwent primary rTSA between January 2017 to January 2019 at a single site by a single surgeon. During the study period 106 shoulders received rTSA with an augmented baseplate and 98 rTSA with a non-augmented baseplate. The primary outcome measures included, the incidence of perioperative complications, patient-reported clinical outcomes (pain and function rated on a visual analog scale, single assessment numeric evaluation, American Shoulder and Elbow Surgeons score, and disabilities of the arm, shoulder, and hand score), range of motion and strength. Preoperative radiographs were assessed for glenoid bone loss and postoperative radiographs were analyzed for evidence of component loosening or scapular notching at final follow-up.

Results: Results: No significant differences were seen in mean patient reported outcomes, range of motion, or strength between the augmented and non-augmented groups. Radiographic analysis demonstrated no differences in baseplate loosening or implant related complications, however, the augmented group had increased lateralization and a significantly lower incidence of humeral bone loss. There was 1 postoperative complication in the augmented group (1.1%) and 4 postoperative complications in the control group (4.7%), which did not reach significance.

Conclusions: Conclusion: The use of augmented baseplates in primary rTSA at short term follow-up did not result in significantly different outcomes compared to non-augmented baseplates. Augmented baseplates have good short-term outcomes with no implant failures and the benefit of glenoid preservation and lateralization in primary rTSA.

OP.07.04

LATERALIZATION AND DISTALIZATION SHOULDER ANGLES DO NOT PREDICT OUTCOME IN REVERSE SHOULDER ARTHROPLASTY FOR CUFF TEAR ARTHROPATHY

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Background: In reverse shoulder arthroplasty (RSA), there is a plethora of measurements regarding implant lateralization and distalization. Two specific measurements known as the lateralization shoulder angle (LSA) and distalization shoulder angle (DSA) have been the recent focus of studies to assess their association with RSA and postoperative function. The aim of this study was to evaluate the prognostic clinical value of the LSA and DSA in a large cohort of patients with cuff tear arthropathy (CTA) who were treated with different RSA systems.

Methods: A local shoulder arthroplasty registry was reviewed for all RSA patients documented with a radiological assessment and complete 2-year follow-up examination. The main inclusion criterion was primary RSA for patients with CTA. Any patients with either a complete teres minor tear, os acromiale or acromial stress fractures reported between the time of surgery and the 24-month follow-up were excluded. Five different RSA implant systems with four different neck-shaft angles were assessed. The Constant Score (CS), Subjective Shoulder Value (SSV) and range of motion (ROM) at two years were correlated with both LSA and DSA assessed on 6-month anteroposterior radiographs. Linear and parabolic univariable regressions were calculated for both shoulder angles, for each prosthesis system and for the entire patient cohort.

Results: Between May 2006 and November 2019, there were a total of 630 CTA patients who had undergone primary RSA. Of this large cohort, 270 were treated with the Promos Reverse (neck-shaft angle [NSA], 155°), 44 with the Aequalis Reversed II (NSA, 155°), 62 with the Lima SMR Reverse (150°), 25 with the Aequalis Ascend Flex (145°) and 229 with the Univers Revers (135°) prosthesis systems. The mean (standard deviation [SD]) LSA was 78° (10; range, 6-107) and the mean DSA was 51° (10; range, 7-91). The average CS at 24 months follow-up was 68.1 (SD: 13; 13-96) points. Neither the linear nor parabolic regression calculations for LSA or DSA revealed significant associations with any of the clinical outcomes.

Conclusions: Different patients may achieve different clinical outcomes despite having identical LSA and DSA values. There is no association between angular radiographic measurements and 2-year functional outcome.

OP.07.05

GOOD CLINICAL AND RADIOLOGICAL OUTCOMES OF ANATOMIC TOTAL SHOULDER ARTHROPLASTY WITH A NOVEL CONVERTIBLE ALL POLYETHYLENE GLENOID WITH HYBRID FIXATION: MINIMUM 2-YEAR FOLLOW-UP

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Background: The ideal glenoid implant for anatomic total shoulder arthroplasty (aTSA) is one that provides sound fixation and allows ease of conversion to a reverse shoulder arthroplasty should the clinical need arise. This study is the first to report consecutive series of patients treated with a novel convertible all polyethylene glenoid with hybrid fixation.

Methods: This is a prospective study including patients from two centres in New Zealand and Sweden. Between August 29th 2017 and April 22nd 2020, 103 patients received an aTSA for osteoarthritis with the SMR TT Hybrid Glenoid implant (Lima Corporate, San Daniele del Friuli, Italy). Ninety-seven patients had a minimum follow-up of 24 months and were therefore included in this study. There were 45 female and 52 male patients. The average age at the time of surgery was 68.2 years (range 49 – 81 years). Pre-operative and post-operative clinical evaluations were performed using the American Shoulder and Elbow Surgeons (ASES) score and the Oxford Shoulder Score (OSS). To compare the shoulder functional capacity pre- vs post-operative, range of motion was assessed using a goniometer. Standardized radiographs were utilized to assess for evidence of component failure and loosening.

Results: The mean follow-up duration was 2.3 years (range 2.0 – 4.6 years). The mean pre-operative and post-operative ASES scores were 29.0 ± 12.4 and 90.3 ± 14.5 , respectively ($P < 0.001$). The mean pre-operative and post-operative OSS were 21.0 ± 6.7 and 45.3 ± 4.4 , respectively ($P < 0.001$). We found significant improvements in the range of motion, with mean forward flexion increasing from 87 to 155 degrees and abduction 73 to 149 degrees, pre- to post-operative respectively. Radiologically, there was no evidence of glenoid or humeral component failure or loosening.

Conclusions: Patients treated with an aTSA with the SMR TT Hybrid Glenoid for primary glenohumeral joint osteoarthritis achieved excellent clinical and radiologic results at a minimum of 2-years. The convertible design of this implant preserves glenoid bone stock and simplifies revision to reverse shoulder arthroplasty should the clinical need arise.

OP.07.06

A NOVEL ISOELASTIC MONOBLOCK GLENOID COMPONENT IN ANATOMIC TOTAL SHOULDER ARTHROPLASTY - PRELIMINARY RESULTS FROM A PROSPECTIVE MULTICENTRE STUDY AT 2 YEARS OF FOLLOW UP

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Background: A main complication in anatomic total shoulder arthroplasty at a long-term follow-up is aseptic glenoid component by different modes of failure. The purpose of this prospective multicentre study is to evaluate the clinical and radiological results of TSA using a novel, uncemented, monoblock glenoid component, which has an elastic modulus similar to bone.

Methods: Between January 2020 and June 2021, a total of 75 cases (33 male, 42 female, mean age 66.6 years) of stemless total shoulder arthroplasties (Affinis short®, Mathys Ltd Bettlach, Switzerland) were performed in 5 surgical centres using a cementless anatomic 2-peg monobloc glenoid component made of a vitamin E-enriched, highly cross-linked PE and coated with a thin layer of titanium particles. Indications for surgery were primary osteoarthritis (n = 68), posttraumatic arthritis (n = 4) and instability arthropathy (n = 2). The clinical outcome was analysed using the adjusted Constant-Score (CS), the Simple Shoulder Test (SST) and range of motion (ROM) assessment. Radiographic evaluation was performed in standardized true anterior-posterior and axial views with special focus on the occurrence of radiolucent lines (RLL). Further postoperative complications were documented.

Results: The CS improved from 36.0 points preoperatively to 93.6 points postoperatively. The SST increased from 2.4 points to 9.8 points. The active ROM improved in all directions. The radiographic evaluation of the humeral and glenoidal components during the follow up was possible in 78.5 % of the cases and did not present a loosening of the implants or were classified at risk for loosening. The radiographic assessment of the glenoid components demonstrates discrete (< 1 mm) in 23.1 % of the implants. These were localised at the backside but not around the anchoring pegs of the implant. without clinical relevance. The complication rate was 2.6 % (n = 1 - partial subscapularis tendon lesion without revision, n = 1 - an intraoperative reamer breakage).

Conclusions: The use of a novel isoelastic monoblock glenoid component in TSA achieve excellent clinical and radiological short-term results. Longer follow-up data are required to confirm these early promising results especially in comparison to the proven results of current cemented PE glenoids.

OP.07.07

COMPARISON OF MANUAL TWO-DIMENSIONAL AND AUTOMATED THREE-DIMENSIONAL METHODS OF ASSESSING SHOULDER JOINT MORPHOLOGY USING COMPUTED TOMOGRAPHY IMAGES

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Background: Background: The identification of morphological changes in the shoulder joint is essential for planning and carrying out the surgical procedure and thus impacts the outcome of shoulder arthroplasties. Such assessments can be done by manual methods that use two-dimensional (2D) computed tomography (CT) images or through software that uses three-dimensional (3D) images. However, the accuracy of these methods and the correlation between them are not well established. Therefore, this study aims to evaluate the interobserver agreement in the measurement of anatomical parameters of the shoulder performed through manual 2D methods or automated 3D using the Blueprint® surgical planning program.

Methods: Methods: This is a cross-sectional study in which 2D CT images of 38 patients with different diagnoses were used. Anatomical parameters were measured by the manual methods described by Friedman, Maurer, and shoulder subluxation according to Walch, by 5 independent qualified shoulder surgeons and compared with the Blueprint® automated program.

Results: Results: Significant differences were found between the version measured through the Friedman manual method and the automated one. These differences were increased in patients with severe glenoid deformities. Mean values of inclination did not show statistically significant differences between both methods. Subluxation was significantly different between automated and manual methods.

Conclusions: Conclusion: The manual method is effective in measuring the glenoid version and inclination when performed by experienced surgeons. The percentage of posterior subluxation of the humeral head presents a great discrepancy between the manual and the automated method. Such differences underscore the need for further studies that aim to assess the impact of such differences on the outcome of the procedures since several uncertainties exist regarding the accuracy of manual and automated methods, and the selection and correct positioning of implants.

OP.07.08

THE EFFECT OF OCULT LOW GRADE INFECTION ON THE OUTCOME OF REVERSED SHOULDER ARTHROPLASTY AFTER FAILED OSTEOSYNTHETIC TREATMENT OF PROXIMAL HUMERUS FRACTURES

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Background: Infections is a common complication of the implantation of reversed shoulder arthroplasty (RSA) after failed osteosynthesis of the proximal humeral fractures (FO-PHF). It is frequent to have a positive culture or histopathological signs of infection during revision surgeries after failed fixation of proximal humeral fractures.

The aim of this work is to evaluate the reinfection rate in patients treated with RSA after FO-PHF who had positive culture or histopathological signs of infection in the biopsies taken during the implantation of RSA.

Methods: In the period between December 2009 till December 2019, we implanted RSA in 131 suffered FO-PHF. All the included patients did not have any signs of infection. Biopsies and cultures were taken during the implantation of RSA. All the patients received antibiotics till negative culture results. In this study we evaluated the reinfection rate in the included patients. We evaluated the outcome of the patients who are still available for follow up (50,3%). The data were collected retrospectively. Patients available for follow up were evaluated clinically, radiologically and the DASH and Constant scores.

Results: We were able to follow up 66 patients. The average follow up was 60,8 months. 89 patients (67.9%) had a negative culture and no histopathological signs of infections in the taken biopsies. 25 patients (19.1%) had positive cultures but negative histopathological examination. 10 patients had positive histological signs of infection but negative cultures. In the remaining 7 patients (5,4%), both examinations were positive. The commonest types of bacteria detected were *Cutibact. acnes* (28,6%) followed by *Staph. epidermidis* (20%).

In the included patients we revised 2 patients because of infection. 2 further patients had superficial infection which was treated conservatively.

The 2 revisions due to infection had neither positive histology nor positive culture in the primary surgery. One patient with wound healing disorders had previously evidence of *Staph. capitis* with negative histology. At the final possible follow up, the mean Constant and DASH scores were 55.3 and 41.3, respectively.

Conclusions: The infection rate after implantation of RSA for FO-PHF can be exceptionally low if the proper patient's selection and correct post operative antibiotic therapy was carried out.

OP.07.09

ASSESSING GLENOID ARTHROPLASTY COMPONENT POSITIONING FOR SURGEONS UTILIZING SURGICAL PLANNING SOFTWARE

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Background: Glenoid component positioning remains a challenge during total shoulder arthroplasty. While preoperative 3D planning software is widely available for most TSA systems today, the degree to which this software affects surgeon pre-operative and intra-operative decision making is unknown. The purpose of this study is to determine whether surgeons using 3D shoulder arthroplasty planning software adhere to glenoid component positioning principles shown to reduce complications and improve outcomes of anatomic TSA (aTSA) and reverse TSA (rTSA) and quantify the rate at which 3D preoperative planning results in concordant intraoperative plan execution.

Methods: A total of 695 consecutive, de-identified, planned surgeries using commercially available software were identified from the case registries of six fellowship trained shoulder arthroplasty surgeons. aTSA glenoid plans were evaluated for final implant position with less than 10° of retroversion, corrective reaming less than 15°, and avoidance of glenoid vault perforation. rTSAs were evaluated for final implant position with less than 15° of retroversion, glenosphere position in neutral or inferior tilt with at least 3 mm of inferior offset and 3 mm of posterior offset, and backside coverage of at least 50% of the baseplate on the native glenoid. ANOVA was performed to determine whether glenoid size resulted in selection of differing implant sizes and whether planned component size correlated with the actual implant size.

Results: 185 aTSAs and 510 rTSAs pre-operatively planned surgeries using commercially available software were analyzed. All planning principles were adhered to in 90% of all aTSA cases and 79% of all rTSA cases. The concordance between preoperative 3D planning implant selection and final implant selection was 90% for aTSA and 91% and 95% for rTSA baseplate and glenosphere implant selection, respectively. Implant size varied in accordance with glenoid size for both aTSA and rTSA ($p < 0.001$).

Conclusions: Surgeons adhered to known principles in most TSA cases when utilizing 3D CT-based shoulder arthroplasty planning software. A high concordance was found between preoperative implant selection and the final glenoid component inserted. Native glenoid size affects surgeon selection of implant and glenosphere size. Understanding how orthopaedic surgeons utilize planning software can help lead to improvements in software design.

OP.07.10

VANCOMYCIN POWDER EMBEDDED IN COLLAGEN SPONGE AFFECTS THE RATE OF PROSTHETIC SHOULDER INFECTION.

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Background: Shoulder prosthesis is a successful procedure to treat the degenerative and traumatic diseases of glenohumeral joint. Periprosthetic infection would represent an infrequent but dreaded complication (2-4%). Application of intrawound vancomycin powder seems to reduce periprosthetic infections but limited information is available on its efficiency in shoulder arthroplasty.

Methods: A retrospective review of 827 patients undergoing Total Shoulder Arthroplasty (TSA) was performed. The study involved a control group of 405 patients and a group of 422 with the intraoperative insertion of vancomycin powder into the wound. Incidence of periprosthetic infection was evaluated into two groups at minimum 12 months follow up. Patient demographics, comorbidities and perioperative information were compared between the two groups.

Results: No infection was observed in the group treated with intra-articular vancomycin, and 13 cases of infection were observed in the control group (3.2%) without subacromial vancomycin application. No wound complications requiring revision were observed as a result of subacromial vancomycin application. A Statistical analysis was performed.

Conclusions: Use of intrawound vancomycin reduces the rate of deep infections in shoulder arthroplasty but does not increase the development of aseptic complications. Our results support the use of intra-articular local vancomycin for prophylaxis of shoulder periprosthetic infections.

OP.07.11

REVERSE SHOULDER ARTHROPLASTY RENDERS BETTER CLINICAL SCORES AT A MINIMUM FOLLOW-UP OF 2 YEARS FOR PATIENTS WITH NO ROTATOR CUFF DEFICIENCY OPERATED BY THE DELTOPECTORAL APPROACH

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Background: The purpose of this multi-centric study was to report outcomes of a large cohort of Reverse shoulder arthroplasty (RSA) at minimum a follow-up of 2 years and to determine patient and surgical factors that influence postoperative outcomes. The hypothesis was that clinical outcomes would be significantly associated with indications for surgery, surgical approach and implant design.

Methods: The reviewed records of 743 RSAs in patients with primary osteoarthritis (OA) with or without rotator cuff lesions, secondary OA due to rotator cuff tears (RCT), and irreparable massive rotator cuff tears (mRCT). The deltopectoral (DP) approach was used in 540 and the anterosuperior (AS) approach in 203. Pre- and post-operative Constant scores (CS) were recorded. Multivariable linear analyses were performed to determine if CS was associated with indications for surgery, surgical approach or implant design.

Results: Of the 743 shoulders, 193 (25.7%) were lost to follow-up, 16 (2.1%) died, and 33 (4.4%) revised, leaving 501 for analysis. At mean follow-up of 3.2 ± 0.9 years, net-improvement in CS was 29.2 ± 17.0 . Multivariable analyses revealed postoperative CS decreased with age, was worse in shoulders that had preoperative rotator cuff deficiency, and in shoulders operated by the AS approach. Multivariable analyses also revealed worse net-improvement in shoulders operated for secondary OA due to RCT or for irreparable mRCT, as well as shoulders operated by the AS approach.

Conclusions: This large multicentric study confirms that, at 2 or more years following RSA, Constant scores are not associated with implant design, but rather with rotator cuff deficiency and surgical approach. Multivariable analysis revealed that postoperative CS was worse for shoulders with preoperative rotator cuff deficiency and for shoulders operated by the AS approach, and the differences exceeded the minimal clinically important difference of 5.7 in both cases. Multivariable analysis also revealed that net-improvement in CS was worse in shoulders treated for secondary OA due to RCT and for shoulders with irreparable mRCT, as well as for shoulders operated by the AS approach.

OP.07.12

MULTIPLANAR ANALYSIS OF PROXIMAL HUMERUS ANATOMY OF PATIENTS WITH ROTATOR CUFF ARTHROPATHY AND RELEVANCE TO REVERSE SHOULDER PRESS-FIT STEM

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Background: Reverse shoulder arthroplasty (RSA) using short stems has become increasingly popular due to their ability to preserve bone stock while allowing for both metaphyseal and diaphyseal fixation. Commercially available stems, however, may not have a geometrically sound design, resulting in component misalignment and loosening. The purpose of this study was to perform a multiplanar analysis of proximal humerus anatomy in patients with rotator cuff arthropathy to better define bone geometry and identify sex-based differences.

Methods: We performed a retrospective review of 117 computed tomography (CT) scans of patients undergoing RSA for rotator cuff arthropathy (RCA). Proximal humerus measures were undertaken following multiplanar reconstruction. Measured parameters included the following: transition point (TP), anteroposterior (AP) and mediolateral (ML) distances, intramedullar (IM) and bone diameter, and cortical thickness. Measurements started at the metaphysis, then proceeded 25 mm and 50 mm distal to the metaphysis followed by 10 mm increments thereafter. Each level was compared to the level above with t-tests in the overall cohort and separately by sex. Height was correlated to ML-AP difference and IM diameter with Pearson's correlation coefficient. Stem sizes that extended 50, 60, 70, and 80 millimeters (mm) from the metaphysis were analyzed to record the percentage of patients in whom the stem would reach past the TP.

Results: The mean TP for all patients was 55.6 mm, 53.3 mm in females, and 58.1 in males. ML and AP distances, and IM diameter became consistent at level 3 (83 mm distal to the GT) in the overall cohort and in both sexes. Height positively correlated with IM diameter, except at 153 mm distal the GT. Males had significantly larger IM diameters compared to females at all levels. Cortical thickness remained relatively consistent throughout the proximal humerus. A 70 mm stem length would extend past the TP in 98% of patients.

Conclusions: Humeral implants in reverse shoulder stem of at least 70 mm in length would reach past the transition point in the majority of cases regardless of sex. At this point, the canal's area is consistent in size and shape which would facilitate diaphyseal fixation.

OP.08.01

THE OUTCOME OF HUMERAL HEAD REPLACEMENT WITH GLENOID REAMING ARTHROPLASTY (REAM AND RUN) IS COMPARABLE TO ANATOMIC TOTAL SHOULDER ARTHROPLASTY

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Background: The purpose of this study was to compare the outcomes of Ream and Run to anatomic total shoulder in younger patients with advanced glenohumeral osteoarthritis.

Methods: This was a retrospective matched cohort study of 110 aTSA and 57 RNR patients, age <66 years, and minimum 2 year follow-up. Patients were matched with propensity scores. A sensitivity analysis using inverse probability weighting including all of the patients was performed.

Mixed effects models examined the association of preoperative variables with outcomes.

Results: 39 patient pairs were matched. All were male, with mean age 58.6±7.3 years and mean follow-up 4.4±2.3 years. Over 75 percent had B or C type glenoids. Patient reported outcome aTSA had better final SST and ASES scores. However, in the mixed effects model analysis arthroplasty type was not associated with outcome. There were no differences in absolute, change from baseline, and %MPI for any PROM and HRQoL score. At >5 year follow-up there were no significant differences in percent achieving Minimally Clinical Important Difference, Substantial Clinical Benefit or Patient Acceptable Symptomatic State for ASES, SST and VAS pain.

Satisfaction

4 (10.2%) patients were dissatisfied after RNR, and 3 (7.7%) were dissatisfied after aTSA. RNR was not significantly associated with final dissatisfaction (OR= 1.76, 95% CI 0.5-6.15, p=0.37). Of the entire cohort of 167 patients 22.9±50.8% were dissatisfied after aTSA compared to 9.4±44.7% after RNR (p=0.03).

Revision

In the propensity matched cohort 3 patients underwent revision for pain after RNR at a mean of 1.9±1.7 years and 2 patients underwent revision for glenoid loosening after aTSA at a mean of 11.6±3.4 years. In the cohort of 167 revision arthroplasty was performed in 5 (8.8%) RNR patients for pain at a mean of 2.7±2.1 and 7 (6.4%) aTSA patients for glenoid loosening at a mean of 10.4±3.2 years.

Conclusions: RNR and aTSA had comparable outcomes in most analyses. The greater early revision rate after RNR should focus attention on optimizing patient selection and post-operative management. Revision for glenoid loosening after aTSA is a concern among younger and active patients. Longer-term study is needed to better understand the relative benefits and disadvantages of these procedures.

OP.08.02

MINIMUM 10-YEAR RESULTS OF PYROCARBON INTERPOSITION SHOULDER ARTHROPLASTY (PISA)

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Background: The treatment of glenohumeral osteoarthritis in younger patients is challenging. Hemiarthroplasty is often favored, although high rates of symptomatic glenoid erosion and revision (up to 21% at 5 years follow up) have been reported. The ideal bearing surface has yet to be found. The objective of this study is to evaluate survival and long-term results of Pyrocarbon Interposition Shoulder Arthroplasty (PISA).

Methods: Between 2009 and 2012, 97 PISAs (InSpyre, Tornier-Wright, Blummington USA) were prospectively followed in a multicentric study; 12 patients died, and 19 patients were lost to follow-up, leaving 66 patients with a follow-up of more than 10 years. The mean age at surgery was 64 \pm 15 years. The etiology was primary osteoarthritis (n=26), fracture sequelae (type 1 n=20, type 4 n=2), post-instability arthritis (n=10), aseptic necrosis (n=2), inflammatory disease (n=2), and failed HA (n=4); 45 shoulders (59%) had undergone prior surgery. Glenoid erosion was assessed in 4 grades according to the Sperling Classification. Humeral erosion was also assessed in 4 grades. Multivariate analysis was utilized to determine predisposing risk factors using for both humeral and glenoid erosion.

Results: At a mean follow-up of 124 \pm 11 months, survival rate was 89%. Seven patients (11%) were revised to RSA: 4 for painful glenoid erosion and 3 for humeral erosion with greater tuberosity stress-fractures. The mean Constant Score and Subjective Shoulder Value (SSV) significantly increased from 39 \pm 14 to 70 \pm 14 points and 34 \pm 15% to 75 \pm 17%, respectively (p<0.001). In the primary OA, the revision rate was higher (p=0.043) as was glenoid wear (p=0.046). The best results were observed in Type-1 Fracture sequelae. On multivariate analysis, we did not find any risk factor for glenoid wear, whereas larger implant size was found to be a risk factor for humeral wear (OR=0.54, [0.38; 0.77], p<0.001).

Conclusions: The survival rate of PISA at 10 years is 89%. This pyrocarbon implant provides satisfactory functional results and can be a salvage treatment option in patients with shoulder arthritis and previous failed surgery. Large diameter implants are at higher risk of glenoid erosion.

OP.08.03

A RETROSPECTIVE COMPARATIVE STUDY FOR SHORT-TERM CLINICAL AND RADIOLOGIC OUTCOMES OF RSA USING SMALL BASEPLATE IN ASIAN POPULATION: DOES SIZE MISMATCH REALLY MATTER ?

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Background: It has been suggested that the size mismatch between small glenoid and large baseplate could cause negative effect on positioning and fixation of the baseplate. This study aimed to figure out the effects of this size mismatch by comparing the clinical and radiologic outcomes of reverse total arthroplasty (RSA) using large and small baseplate.

Methods: A retrospective data analysis of 48 RSAs using a 33.8-mm baseplate and 34 RSAs using 29.5-mm baseplate of Equinoxe reverse system (Exactech, Gainesville, FL, USA) between 2017 and 2021 was conducted. Anatomical measurement including glenoid size, TSA and RSA angle, radiologic outcomes including superior inclination, inferior overhang, central cage location within the vault were measured. Range of motion (ROM), American Shoulder and Elbow Surgeons (ASES) score, pain/function visual analog scale (PVAS, FVAS), Constant score were evaluated at preoperative and postoperative 1 year. Scapular notching was evaluated at postoperative 1 year.

Results: Clinical scores and ROM at postoperative 1 year were significantly improved in both groups. There was no significant difference in clinical outcomes between two groups except for the external rotation (Large $40.4 \pm 15.0^\circ$ vs. Small $32.7 \pm 14.0^\circ$, $p=0.027$). Mean glenoid height was 33.19 mm (SD: 2.74) and width was 25.3 mm (SD: 2.88). Baseplate inclination, inferior overhang and scapular notching did not show significant difference between two group ($p=0.542$, $p=0.076$, $p=0.237$, respectively). However, glenoid vault perforation was significantly frequent in large baseplate (43.7% vs. small 14.7%, $p=0.005$). In RSAs using large baseplate, size mismatch was occurred in 62.5% and negatively correlated with glenoid perforation ($p=0.079$). Glenoid vault perforation in large baseplate group was also significantly correlated with superior positioning of baseplate ($p=0.011$) followed by scapular notching ($p=0.008$). In RSAs using small baseplate, additional correction of superior inclination was needed ($3.42 \pm 2.97^\circ$) than RSAs using large baseplate.

Conclusions: RSA using large or small baseplate showed favorable clinical and radiologic short-term outcome. However, in patients with small glenoid, using large baseplate may cause size-mismatch which could negatively affect longevity and stability of RSA. We recommend to use size-matched baseplate and baseplate-specific measurement for appropriate position of baseplate.

OP.08.04

CLINICAL AND RADIOGRAPHIC OUTCOMES FOLLOWING PRIMARY REVERSE TOTAL SHOULDER ARTHROPLASTY WITH MINIMUM FOLLOW-UP OF 10 YEARS

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Background: Reverse total shoulder arthroplasty (RTSA) results in satisfactory outcome for a variety of indications. However, long-term clinical and radiographic data are still sparse. The purpose of this study was to report long-term clinical and radiographic outcome data following RTSA implantation.

Methods: All primary RTSAs from our prospectively followed, tertiary referral monocenter database were analyzed at a minimum follow-up of ten years. The clinical outcome analyzes included absolute and relative Constant-Murley score (CSa and CSr), Subjective Shoulder Value (SSV), complete range of motion, pain, complications and reintervention rate. The radiographic measurement included critical shoulder angle (CSA), distalization shoulder angle (DSA), lateralization shoulder angle (LSA), reverse shoulder angle (RSA), acromiohumeral distance (ACHD), center of rotation, glenoid height, as well as analysis of notching, radiolucent lines, heterotopic ossification, and tubercula resorption.

Results: A total of 135 RTSAs (133 patients) were available for analysis at a mean follow-up of 10.9 ± 1.6 years. The mean age was 69 ± 8 years with 76 female shoulders (76 patients, 56%). CSa (32 ± 14 to 64 ± 16), CSr ($40\% \pm 17\%$ to $79\% \pm 18\%$), SSV ($28\% \pm 18\%$ to $79\% \pm 21\%$), CS pain (7 ± 4 to 14 ± 3) as well as flexion ($77^\circ \pm 43^\circ$ to $117^\circ \pm 26^\circ$) and abduction ($69^\circ \pm 40^\circ$ to $125^\circ \pm 35^\circ$) improved comparing preoperative to long-term postoperative status. Interestingly, now further improvement was seen comparing short-term and long-term outcome for CSa, CSr and SSV, abduction and internal rotation. However, flexion and external rotation deteriorated over time, whereas pain improved. Radiographic analysis revealed only increase of notching and radiolucent lines over the course of the time. The other parameters did not change in the due course. Univariate regression analysis of all demographic and radiographic parameters revealed younger age, resorption of the tubercula, glenoid radiolucent lines as predictive for impaired outcome. The complication rate was 28%, the reintervention rate was 11%.

Conclusions: RTSA achieves very satisfactory outcome results without significant deterioration for most of the clinical parameters at long-term follow-up. Negative clinical outcome predictors were younger age, radiolucent lines around the glenoid and tubercula resorption.

OP.08.05

POSTOPERATIVE TIMEFRAMES FOR RECOVERY OF ACTIVITIES OF DAILY LIVING AFTER TOTAL SHOULDER ARTHROPLASTY

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Background: Patients' expectations are high for functional and prosthetic surgery. Literature is full of data on postoperative results in terms of mobility, pain, satisfaction. However, to our knowledge no study assessed the timeframe to regain one's activities of daily living. The purpose of this study is to investigate the recovery timeframe of different daily living activities after total shoulder arthroplasty.

Methods: For this international multicentric study, in 5 centers, we delivered in consultation since 01/01/2022 a form filled out by patients operated after the 01/01/2021 of a total shoulder arthroplasty. It consisted of questions on the date of recovery for 22 daily living activities. We also included a preoperative and different postoperative Subjective Shoulder Value (SSV) to evaluate the recovery kinematics.

Results: Preliminary results showed that 150 patients were included with 92 forms completed. 64 Women and 28 Men. For activities involving shoulder flexion, before 45 days, 40% of patients were already able to make a call, drink a cup of coffee, eat with a fork. However, when the range of motion exceeds 90°, the recovery time increases significantly. At 3 months postoperative, we notified, that more than 70% could: brush their hair, eat with a fork, drive. Almost 80% of patients were able to perform actions in the lower back such as putting their shirt in their pants or wiping themselves at the toilet. Notwithstanding, only 10% of patients were able to unfasten the bra in the back, with an average of almost 7 months. Recovery for activities with high demand, such as gardening, mowing, required a longer recovery time with 50% recovery at 5 months. At 3 months, we observed that patients already recovered an average SSV of 72%. After 6 months, 75% of the patients had a SSV over 80%. Data collection is still in progress to increase the statistical power of the study.

Conclusions: Our study produced relevant data for the patients to understand the timeframe of his postoperative progresses. These results will lead to create an information leaflet given to the patients before surgery so that the clinical results could be as close as possible to the patients' expectations.

OP.08.06

POROUS METAL WEDGE AUGMENTS TO ADDRESS GLENOID RETROVERSION IN PRIMARY ANATOMICAL TOTAL SHOULDER ARTHROPLASTY – AN UPDATE.

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Background: This paper presents an ongoing review of the use of a wedge-shaped porous metal augments in the shoulder to address glenoid retroversion as part of anatomical total shoulder arthroplasty (aTSA).

Methods: 75 shoulders in 66 patients (23 women and 43 men, aged 42 to 85 years) with Walch grade B2 or C glenoids underwent porous metal glenoid augment (PMGA) insertion as part of aTSA. Patients received either a 15° or 30° PMGA wedge (secured by screws to the native glenoid) to correct excessive glenoid retroversion before a standard glenoid component was implanted using bone cement. Neither patient-specific guides nor navigation were used. Patients were prospectively assessed using shoulder functional assessments (Oxford Shoulder Score [OSS], American Shoulder and Elbow Standardized Shoulder Assessment Form [ASES], visual analogue scale [VAS] pain scores and forward elevation [FE]) preoperatively, at three, six, and 12 months, and yearly thereafter, with similar radiological surveillance.

Results: 49 consecutive series shoulders had a follow-up of greater than 24 months, with a median follow-up of 48 months (range: 24–87 months). Median outcome scores improved for OSS (21 to 44), ASES (24 to 92), VAS (7 to 0), and FE (90° to 140°). Four patients died, but no others were lost to follow-up. Apart from one infection at 18 months postoperatively and one minor peg perforation, there were no complications, hardware failures, implant displacements, significant lucency or posterior re-subluxations. Radiographs showed good incorporation of the wedge augment with correction of glenoid retroversion from median 22° (13° to 46°) to 4°. All but four glenoids were corrected to within the target range (less than 10° retroversion).

Conclusions: The porous metal wedge-shaped augments effectively addressed posterior glenoid deficiency as part of aTSA for rotator cuff intact osteoarthritis, producing satisfactory clinical outcomes with no signs of impending future failure.

OP.08.07

IMPACT OF ADVANCED DIGITAL PLANNING AND PATIENT SPECIFIC INSTRUMENTATION ON PATIENT REPORTED OUTCOMES IN TOTAL SHOULDER ARTHROPLASTY

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Background: Shoulder arthroplasty is technically demanding and relies on accurate glenoid placement to achieve good functional outcomes and prevent implant failure. This remains a challenge due to difficult exposure, glenoid anatomy and bone loss. Studies have previously assessed accuracy of glenoid placement using patient specific instrumentation (PSI). However, this is the first study to assess effect on functional and patient derived outcomes.

The aim of the study was to assess the influence of advanced imaging and templating on clinical outcome in patients undergoing shoulder arthroplasty comparing Digital planning (DP), PSI or Conventional surgery (CS).

Methods: A pragmatic consecutive series utilising prospective data a single surgeon and institution from November 2005 to July 2018 (CS) and August 2018 to December 2021 (DP/PSI). Inclusion criteria: all patients undergoing primary stemmed RSA or TSA. One implant system was utilised for the procedures and all patients included. The CS cohort included 158 patients whereas the DP and PSI cohort had 33 and 22 patients respectively. Outcomes assessed were: Oxford shoulder score (OSS), ROM (flexion/abduction/ER) and revision. Scores were taken pre surgery and at 12 months post-surgery. There were comparable demographics across age, gender, ASA, BMI, and diagnosis.

Results: Each group showed excellent improvement in OSS at 12 months with no statistical or clinically significant difference between groups. Improvement from pre-op to 12 months post-op in OSS was statistically significant in CS (25.28), PSI (18.7) and DP (16.7). Improvement in ROM 12 months post-op was both statistically and clinically different to pre-op scores in each group. The CS group, however had lower abduction range than DP/PSI groups ($p < 0.05$). The only revisions to occur were in the CS cohort ($n=2$).

Conclusions: DP and PSI have been widely used in hip and knee replacement with limited evidence of positive effect on functional and patient derived outcomes. Shoulder arthroplasty has had slower uptake but potential for larger benefit due to difficulty in exposure, glenoid morphology or bone loss. Our study showed at 12 months there was no difference in functional and patient derived outcomes when using DP/PSI, but improvement in range of motion.

OP.08.08

IMPLANT UTILIZATION: A COMPARISON OF PREOPERATIVE PLANNING WITH AND WITHOUT COMPUTER ASSISTED NAVIGATION

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Background: Preoperative planning for anatomic and reverse total shoulder arthroplasty (aTSA and rTSA) is becoming increasingly common. While preoperative planning allows surgeons to determine individualized implant types, utilization of intraoperative navigation improves the accuracy of implant placement and may increase confidence in the preoperative plan. The purpose of this study was to evaluate and compare the rate at which surgeons utilize an implant different than their preoperative plan with and without the use of computer navigation.

Methods: A retrospective review of a multicenter prospectively-collected shoulder arthroplasty database was performed between 2016-2022. Inclusion criteria were primary aTSA or rTSA with an available preoperative plan and actual implant utilized. Change in implant was defined as a deviation in final implant from the preoperative plan in regard to backside shape (unaugmented vs augment or differing augment shape).

Results: We included 1,744 (462 aTSA, 1,282 rTSA) TSAs performed with preoperative planning and intraoperative navigation and 101 (33 aTSA, 68 rTSA) TSAs performed with preoperative planning alone. Overall, the final implant deviated from the preoperative plan less frequently when intraoperative navigation was used compared to preoperative planning alone (6.7%[n=116] vs. 13.9%[n=14], $P=0.014$; $OR=2.3$ [95%CI=1.1-4.1]). When stratified by procedure, deviation from the preoperative plan occurred significantly less for rTSA when preoperative planning was used with intraoperative navigation versus planning alone (6.9%[n=90] vs. 17.6%[n=13], $P=0.003$; $OR=2.9$ [95%CI=1.3-5.7]). There was no significant difference in plan deviation with and without intraoperative navigation for aTSA (5.8%[n=27] vs. 6.1%[n=2], $P=1$).

Conclusions: Use of intraoperative navigation is associated with increased adherence to the preoperative plan. It is possible that use of navigation increases surgeon confidence despite known limitations of glenoid visualization during this procedure. This may offer advantages in outpatient surgery centers and smaller hospitals where inventory space may be limited. Further studies are needed to examine the causes for intraoperative deviations.

OP.08.09

REVERSE SHOULDER ARTHROPLASTY WITHOUT REPAIRING THE SUBSCAPULARIS TENDON RESULTS IN SATISFACTORY FUNCTIONAL INTERNAL ROTATION

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Background: During reverse shoulder arthroplasty (RSA), the subscapularis muscle is most commonly detached. Most surgeons prefer to repair the subscapularis muscle, whereas some rather leave it detached. There are no large cohort studies investigating the functional internal rotation after RSA without subscapularis repair. Therefore, the aim of this study is to assess the functional internal rotation after RSA without subscapularis repair, using the Activities of Daily Living which require Internal Rotation (ADLIR) score.

Methods: All patients that underwent primary RSA without repair of the subscapularis between 2015 and 2020 were retrospectively included to ensure a minimum follow-up of 2 years. Included patients were contacted and requested to fill in a questionnaire. The following outcomes were collected: ADLIR, Activities of Daily Living which require Internal Rotation (ADLER), Subjective Shoulder Value (SSV), Auto-Constant, American Shoulder and Elbow Surgeons (ASES) and pain. The ADLIR score consists of nine questions on activities requiring internal rotation resulting in a score ranging from 15 (unable to perform any of the activities) to 100 (no difficulty in performing all activities).

Results: Of the 196 contacted patients, a total of 152 (77,5%) patients completed the questionnaire with a mean follow-up of 4,5 (range: 2,0-7,6) years. The mean age was 72,8 (standard deviation: 8,1). There were no revisions for dislocations or instability, 6,6% of all patients had revision surgery for other reasons at a median time of 7,0 months (interquartile range; IQR: 1,0-10,3). At final follow-up the median ADLIR score was 88,0 (IQR: 81,0-95,5), ADLER was 29,5 (IQR: 28,0-30,0), SSV was 85,0 (IQR: 80,0-95,0), Auto-Constant was 73,2 (IQR: 60,0-86,3), ASES was 90,0 (IQR: 75,0-96,7) and median pain was 3,3 (IQR: 0,0-20,0).

Conclusions: The median ADLIR score at a mean 4,5 years after RSA without subscapularis repair was 88,0, demonstrating satisfactory functional internal rotation. Furthermore, there were no revisions for dislocation or instability. These results suggest that the altered biomechanical functioning after reverse shoulder arthroplasty may render the subscapularis obsolete. However, future studies comparing the functional internal and external rotation in daily life between RSA with and without subscapularis repair are required to demonstrate functional superiority of one of the two techniques.

OP.08.10

HYDROGEN PEROXIDE APPLIED TO THE DERMIS FOLLOWING SKIN INCISION DECREASES DEEP CUTIBACTERIUM ACNES CONTAMINATION DURING SHOULDER ARTHROPLASTY; A RANDOMIZED CONTROLLED TRIAL

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Background: Despite all efforts to minimize risk, periprosthetic joint infections occur in 1-4% of primary total shoulder arthroplasties (TSAs). *Cutibacterium acnes* is the most implicated organism and has been shown to persist in the dermis despite use of preoperative antibiotics and standard skin preparation. Multiple studies have shown decreased *C. acnes* rates with the use of preoperative benzoyl peroxide or hydrogen peroxide (H₂O₂), but positive deep cultures are still common. We sought to determine if an additional application of H₂O₂ directly to the dermis following skin incision would further decrease deep culture positivity rates.

Methods: We performed a single-blinded, randomized controlled trial comparing rates of positive tissue cultures at the time of primary TSA in male patients with no prior shoulder surgery who received our standard skin preparation consisting of H₂O₂, ethanol, and ChlorPrep vs. an additional application of H₂O₂ to the dermis immediately after skin incision. Bivariable and multivariable analysis was performed comparing rates of positive cultures based on demographic and surgical factors.

Results: Positive *C. acnes* dermal cultures occurred at similar rates between experimental and control cohorts during the initial (22% vs. 28%, $P=0.500$) and final dermal swabs (61% vs. 50%, $P=0.843$). On bivariable analysis, the rate of positive deep cultures for *C. acnes* trended towards being lower in the experimental group (28% vs. 44%, $P=0.054$). Patients who underwent anatomic TSA had a significantly greater rate of positive *C. acnes* deep cultures (57% vs. 28%, $P=0.006$), however, and when controlling for this on multivariable analysis, the experimental cohort was found to be associated with a significantly lower odds of positive deep cultures (Odds Ratio=0.37, 95%CI=[0.16-0.90], $P=0.023$). There were no wound complications in either cohort.

Conclusions: An additional H₂O₂ application directly to the dermis following skin incision resulted in a statistically significant decrease in the odds of having deep cultures positive for *C. acnes* without obvious adverse effects on wound healing. Given the negligible added cost, this intervention may be considered as an adjuvant to preoperative use of BPO or H₂O₂ in revisions where accurate culture results will affect further treatment.

OP.08.11

REVERSED TOTAL SHOULDER ARTHROPLASTY FOR ROTATOR CUFF ARTHROPATHY RESTORES GLOBAL ELEVATION BUT NOT THE NORMAL SCAPULOHUMERAL RHYTHM: A KINEMATIC LONGITUDINAL 2 YEAR FOLLOW-UP STUDY

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Background: Reversed total shoulder arthroplasty (RTSA) is a standard surgical procedure to treat rotator cuff tear arthropathy (CTA). Nevertheless, little is known about the kinematics following this surgical procedure. Arm elevation in the scapular plane is a coordinated motion in the glenohumeral and scapulothoracic joints. The purpose of our study was to investigate if the normal scapulohumeral rhythm can be restored within two years postoperatively after RTSA for CTA.

Methods: In a prospective longitudinal kinematic study scapulohumeral rhythm was studied in 20 patients (22 shoulders) before and up to two years after the implantation of RTSA for CTA. The scapulohumeral rhythm of the patient cohort (10 females and 10 males, mean age 73 ± 6.2 yr.) was compared to the normal scapulohumeral rhythm of a reference group (20 young healthy volunteers, age 27 ± 6.2 yr.). We used the VICON three-dimensional motion analysis system with high-speed infrared cameras and skin markers. Glenohumeral (GH) and scapulothoracic kinematics were studied using the Upper Limb Evaluation in the Movement Analysis (ULEMA) model. Data analysis (double normalization) and statistics were performed with Matlab and R.

Results: The average arm elevation was 89° ($SD \pm 33^\circ$) preoperatively, 135° ($SD \pm 28^\circ$) at 3 months, 161° ($\pm 20^\circ$) at 6 months, 169° ($\pm 18^\circ$) at 12 months and 165° ($\pm 19^\circ$) at 24 months. Postoperatively the scapulohumeral rhythm remains also 3-phasic: predominantly GH motion up to approximately 50° of arm elevation, predominantly lateral scapula rotation up to approximately 105° , followed by predominantly GH motion. Parametric mapping revealed that the postoperative scapulohumeral rhythm remains different between the two groups between 38° and 72° of arm elevation.

Conclusions: This study shows that the normal scapulohumeral rhythm is not restored after RTSA for CTA. In the midrange of motion the scapulothoracic segment contributes more to arm elevation than the glenohumeral segment. This increased scapulothoracic engagement should be included in the modern computer planning of RTSA.

OP.08.12

REVERSE SHOULDER ARTHROPLASTY WITH A MODULAR SEGMENTAL METALLIC "TUMOR" PROSTHESIS FOR SEVERE PROXIMAL HUMERUS BONE LOSS

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Background: Shoulder arthroplasty in the setting of severe proximal humerus bone loss can be challenging. Reconstructive options include conical fluted prosthesis, allograft prosthetic composites (APC), and modular segmental metallic ('tumor') prostheses. Modular segmental metallic prostheses provide a very attractive, versatile solution. The purpose of this study was to evaluate the outcomes of one particular modular segmental prosthesis when implanted in a reverse configuration for complex primary or revision shoulder arthroplasty and for reconstruction at the time of oncologic resection.

Methods: Our Joint Registry Database was queried to identify all shoulder arthroplasties performed at a single institution using the Skeletal Reconstruction System reverse shoulder arthroplasty (SRS-RSA, Zimmer Biomet, Warsaw, IN, USA). A retrospective review of electronic medical records and radiographs was performed to record indication for the procedure, outcomes, complications, and reoperations. Between 2012 and 2021, 76 consecutive SRS-RSA had been implanted. 48 patients were female, and mean cohort age was 65.6 years. Indications included failed shoulder arthroplasty (30), tumor resection (29), sequela of proximal humerus trauma (12), catastrophic humeral bone loss secondary to failed TEA (2), failed APC (2), and cuff tear arthropathy with severe proximal humerus bone loss (1).

Results: Complications occurred in 25 shoulders (33%), including dislocation (9), humeral loosening (8), periprosthetic joint infection (4), periprosthetic humeral fracture (3), glenoid loosening (2), and acromial stress fracture (1). Most complications (22/27) occurred in the first 2 years after surgery. 10 shoulders (13%) required reoperation within the first two years and 5 experienced a complication requiring reoperation after two years, for an overall reoperation rate of 20%. Of the 51 shoulders without complications, 26 had died or were lost to follow-up within the first two years. For shoulders with no reoperations, at most recent follow up VAS pain score was 1.6, mean active elevation was 98, and mean external rotation was 30.

Conclusions: Reverse shoulder arthroplasty using modular segmental metallic ('tumor') prostheses remain a reliable salvage option for proximal humeral bone loss reconstruction. Due to the substantial bone loss and soft tissue deficiencies present in these patients, surgeons should educate patients on their relatively high complication rate.

OP.09.01

SHOULD WE KEEP THE BICEPS ALIVE IN STAGE 1 SUPRA-SPINATUS TEARS ?

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Background: The long head of the biceps tendon (LHBT) is a common cause of pain with rotator cuff tears and a source of residual pain following tendon repair for which systematic tenotomy of the LHBT, with or without tenodesis, was recommended. However, recent literature suggests comparable long-term functional outcomes with normal biceps left-in-place during supraspinatus tendon repair versus tenotomy. The objective of this study is to test the hypothesis that conserving the LHBT with a normal aspect might be clinically better when repairing an isolated stage-1 supraspinatus tendon rupture.

Methods: A nation-wide clinical prospective randomized, single-blind study, enrolled 218 participants comparing two parallel groups, undergoing an arthroscopic repair for stage-1 supraspinatus tear with a normal LHBT, who were randomly subjected to either LHBT preservation (group A) or sectioning (group B). The primary outcome measure was the Constant-Murley score, while the ASES score, SSV score, biceps clinical assessment, visual analog scale score, evaluation of the healing rate of cuff repair and preserved LHBT on ultrasound, and evaluation of failure factors of cuff repair represented secondary outcome measures.

Results: Currently the study is ongoing. The revision rate at 2-years follow-up is 88%. On 189 patients reviewed, 92 had a tenotomy/tenodesis while 97 had a LHBT conservation. Based on the preliminary results, there wasn't any significant difference for the Constant-Murley score: 86.8 points Vs 83.9 points respectively ($p=0.052$). There were significant higher SSV and ASES scores in the group of tenotomy/tenodesis (94.5 Vs 90.7 ($p=0.02$) and 91.2 Vs 82 ($p=0.007$)).

Conclusions: This abstract shows preliminary data and would be finished prior to the September event.

OP.09.02

EFFECTIVENESS OF "SPLINTING" THE PATHOLOGIC BICEPS WITH SLAP LESIONS TO PREVENT RETEAR AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR

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Background: Biceps rerouting is an effective technique for reducing the re-tear rate after arthroscopic rotator cuff repair. However, the pathology of the long head of the biceps tendon (LHBT), including the superior labrum anterior to posterior (SLAP) lesion, is common with full-thickness rotator cuff tears (FTRCTs). Therefore, it is important to determine whether to remove or utilize these pathologic LHBT as a "splint".

Methods: This retrospective, historical cohort study was conducted on 73 patients who underwent arthroscopic repair of an FTRCT with an accompanying pathology of the LHBT or a type II SLAP lesion or both. Thirty-eight patients were treated with concomitant subpectoral tenodesis (SPT), while 35 patients underwent "biceps splinting" (BSP) without SLAP or LHBT repair. The patients were evaluated by magnetic resonance imaging (MRI) and clinical outcome, including muscle degeneration, acromiohumeral distance, Sugaya classification, pain visual analogue scale, American Shoulder and Elbow Surgeons score, Constant-Murley score, motor power in internal/external rotation and forward flexion at least 12 months postoperatively. In addition, subgroup analysis was performed on postoperative LHBT continuity as evaluated in one-year MRI within the BSP group.

Results: Other than the age at time of surgery (SPT vs. BSP: 61.1 years vs. 64.7 years, $P=0.019$), baseline preoperative data were similar in the SPT and BSP groups. Although postoperative clinical scores and muscle power were not significantly different, the BSP group had a significantly lower re-tear rate (SPT vs. BSP: 31.6% vs. 8.6%, $P=0.020$) and a higher percent increase in acromiohumeral distance (SPT vs. BSP: 113.1% vs. 128.0%, $P=0.035$). Within the BSP group, outcomes were comparable regardless of the continuity of the splinted LHBT as confirmed in one-year postoperative MRI. No Popeye deformity was noted in any of the patients.

Conclusions: Even with a pathologic LHBT complex, augmenting the rotator cuff repair by BSP significantly reduced re-tear rates and produced clinical scores comparable to SPT. Loss of LHBT continuity after BSP did not significantly influence outcomes.

OP.09.03

FUNCTIONAL AND STRUCTURAL OUTCOMES OF DOUBLE LAYERED REPAIR WITH LASSO LOOP AND SUTURE BRIDGE TECHNIQUE (TRIPLE ROW REPAIR) FOR DELAMINATED ROTATOR CUFF TEARS

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Background: The delaminated rotator cuff tear(RCT) is considered as a negative prognostic factor for tendon healing. The purpose of this study was to evaluate the functional and clinical outcomes of double layered repair with lasso loop and suture bridge technique(triple row repair) for delaminated RCT.

Methods: The study included 324 patients who underwent triple row repair for laminated RCT with a follow-up visit for more than 2 years. There was small-(27), medium-(199), large-(67), and massive-sized tear group(31) divided by the DeOrio and Cofield classification. The surgical outcomes were evaluated with the preoperative and postoperative clinical and functional scores. Repair integrity was assessed with MRI(mean 25.6 months, range 6-39 months) and divided by Sugaya's, Cho's, and novel classification (type I: no discontinuity of inner and outer layer, type II: discontinuity of outer layer, type III: discontinuity of inner layer, and Type IV: discontinuity of inner and outer layer).

Results: Statistically significant improvement was found in the VAS score(6.9 to 0.6, $p < 0.001$), ASES(42.4 to 94.6, $p < 0.001$), UCLA score(14.7 to 32.2, $p < 0.001$), and Constant score(42.6 to 92.1, $p < 0.001$). Repair integrity with Sugaya's classification was as follows; small tear(I,19; II,7; III,0; IV,1; V,0), medium tear(I,89; II,102; III,3; IV,5; V,0), large tear(I,21; II,39; III,4; IV,3; V,0), and massive tear(I,3; II,21; III,3; IV,3; V,1). In Cho's classification, all the retear cases were type I. Repair integrity with novel classification was as follows; small tear(I,26; II,0; III,1; IV,0), medium tear(I,194; II,2; III,2; IV,1) large tear(I,64; II,2; III,1; IV,0), and massive tear(I,27; II,1; III,1; IV,2).

Conclusions: The overall retear rate of the triple row repair was 4.01%(13/324). When a retear occurred in the triple row repair, it had a tendency that either one of outer or inner layer(10/13) was torn rather than both layers(3/13). Also, there was a low rate(0.30%, 1/324) of major discontinuity in the retear of triple row repair. Additionally, the triple row repair can be considered to have low medial row stress because type II tear in Cho's classification was not found. Triple row repair for delaminated RCT can be one of the optimal surgical options with low retear rates and good clinical outcomes.

OP.09.04

COST EFFECTIVENESS ANALYSIS BASED ON CONSTRUCT, TEAR SIZE, AND IMPLANT COST FOR ROTATOR CUFF REPAIR AT 1, 5 AND 10 YEARS

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Background: Techniques for arthroscopic rotator cuff repair continue to improve, and there is increasing interest in cost effectiveness of different implants and constructs. No cost effectiveness study to date has evaluated specific suture anchors and constructs for short- and long-term cost effectiveness.

Methods: Real-world cost data from a high-volume institution and previously published data on both anchor failure strengths and estimated retear rates were input into a Markov model with time points of one, five, and ten years. Estimated retear rates were calculated using a combination of construct, anchor pullout strength, and initial tear size. Cost effectiveness was assessed in terms of societal cost per quality adjusted life year. Health states included intact repair, asymptomatic or symptomatic retear, revision RCR, and cuff tear arthropathy. Knotted and knotless single row (SR) and double row (DR) constructs using anchors from Smith & Nephew, Arthrex, and Stryker were included. The incremental cost effectiveness ratio (ICER) was calculated with a willingness to pay threshold of USD \$50,000/QALY. One-way deterministic and probabilistic sensitivity analyses were conducted.

Results: For small tears, the optimal 10-year strategy was Arthrex SR knotless, which had an ICER of \$11,869/QALY over nonoperative treatment while adding 0.54 QALY. For medium tears, the optimal strategy was Arthrex DR knotted, which had an ICER of \$16,678/QALY and added 0.51 QALY. For large and massive tears, DR knotless strategies from all three manufacturers were preferred and were all similar in cost while providing equivalent effectiveness. These added up to 0.53 QALY (large) and 0.46 QALY (massive) over nonoperative treatment. No operative treatment was cost effective at one year, but at ten years operative treatment was cost effective across all tear sizes. Constructs that provided the lowest chance of retear were the most cost effective at ten years. The use of stronger anchors and double row constructs, although initially more expensive, provided a societal cost savings in the long run by preventing revision surgery and development of cuff tear arthropathy.

Conclusions: Surgeons and healthcare providers may use the results of this study to help with anchor and construct selection when performing arthroscopic rotator cuff repairs for optimum value based care.

OP.09.05

TIME TO ACHIEVEMENT OF CLINICALLY SIGNIFICANT OUTCOMES FOLLOWING REVISION ROTATOR CUFF REPAIR

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Background: To comprehensively define the time required to achieve outcomes (CSOs) after revision rotator cuff repair (RCR). The primary outcome was to identify an evidence-based timepoint for functional recovery, including the time needed to attain minimally clinically important difference (MCID), patient acceptable symptomatic state (PASS), and SCB for revision RCR.

Methods: Patients who underwent rotator cuff repair between 2016 and 2022 were collected. Those with completed preoperative and at least 1 post-operative (3-month, 6-month, 1 year, and 2 years) Patient-Reported Outcome Measures (PROMs), including American Shoulder and Elbow Surgeons (ASES), or Single Assessment Numeric Evaluation (SANE) were included. Exclusion criteria included patients with significant concomitant procedures, or primary rotator cuff repairs. MCID, PASS, and SCB for each PROM were identified from prior literature and utilized as a threshold needed to attain functional recovery. The time needed to achieve CSO was then calculated and plotted using Kaplan-Meier survival analysis.

Results: The average patient was 58.8 years old, male (66%), and white (72%). Of the 99 included patients, 48 patients had completed SANE forms, and 52 had completed ASES forms. Patients attained SANE achievement rates of 68.8% for MCID and 35.5% for PASS, and ASES achievement rates of 75% for MCID and 38.5% for PASS. Median achievement time across both surveys ranged between 4.3 – 5.01 months for MCID, and between 5.01 – 5.72 months for PASS. Averages for achievement time for MCID ranged from 5.2 – 5.6 months, and for PASS from 6.3-9.2 months, in respective PRO surveys.

Conclusions: When comparing the mean time to CSO of revision RCR to primary RCR in previously published literature, the results are not only similar, but illustrate a slightly earlier time to CSO in revision cases. However, the overall percentage of MCID and PASS attainment are significantly reduced. This can potentially inform clinicians, that while a lower percentage of the revision cases will attain clinically significant outcomes compared to primary patients, those who do attain CSO will have a similar post-operative course. The timeline for achieving improvement that was established by this study may aid in setting patient expectations and designing future outcome studies involving revision RCR.

OP.09.07

ANTERIOR CAPSULAR RECONSTRUCTION IN IRREPARABLE SUBSCAPULARIS TEAR: HUMAN DERMAL ALLOGRAFT

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Background: The irreparable subscapularis (SSc) tears pose an extremely difficult situation to manage, especially in younger population. The anterior capsular reconstruction (ACR) with human dermal allograft (HDA) is an alternative to tendon transfer with sound biomechanical advantages and clinical outcomes.

Methods: Eighteen patients, who had the open ACR with HDA for irreparable SSc tears between August 2020 to February 2022 were enrolled. There were 11 males and 7 females with average age of 63.7 years and mean follow up of 17 months. Ten of them had the SSc torn on their dominant side. One of 18 had reconstruction with single layer HDA, 14 had double layer and 3 had the SSc augmentation over the double layer HDA. Clinical and radiological outcomes were assessed and compared pre- and post-operatively.

Results: There was significant improvement in VAS score from 6.64 ± 1.60 to 1.57 ± 1.45 ($p=0.0005$) and in the total UCLA score from 12.36 ± 4.29 to 29 ± 4.52 ($p=0.0005$). The forward flexion, abduction and internal rotation increased by 28.57, 32.5 and 11.79, respectively ($p<0.0001$). The external rotation decreased by 6.43 ($p=0.02$). There was notable improvement in IR strength (percentage of that of opposite normal side) from $65.95 \pm 19.36\%$ to $84.39 \pm 22.34\%$ ($p=0.008$). The mean post-operative, coraco-humeral distance improved from 3.03 to 6.03 mm ($p<0.0001$), the anterior translation of humeral head reduced from 1.45 to 0.45 mm ($p=0.21$) and the acromio-humeral interval from 8.12 to 8.83 mm ($p=0.07$). The patients' satisfaction at the final follow up was 4.07 of 5 ($p=0.0005$). Sixteen of 18 (88.9%) had the HDA healed at glenoid and humeral side, 2 (11.1%) had re-tear at the final follow up. Among the 17, who had double layer HDA, none showed any healing between the layers

Conclusions: This study showed that the significant and comprehensive improvement inclusive of pain relief, improvement in range of motion, internal rotation strength and reduction of antero-superior translation was achievable by the open ACR with HDA for irreparable SSc tear.

OP.09.08

ARTHROSCOPIC BICEPS TENODESIS: INLAY OR ONLAY?

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Background: Literature on studies comparing arthroscopic biceps tenodesis (ABT) with an inlay or onlay technique is limited. It was aimed to evaluate the effectiveness of ABT performed in the groove (inlay) or on the groove (onlay).

Methods: Between 2015-2021, treatment outcomes of 54 patients who underwent inlay or onlay ABT were evaluated retrospectively. Age, follow-up period, gender, side, accompanying shoulder problems, preoperative and postoperative range of motion and functional scores (VAS and Constant), cramping complaints, and complications were recorded. 28 patients (6 Female/22 Male, 13 Left/15 Right, 18 degenerated biceps/10 SLAP lesions) who underwent inlay ABT (Group 1) and 26 patients (3 Female/23 Male, 7 Left/19 Right, 18 degenerate biceps/8 SLAP lesions) who underwent onlay ABT (Group 2) were included. The significance level was accepted as 0.05. SPSS 26.0.0.0 MacOS was used as statistical software.

Results: Mean age of the patients was 48.81 (range: 35-67) years in Group 1 and 48.52 (range: 14-81) years in Group 2 ($p > 0.05$). Mean follow-up period was 58.24 (range: 12-82) months in Group 1 and 60.13 (range: 12-73) months in Group 2 ($p > 0.05$). In Group 1, mean preoperative VAS score was 6.09 ± 1.92 and mean Constant score was 59.56 ± 18.19 , while postoperative mean VAS score was 0.21 ± 0.45 and mean Constant score was 92.73 ± 8.23 (respectively; $p < 0.01$, $p < 0.01$). In Group 2, mean preoperative VAS score was 5.6 ± 1.14 and mean Constant score was 69.75 ± 6.75 , while postoperative mean VAS score was 0.18 ± 0.37 and mean Constant score was 95.47 ± 5.12 (respectively; $p < 0.01$, $p < 0.01$). Mean recovery time was 12.32 ± 4.8 weeks in Group 1, and 8.36 ± 3.72 weeks in Group 2 ($p = 0.04$). While a complaint of cramps was present in 21.42% of the patients in Group 1, it was 7.69% in Group 2 ($p < 0.01$). In Group 1, one patient was treated surgically due to a screw pulling out, while two patients who had popeye signs were followed conservatively. Aspiration was required 4 times due to recurrent hematoma for one patient. In Group 2, one patient with a popeye sign was followed up conservatively.

Conclusions: This study demonstrates that inlay ABT and onlay ABT are effective treatment modalities in the treatment of biceps degeneration and SLAP lesions. However, onlay ABT, which has a shorter recovery time and less complication rate, seems to be more advantageous.

OP.09.09

EVALUATION OF SURVIVORSHIP OF ASYMPTOMATIC DEGENERATIVE ROTATOR CUFF TEARS IN PATIENTS 65 YEARS AND YOUNGER: A PROSPECTIVE ANALYSIS WITH LONG-TERM FOLLOW UP

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Background: The purpose of this prospective study is to describe the mid to long-term natural history of untreated asymptomatic degenerative rotator cuff tears in patients 65 years and younger.

Methods: Subjects with an asymptomatic rotator cuff tear in one shoulder and a contralateral painful cuff tear age 65 years or younger were enrolled in a prospective longitudinal study. Annual physical and ultrasonographic evaluations and surveillance for pain development were performed utilizing independent examiners. Two hundred twenty-nine subjects (mean age 57.1 years) were followed for a median of 7.1 (range 0.3-13.1) years.

Results: Tear enlargement occurred in 138 (60%) shoulders. Full-thickness tears were at greater risk for enlargement compared to partial-thickness (HR=2.93, 95%CI 1.71-5.03, $p<0.0001$) and controls. (HR=18.8, 95%CI 4.63-76.1, $p<0.0001$). Mean survival rates indicate that full-thickness tears enlarged earlier (mean 4.7, 95%CI 4.1-5.2 years) than partial-thickness (mean 7.4, 95%CI 6.2-8.5 years) and control shoulders (mean 9.7, 95%CI 9.0-10.4 years). Patient age ($p=0.37$) and gender ($p=0.74$) were not associated with tear enlargement. The 2,5 and 8-year survivorship free of tear enlargement for full-thickness tears was 74%, 42% and 20%, respectively. Shoulder pain developed in 131 (57%) shoulders. Pain development was associated with tear enlargement (HR=1.79, 95%CI 1.24-2.58, $p=0.002$) and was more common in full-thickness tears compared to controls ($p=0.0003$) and partial tears ($p=0.01$).

Analysis of muscle degeneration was performed 138 shoulders with full-thickness tears. Progression of muscle fatty degeneration was seen in the supraspinatus in 46 (33%) and the infraspinatus in 40 (29%) shoulders. Both the presence of fatty muscle degeneration and the progression of muscle changes for both the supraspinatus ($p<0.0001$) and infraspinatus ($p<0.0001$) muscles were associated with tear size. For both the supraspinatus ($p=0.03$) and infraspinatus ($p=0.03$) muscles, tear enlargement was significantly associated with progression of muscle fatty degeneration. Anterior cable integrity was significantly associated with the risk of muscle degeneration progression for both the supraspinatus ($p<0.0001$) and the infraspinatus ($p=0.005$) muscles.

Conclusions: Asymptomatic degenerative rotator cuff tears progress in patient 65 years and younger. Full-thickness rotator cuff tears have a higher risk of continued tear enlargement, progression of fatty muscle degeneration and pain development than partial-thickness tears.

OP.09.10

COMPARISON OF ANTERIOR CABLE RECONSTRUCTION USING THE PROXIMAL BICEPS TENDON AND PATCH AUGMENTATION USING ACELLULAR DERMAL MATRIX IN LARGE RETRACTED ANTERIOR ROTATOR CUFF TEARS

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Background: The purpose of this study is to compare the clinical outcomes and tendon integrity of anterior cable reconstruction using the proximal biceps tendon and partial repair combined with patch augmentation using acellular dermal matrix in large retracted anterior rotator cuff tear where complete coverage of the footprint is not possible.

Methods: This retrospective study included 92 patients who underwent arthroscopic rotator cuff repair with anterior cable reconstruction using the proximal biceps tendon (ACR group; n=55) or patch augmentation using an acellular dermal matrix (PA group; n=37) for large retracted anterior L-shaped rotator cuff tears. Additional procedures were decided during arthroscopic procedure when retracted supraspinatus tendon could not cover the footprint completely. Clinical outcomes were assessed using visual analogue scale for pain, American Shoulder and Elbow Surgeons score, Constant score, satisfaction score and active range of motion during the follow-up period. Tendon integrity was evaluated by MRI at 6 months postoperatively.

Results: Preoperative rotator cuff tear size showed no differences in both groups. (medial to lateral direction: ACR group 30.1 ± 5.1 mm vs PA group 29.2 ± 3.8 mm, $P = .367$, and anterior to posterior directional: ACR group 23.3 ± 5.5 mm vs PA group 21.9 ± 5.1 mm, $p = .225$). The mean ASES and Constant scores significantly improved from 68.8 ± 15.2 and 58.4 ± 16.7 preoperatively to 91.4 ± 6.2 and 87.8 ± 5.9 at final follow-up in ACR group ($P < .001$) and from 69.7 ± 16.5 and 57.9 ± 15.2 preoperatively to 93.1 ± 6.5 and 88.3 ± 6.1 at final follow-up in PA group ($P < .001$). Active ROM was increased continuously during the follow-up period in both groups ($P < .001$). There were no significant differences between the two groups in clinical outcomes. As for tendon integrity, 9 out of 55 patients (16.3%) re-teared in ACR group and in PA group, 3 out of 37 patients (8.1%) re-teared ($p = .225$).

Conclusions: In large retracted anterior rotator cuff tears, both anterior cable reconstruction using the proximal biceps tendon and partial repair combined with patch augmentation using an acellular dermal matrix provided satisfactory clinical and radiological outcomes. Both surgical techniques could be viable option for the patients with large retracted anterior rotator cuff tear.

OP.09.11

ARTHROSCOPIC REPAIR BENEFITS ROTATOR CUFF TEARS PATIENTS OLDER THAN 65 YEARS WITH A HISTORY OF TRAUMATIC EVENTS

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Background: Rotator cuff tears (RCTs) are a common cause of shoulder pain and dysfunction in older patients. The beneficial effect of ARCR on different durations of symptom of RCT patients older than 65 years with a history of traumatic events needs to be clarified. This study is to evaluate the clinical outcomes of a two two-year year follow follow-up of arthroscopic rotator cuff repair (ARCR) in patients older than 65 years with a history of traumatic events after separately dividing the patients into each symptom duration (<3, 3-6, and >6 months from injury to surgery) groups and to compared the Patient Reported Outcomes (PROs) among the three groups.

Methods: Between 2015 and 2020, 110 patients who met inclusion criteria were enrolled in this study, which and were divided into three groups according to symptom duration (<3, 3-6, and >6 months). Preoperative and 2-year postoperative clinical outcomes were compared, which including American Shoulder and Elbow Surgeons score (ASES), Constant-Murley score (CMS), University of California, Los Angeles score (UCLA), simple shoulder test score (SST), visual analog scale (VAS), forward elevation (FE), external rotation (ER), and internal rotation (IR). The Minimal Clinically Important Difference (MCID), Patient Acceptable Symptom State (PASS), Substantial Clinical Benefit (SCB), and Maximum Outcome Improvement (MOI) were also used to compared among the groups.

Results: The ASES, as the primary outcome, improved significantly from 41.0 ± 18.5 to 85.4 ± 8.1 in group Group A, from 53.7 ± 14.3 to 86.3 ± 11.7 in group Group B and from 49.7 ± 18.5 to 83.9 ± 11.9 in group Group C. The Others parameters were all demonstrated statistically significant improvements at 2 2-years follow follow-up in each group (all $P < 0.05$). There was no significant difference among the three groups in each parameters except VAS, which didn't achieve MCID. Overall, 86 (78.2%) patients exceeded MCID, 87 (79.1%) patients achieved PASS, 77 (70.0%) patients achieved SCB and 62 (56.4%) patients achieved MOI without significant differences among the three groups.

Conclusions: In RCT patients older than 65 years with a history of traumatic events, ARCR significantly improves clinical outcomes at the two- years follow- up, regardless of symptom duration if the tear is fully repairable.

OP.09.12

THE INFLUENCE OF WORKER'S COMPENSATION STATUS ON THE OUTCOMES OF ROTATOR CUFF REPAIR: A SYSTEMATIC REVIEW.

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Background: Although there is a lot of evidence on the results of surgical treatment of the rotator cuff tears (RC), the influence of workers' compensation claims on the results of surgery is still unclear.

Objective: to evaluate the influence of work compensation on the results of rotator cuff repair (RCR) having as a primary outcome the return-to-work rate after one year.

Methods: A systematic review of prospective studies comparing RCR results in patients with and without workers' compensation.

Results: Seven prospective studies were included, with a total of 897 patients, 253 with work compensation claims. Patients with compensation were more likely to not return to work one year after RCR when compared to patients without compensation. Postoperative pain measured by the visual analogue scale was higher in patients with compensation, however, the result did not reach minimal clinically important difference (MCID). The functional result evaluated by the SST was lower in patients with labor compensation, but, on average, it did not reach the MCID. There was no difference in the functional outcome assessed by the ASES score between the groups.

Conclusions: The presence of work compensation had a negative influence on return to work rates in patients undergoing RCR one year after the procedure. Patients with work compensation demonstrated greater pain in the one-year postoperative period of the RCR, however, without clinical significance. Patients with work compensation had lower functional results measured by the SST score one year after RCR, however, without clinical significance. There was no functional difference measured by the ASES score in the same period.

OP09.06

ARTHROSCOPIC CONCOMITANT PANCAPSULAR RELEASE IN ROTATOR CUFF REPAIR; IS IT NECESSARY?

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Background: To compare the clinical results between patients who had anterior capsular release and expansion to the posterior capsule (pan-capsular) release during RC repair of rotator cuff tears with adhesive capsulitis.

Methods: From August 2018 to December 2019, a total of 58 consecutive shoulders were included. All patients had either full-thickness or high-grade (>50%) RC tears. Patients were randomized into 2 groups: Anterior capsule release (ACR) and pancapsule release PCR with rotator cuff repair (RCR). An evaluation was performed preoperatively, at 6 months postoperatively, and at a final follow-up a minimum of 24 months postoperatively using the American Shoulder and Elbow Surgeons (ASES) score, range of motion examination, and pain visual analog scale (VAS).

Results: After simple randomization, 27 shoulders were allocated to the ACR+RCR group, and 31 were placed in the PCR+RCR group. Four shoulders in the ACR+RCR group and three in the PCR+RCR group were excluded from the analysis due to loss of follow-up. Therefore, the evaluation was performed for 23 shoulders in the ACR+RCR group and 28 shoulders in the isolated RCR group. The mean follow-up period was 32.7 months in the ACR+RCR group and 29.0 months in the PCR+RCR group. There were no differences in age, sex, symptom duration, RC tear size, or preoperative ASES, and VAS scores between the 2 groups ($P > .05$). At the final follow-up, the ASES, ROM, and VAS scores were significantly improved in both groups ($P < .001$). There were no differences in ASES, ROM, and VAS scores between the 2 groups at the final follow-up ($P > .05$), and there was no difference in retear rate (7 in the DCR+RCR group and 5 in the isolated RCR group) between the 2 groups ($P > .05$). However, postoperative ROM was significant inferior at 6 months postoperatively ($P < 0.05$).

Conclusions: There was no difference in the clinical evaluations between the combined arthroscopic ACR and RCR group and the PCR and RCR group at a minimum 24-month follow-up. There might be an advantageous effect on rapid recovery in a range of motion after rotator cuff repair.

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DYNAMIC VIDEO-RASTER-STEREOGRAPHY ENHANCES DETECTION OF DYSKINETIC PATTERNS DURING SHOULDER MOVEMENTS

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Background: Scapular dyskinesis is defined by an observable asymmetry in the normal scapular position at rest as well as the altered patterns of scapular motion in relation to the thoracic cage. Outside research settings, visual observation at rest and during active elevation in the plane of the scapula are the most commonly used methods, which base on an indirect and intuitive observation of muscle activation patterns have a limited inter- and intra-observer reliability. This study aims at evaluating the diagnostic performance of a dynamic raster-stereography assisted visual observation in detecting dyskinetic patterns.

Methods: Subjects with undisturbed full range of motion of the shoulder were included in this prospective study. Each subject performed a repetition of three cycles of shoulder abduction/adduction in the scapular plane and shoulder forward flexion/extension without additional weights. Video-raster-stereography was used to model the surface of the trunk. The quality of the videos was assessed in terms of visualisation of relevant anatomical landmarks and overall assessment of scapular movements on a Likert scale. Conventional videos were compared with raster-stereography-augmented videos to assess diagnostic performance in terms of recognition of dyskinetic patterns (static asymmetries, dynamic asymmetries, movement delays, fast compensatory movements).

Results: 129 videos were evaluated (conventional: 63; raster-stereography-augmented videos: 66). The quality of the raster-stereography-augmented videos was significantly superior to the quality of the conventional ones both in terms of visualisation of relevant anatomical landmarks and overall assessment of scapular movements ($p=0.0017$ and $p=0.0146$). The detection of dynamic asymmetries and movement delays was significantly superior in raster-stereography-augmented videos ($p = 0.0001$ and $p = 0.0024$). No significant differences between the two techniques were detected when assessing the presence of static asymmetries and fast compensatory movements ($p : n.s.$).

Conclusions: Video-raster-stereography can be used to create a dynamic model of the surface of the trunk which enables a superior detection of dyskinetic patterns during shoulder abduction/adduction in the scapular plane and shoulder forward flexion/extension. This digital technology appears to be a promising tool to improve the evaluation of scapular kinematics and scapular dyskinesis both in the clinical and in the research setting.

IFP.01.02

PROPRIOCEPTION AFTER ARTHROSCOPIC LATARJET PROCEDURE

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Background: Bone stabilization of the shoulder using the arthroscopic Latarjet technique has been known since 2007. During our arthroscopic surgical procedures, we do not reinsert the capsule or the labrum.

In this study, we want to evaluate in an innovative and objective way the postoperative state of the patient by analyzing the proprioception of the shoulder and to show that the operated shoulder does not present inferior results to the healthy side.

Methods: We performed a retrospective single-center study from 2018 to 2022 including 58 arthroscopic Latarjet, performed by 1 senior surgeon, using 1 technique. Proprioception, the awareness of position and movement of a limb in space, was assessed on the healthy side and the operated side. This was studied at 4.5 months postoperatively. After fixing a laser on the patient's index finger, a mark was made on a target, once visualized and aimed by the laser pointer, the patient put the arm along the and then his vision was occluded. He then had to find the mark. A result ranging from 0-4 cm of error was considered excellent, 4.8 cm good, 8-16cm normal, greater than 16cm as bad. This was assessed vertically and horizontally.

Results: We had 100% arthroscopic Latarjet, an average age of 28.9 years 75% male, 45.8% right side, 73% operated on the dominant side.

After a one side analysis of the results of vertical and horizontal proprioception comparing the healthy side and the operated side showed that there was no significant difference between the two groups ($p=1$) with good and excellent results in more than 80% of cases in both groups. Thus, we performed a two-sided test showing that the results on the operated side were even superior to those on the healthy side ($p<0.0001$).

Conclusions: We have more than 80% good to excellent results regarding vertical and horizontal proprioception after our surgeries without reinserting the capsule or labrum. Our main hypothesis of non-inferiority is confirmed and we even note that the results are superior on the operated side.

We wonder about the beneficial effect of physiotherapy and the influence of the dominant side on the results.

IFP.01.03

SCAPULA KINEMATICS DISORDERS: A NEW CLASSIFICATION BASED ON OBJECTIVE ANALYSIS OF SCAPULA MOBILITY CLINICAL STUDY ON 100 PATIENTS

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Background: Disorders of scapular kinematics, known as scapular dyskinesias or scapulothoracic abnormal motion, have been the subject of clinical studies and some have proposed classifications. Until now, have been interested in the stability of the scapula by subjectively observing the scapular detachment. The active mobility of the scapula was not assessed objectively. The upward rotation of the scapula is however essential in the global kinematics of the shoulder. The aim of our study is to arrive at a new classification based mainly on the objective analysis of the mobility of the scapula in upward rotation during active elevation.

Methods: The population of this study is 100 patients who consulted for shoulder problems and presented with scapula dyskinesia (inclusion by the Yes/No Ulh method).

We used a plurimeter, a validated measuring tool for scapula mobility (Watson), to measure upward rotation.

The measurement of upward rotation was associated with a clinical examination:

- measurement of shoulder range of motion.
- scapula stability (detachment forward/backward/both)
- specific tests Scapular Assistance Test and Scapular Retraction Test (Kibler).

Results: We were able to identify 5 groups according to the measurement of scapula mobility in upward rotation, the associated clinical examination, and the etiology of the dyskinesia.

The first 3 groups (A,B,C) correspond to a deficit of mobility in upward rotation (SURD: Scapular Upward Rotation Deficit) Group A: neurological damage of long thoracic nerve. Group B: neurological damage to the accessory nerve. Group C: neuromotor control disorders without neurological damage involvement.

Group D corresponds to reverse kinesiia (SURRK: Scapular Upward Rotation Reverse Kinesiia) associated with active contraction of pectoralis minor and often with posterior instability.

Group E corresponds to compensatory hyperkinesiia (SUREH: Scapular Upward Rotation Early Hyperkinesiia) because of glenohumeral stiffness, active cuff deficiency,

Conclusions: In conclusion, this new classification, based on a reliable clinical examination, allows to establish a precise diagnosis and to give the most appropriate treatment for the patient, whether it be rehabilitative or sometimes surgical when necessary.

IFP.01.04

SHOULDER AND SCAPULAR MUSCLE ACTIVITY DURING LOW AND HIGH PLANK VARIATIONS WITH DIFFERENT -WEIGHT-BEARING STATUS

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Background: For the restoration of functional stability in shoulder rehabilitation, it is recommended to use -weight-bearing (BWB) closed kinetic chain exercises from the early period. However, there are limited information about how the muscular activation levels and relative activation ratios of the scapula and shoulder girdle muscles changes during closed kinetic chain exercises. Therefore, this study was designed to investigate the muscle activation levels and relative activation ratios of the scapula and shoulder girdle muscles during low and high plank variations with different BWB status.

Methods: Twenty-one asymptomatic males (Age: 26 ± 6.5 years, Mass Index: 24.4 ± 2.4 kg/m²) were included in the study. A total of ten distinctive plank exercises with varied elbow joint positions (low plank and high plank) and weight bearing (BWB) status (four-point, three-pod and two-point) were performed by participants in a mixed order. The activation levels of the upper trapezius (UT), middle trapezius (LT), lower trapezius (LT), serratus anterior (SA), infraspinatus (IS), biceps brachii (BB) and triceps brachii (TB) muscles were measured by surface electromyography.

Results: Plank variations mostly revealed low to moderate activation for scapular and shoulder muscles. SA was revealed a high muscular activation during two-point bird dog exercise and moderate activation levels were recorded for other nine plank variations. Findings of this study showed that, elbow position changes resulted in higher LT and TB activation in high plank exercise ($p=0.01$ and $p=0.001$, respectively). In general, it was observed that increase in BWB status were effective in increasing activation levels for scapula and shoulder girdle muscles. UT/MT, UT/LT and UT/SA ratios were less than 1 during side plank and plank with shoulder external rotation resistance exercise. High plank with toe touch exercise resulted in an increased activation in the UT.

Conclusions: It was concluded that plank exercises may be involved in shoulder rehabilitation programs and the progression in plank exercise might achieved by using elbow position and BWB status based on individual requirements.

IFP.01.05

ARMELEVATIONSPEEDAFFECTSTHECOORDINATEDMOVEMENTOFTHEGLENOHUMERAL AND SCAPULOTHORACIC JOINTS

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Background: Arm elevation speed may influence scapular kinematics, but little evidence demonstrates this. This study aimed to investigate the scapulohumeral rhythm and angular velocities of the humerus and scapula and clarify the dynamics of the scapula in coordinated shoulder joint motion depending on the arm elevation speed.

Methods: Five reciprocating abduction-adduction movements of 52 shoulders from 26 participants were recorded using a motion capture system under slow and fast conditions (40 and 120 beats per minute). We used an acromion marker cluster to obtain scapular motion. The glenohumeral joint elevation (GH) and scapulothoracic joint upward rotation (ST) angular velocities were calculated and time-normalized during shoulder abduction movement (0–100%). The movement pattern of GH and ST during the shoulder abduction were compared using the angular velocity-angular velocity plot (X-axis: ST, Y-axis: GH). In addition, to show the ratio of the magnitude of joint angular velocities in the early phase of elevation between the arm speed conditions, the slopes of the linear regressions of the phase plot ranged from resting position to the 10° and 20° increments of the humerothoracic elevation in each participant were calculated. The slopes of the linear regression lines in the phase plots were compared between two velocity conditions using paired t-test with Bonferroni correction.

Results: The trajectory of the phase plot in the slow condition showed clockwise, suggesting that GH angular velocity was higher than that of ST at the early phase of elevation, then it was overtaken by the ST. In the fast movement, the trajectory showed counterclockwise. We found a significant difference in the slope between conditions at the HT10 (Mean±SD, 1.11 ± 0.78 in slow condition, 0.79 ± 0.52 in fast condition).

Conclusions: These results indicated that GH contributed more to the early phase of elevation in the slow condition. Otherwise, the ST contributed more to the fast condition. It suggested that the dynamics of the scapula were affected by the speed of arm elevation and the coordinated humerus and scapula motion during shoulder abduction also differed depending on the arm elevation speed.

IFP.01.06

COMPARISON BETWEEN TWO SCAPULAR CLUSTER METHODS IN OPTICAL MOTION CAPTURE: ACROMION MARKER CLUSTER AND SCAPULAR SPINAL MARKER CLUSTER METHODS

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Background: The acromion marker cluster (AMC) method is one of the most common methods to reduce scapular skin tissue artifacts. However, the AMC is sensitive to deltoid muscle contraction, and we hypothesized that the attachment of the marker cluster to the scapula spine is less influenced than that on the acromion. In this study, we evaluated the accuracy of AMC and the scapular spinal marker cluster (SSMC) methods using upright four-dimensional computed tomography (4DCT).

Methods: Sixteen shoulders from eight healthy males had attached the reflective markers according to the coordinate system of the international society of biomechanics, and marker clusters were placed on the acromion and the center of the scapular spine. Their active shoulder elevation in the CT gantry was tracked using upright 4DCT and optical motion capture system. The 4DCT data were analyzed using the 3D-3D registration method, and the motion capture data were analyzed using AMC and SSMC methods. The results of the scapular rotation angles were compared between 4DCT and motion capture calculated from AMC and SSMC. The AMC and SSMC movements with shoulder elevation were also compared.

Results: During 10° to 140° of elevation, scapular rotations calculated by AMC and SSMC were different from the angle calculated by 4DCT at the elevated arm position. Scapular upward rotation became significant from 120° of elevation in AMC and 40° of elevation in SSMC. The internal rotation was significantly different from 50° of elevation in AMC, while no significant difference was observed in SSMC. Posterior tilting became significant from 90° of elevation in AMC and 140° of elevation in SSMC. The mean marker cluster movement distances were significantly smaller in AMC (28.7 ± 4.0 mm) than in SSMC (38.6 ± 5.8 mm).

Conclusions: AMC and SSMC methods showed differences in rotation angles compared to the 4DCT analysis. Although the marker cluster movement was smaller in AMC, the attachment position of the AMC was more inclined likely due to the deltoid muscle contraction. Therefore, SSMC was thought to be more accurate in evaluating the internal rotation and posterior tilting of the scapula.

IFP.01.07

ASSOCIATION BETWEEN THE MODIFIED SCAPULAR ASSISTANCE TEST AND SCAPULAR DYSKINESIS IN PATIENTS WITH NON-SPECIFIC SHOULDER PAIN: A CROSS SECTIONAL STUDY

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Background: Shoulder pain (SP) is one of the most prevalent musculoskeletal conditions worldwide. The assessment of scapular dyskinesia (SD), defined as an altered position of the scapula or altered motion patterns, is frequently recommended in order to manage SP. On the other side, the modified scapular assistance test (mSAT) is used to determine the impact of SD in symptomatology. This active manipulation of the scapula has been shown to increase the subacromial space, which might explain symptom improvement. However, limited evidence exists in determining mSAT's relationship with the presence or absence of SD. The main objective of this study is to determine whether there is an association between the mSAT results and the presence of SD in patients with SP.

Methods: An observational and cross-sectional study was conducted in a hospital in Buenos Aires, Argentina. Adult patients referred to the physical therapy clinic with a diagnosis of SP and with pain during anterior flexion were included. The mSAT, scapular dyskinesia test (SDT), and shoulder function were assessed. The presence of SD was classified into three categories: "normal", "subtle" or "evident" by the examiner. Then a dichotomy re-classification was made: "no dyskinesia" (normal), and "with dyskinesia" (subtle and obvious).

Results: The prevalence of SDT was 54.29% after dichotomy categorization, and 45.71%, 25.71%, and 28.57% when categorized as "normal", "subtle" or "evident", respectively. No statistically significant associations were detected when assessing the relation between the presence of mSAT and SDT, after a dichotomy (p-value 0.93) and polychotomy (p-value 0.84) classification. No statistically significant association was observed between mSAT and the diagnosis or between mSAT and shoulder function. When comparing changes in pain in the verbal NRS during the mSAT in patients with a positive test, no differences were seen between patients with SD and patients without SD (p-value 0.26).

Conclusions: The distribution of mSAT results was equal between individuals with or without SD. These findings suggest that the presence or absence of SD in individuals with SP was independent of the mSAT result. mSAT should not be used for assessment of SD in clinical practice nor be influenced by the SDT result.

IFP.01.08

THE EFFECT OF BLOOD FLOW RESTRICTION TRAINING ON SHOULDER MUSCLE THICKNESS, AND ROTATOR CUFF STRENGTH IN ROTATOR CUFF TENDINOPATHY

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Background: Little is known about the effectiveness of blood flow restriction training (BFRT) on the shoulder such as rotator cuff (RC) and scapular muscles. This study aimed to investigate the effect of BFRT on shoulder muscle thickness, RC strength, and shoulder symptoms in rotator cuff tendinopathy (RCT).

Methods: Thirty-two participants with a diagnosis of RCT were included in the BFRT group (n=16) and control group (n=16) for 8 weeks (2 days/week) of rehabilitation. RC and scapula stabilizer muscle-focused low-load (30% of 1 maximum repetition) exercise training was performed on the BFRT group with a cuff, while the same exercise protocol was performed on the control group without blood flow restriction. The thickness of supraspinatus, infraspinatus, biceps brachii, deltoid, and scapula retractor muscles in both groups in the affected extremity was measured using ultrasonography; shoulder internal rotator (IR) and external rotator (ER) muscle strength measured using an isokinetic dynamometer at 60°/s angular velocity before and after the rehabilitation. The Shoulder Pain and Disability Index was used to evaluate shoulder pain and function. The rating of perceived exertion (RPE) at the end of each exercise session was recorded to document difficulty. The shoulder muscle thickness, RC strength and shoulder functional score changes were calculated as ((posttest - pretest)/pretest) * 100 and expressed as %change. Mann-Whitney U test was used for intergroup comparison.

Results: The BFRT group had greater increases in biceps (p=.001) and deltoid (p=.003) muscle thickness compared to the control group. RPE during exercises was significantly higher in the BFR group (p<0.001). No differences were observed in other measurements.

Conclusions: Low-load BFRT resulted in a greater increase in biceps and deltoid muscle thickness in individuals with RCT compared to the control group. However, no superiority of either exercise training as regards improving shoulder function in RCT. The results of this study support the effects of BFRT on muscle hypertrophy at the site of the occlusion and distal, but no effect was found at the proximal sites.

IFP.01.09

ISOMETRIC SHOULDER STRENGTH FOR THE CONSTANT SCORE: NORMATIVE AUSTRALIAN POPULATION DATA AND ASSOCIATED FACTORS

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Background: The Constant score is a widely used and reliable outcome measure for assessment of shoulder function. Normalisation protocols of the Constant Score have been established to account for sex and age differences, however it is important that normative shoulder strength values are updated and based on a representative population. Current standard practice in our unit is the use of the Chatillon (Ametek, Florida, USA) force gauge to measure shoulder strength. More recently, the IDO isometer (Innovative Design Orthopaedics, London, UK) has been developed to specifically measure the strength element of the Constant score.

The aims of the study were to:

- 1) provide Australian normative data stratified by sex and age, to detect any additional predictors of shoulder strength, and to compare these data to previous published normative data studies; and
- 2) determine inter-device, inter-rater, and intra-rater reliability of the Chatillon and IDO devices for measuring shoulder strength in asymptomatic shoulders.

Methods: 511 Australian adults (259F-252M) aged 18 – 89 without shoulder pathology volunteered to participate. Bilateral isometric shoulder abduction strength measured with both the Chatillon force gauge and IDO Isometer devices. Linear regression models were used to assess predictor variables. Intra-class correlation coefficients (ICC) were calculated to assess inter-device, intra-rater and inter-rater reliability (>0.75 excellent). A Bland-Altman plot was used to assess inter-device agreement.

Results: Height ($p=.03$) was a significant predictor of strength in females and weight was a significant predictor of strength in males ($p<.001$). An effect of hand dominance was also observed, with non-dominant shoulder strength associated with higher strength in females ($p<.001$) and lower strength in males ($p<.001$). Inter-device reliability was excellent for both devices (ICC 0.89), as was inter- and intra- rater reliability (ICC >0.85). The agreement between the Chatillon and IDO devices is associated with the strength of the individual, with increasing inter-device error with increasing strength.

Conclusions: We have validated the widely used IDO isometer against the Chatillon dynamometer in a healthy representative cohort, with both devices demonstrating excellent inter-device, intra-rater, and inter-rater reliability. The normative data for each sex and age group can be used as a standard for future shoulder studies investigating the Constant score.

IFP.01.10

PRELIMINARY INVESTIGATION OF JOINT POSITION SENSE OF THE SHOULDER: A MATCHED CASE CONTROL STUDY

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Background: Hypothesis: Few studies have investigated JPS deficits in multiple planes for shoulder pain. The objective of this study was to examine the clinical utility of a novel multidirectional JPS test using laser pointer in a cohort of patients with unilateral shoulder pain presenting to outpatient PT.

Methods: In this single-session case-control study, 56 participants rated their current pain intensity (11-point Numeric Rating Scale) and shoulder disability (QuickDASH). While blindfolded and with a laser pointer attached to the elbow, participants performed movements into a sagittal or transverse plane direction to determine accuracy in repositioning their shoulder. Movements assessed included low (55 degrees), mid (90 degrees), and high flexion (145 degrees), horizontal adduction (10 degrees), low horizontal abduction (30 degrees) and high horizontal abduction (50 degrees), three trials each. For reference test, participants moved and held their arm at the target range (+/- 10 degrees), while a reference point was on a coordinate grid. Participants returned their arm to the starting position, then reproduced and held the same movement so a reposition point could be marked. The absolute coordinate difference between reference and reposition tests was computed. JPS was determined based on the average magnitude of y-axis, x-axis, and global errors. A nonparametric factorial analysis of variance examined a group (shoulder pain vs. controls) by side (affected/dominant vs. unaffected/nondominant) effect. We performed Spearman rho correlations for associations between joint position sense with current pain intensity and shoulder disability.

Results: Patients reported a mean [SD] pain intensity rating of 1.4 [1.8] and disability score of 23.5 [13.8] at the testing visit. No significant group by side interactions were detected. There was a significant group effect for horizontal adduction x-axis and global errors ($p < 0.05$), with patients demonstrating greater magnitude of error compared to controls. In the patient group, greater mid-flexion y-axis ($\rho = 0.66$, $p < 0.01$) and global errors ($\rho = 0.55$, $p < 0.05$) were significantly associated with higher current pain intensity.

Conclusions: Patients with shoulder pain demonstrate JPS deficits in horizontal adduction compared to matched controls. There was a strong association between mid-range flexion JPS and current pain intensity.

IFP.02.01

CLINICAL OUTCOMES OF A SUBSCAPULARIS EXPOSURE SPECIFIC REHABILITATION PROGRAM FOLLOWING SHOULDER ARTHROPLASTY FOR OSTEOARTHRITIS - KEEPING THE DOOR CLOSED

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Background: We have previously published a subscapularis “takedown” specific rehabilitation approach for anatomic total shoulder arthroplasty in patients with osteoarthritis. Our approach aims to address the need to rehabilitate patients specific to the method of subscapularis approach at time of surgery; be that subscapularis tenotomy, subscapularis peel or lesser tuberosity osteotomy.

Here we present the clinical outcomes of our rehabilitation approach to examine whether we are maintaining subscapularis integrity “keeping the door closed” while trying to ensure an optimal functional result.

Methods: A prospective cohort of 32 consecutive patients undergoing anatomic shoulder arthroplasty for osteoarthritis with an intact rotator cuff were managed following our rehabilitation approach. The surgical technique for accessing the shoulder joint was via a subscapularis tenotomy. Patients completed an Oxford shoulder score and a Constant score preoperatively and at 6 months postoperatively. At six months patients also had an ultrasound scan and clinical evaluation of the subscapularis construct. The clinical evaluation and ultrasound scans were performed by a single physiotherapist.

Results: There were 21 female and 11 male patients with a mean age of 67. Twenty-six patients had anatomic total shoulder replacement while six had a hemiarthroplasty only. All 32 patients completed preoperative and postoperative outcomes. The mean Oxford shoulder score showed clinical and statistical improvement ($p < 0.001$) from 19 (SD = 8.2) preoperatively to 41 (SD = 7) at 6 months. The mean Constant score improved clinically and statistically ($p < 0.001$) from 25 (SD = 10.4) preoperatively to 64 (SD = 14.9) at 6 months. Thirty-one patients had a normal subscapularis belly press and lift off test on clinical examination. One patient had a positive belly press and lift off. This patient also had a subscapularis failure on ultrasound assessment. Thirty-one patients had shoulder ultrasound of the subscapularis at 6 months, 30 (97%) of which showed an intact subscapularis. One patient had a rupture while one patient did not have a scan.

Conclusions: Our rehabilitation approach has shown encouraging clinical results. The 97% intact subscapularis rate on ultrasound coupled with the clinical findings support our theoretical rehabilitation assumptions. Further clinical work should examine if this approach has similar results for the alternative subscapularis surgical approaches.

IFP.02.02

REHABILITATION FOR TOTAL SHOULDER ARTHROPLASTY - THE PERSPECTIVES OF AUSTRALIAN SHOULDER SURGEONS

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Background: Patient satisfaction following total shoulder arthroplasty (TSA) is heavily influenced by post operative rehabilitation. However, no international guidelines for TSA rehabilitation exist, reflecting a paucity of high quality research on this topic. Prior to commencing trials to compare rehabilitation programs, it is important to understand current rehabilitation practices. This study surveys shoulder surgeons nationally and subsequently presents the most comprehensive description of Australian TSA rehabilitation practices to date.

Methods: A cross-sectional survey of Australian shoulder surgeons was performed. This was developed and refined by faculty of the Shoulder and Elbow Society of Australia (SESA). 125 Australian shoulder surgeons were invited to participate. Responses were stratified to analyse rehabilitation post anatomical total shoulder arthroplasty (aTSA) and reverse total shoulder arthroplasty (rTSA). Quantitative and qualitative data were collected and descriptive analysis performed.

Results: 41 responses were received. The most common immobilisation practice (43%) was an internal rotation sling for 4-6 weeks post aTSA and a neutral sling with abduction wedge for 4-6 weeks (29%) post rTSA. All respondents restricted lifting weight >10kg for at least 6 weeks post aTSA and rTSA, and most maintained this restriction for at least six months (73% for aTSA and 55% for rTSA). Regarding range of movement, passive shoulder flexion >90 degrees most commonly commenced at 4-6 weeks (43% for aTSA and 29% for rTSA). Nearly all respondents allowed unrestricted passive external rotation (ER) and internal rotation (IR) after 6 months post aTSA and rTSA (100% and 94% respectively). Unrestricted active flexion, ER and IR commenced at an average of 17 weeks for over 80% of respondents post aTSA and rTSA. Over 50% of respondents allowed patients to return to swimming, golf, tennis and lawn bowling at an average of 17 weeks post procedure, but restricted gym/ free weights until an average of 9 months post rTSA and aTSA.

Conclusions: This study presents the most commonly used rehabilitation protocols for aTSA and rTSA according to Australian shoulder surgeons. Variation between surgeons' practices reflects uncertainty regarding best practice and a need to develop evidence-based rehabilitation guidelines.

IFP.02.03

TELEREABILITATION OF 2 DIFFERENT DESIGN OF REVERSE TOTAL SHOULDER ARTHROPLASTY DURING SARS-COV-2 PANDEMIC: ONLAY VS INLAY HUMERAL STEM

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Background: Two main humeral prosthetic designs have been described: Inlay and Onlay. The former was the classic Grammont design, medializing the center of rotation. The Onlay design was developed to lateralize the center of rotation, increase the deltoid wrapping effect and reduce the scapular notching. Post-operative rehabilitation is believed to be crucial in optimizing clinical function after RTSA. Sars-Cov-2 pandemic limited post-operative rehabilitation protocol.

The purpose of this study was to determine the clinical advantage of telerehabilitation in patients treated with RTSA during Sars-Cov-2 pandemic; the second aim was to detect clinical differences in patients treated with Inlay versus Onlay prosthetic designs.

Methods: Twenty-six consecutive patients have been prospectively enrolled in this study between March 2020 and December 2020, they performed either an Inlay or Onlay prosthesis. Telerehabilitation session once a week, in addition to physiotherapy sessions twice a week, starting 4 weeks after the surgery and continued for four months. Outcomes evaluated included: Range of Motion (ROM) (forward flexion, abduction, external rotation and internal rotation), complications and patient reported outcomes at different follow-up (VAS, DASH, Simple Shoulder Test [SST], Constant Score [CS] and ASES).

Results: Fourteen patients were treated with Inlay and twelve with Onlay design. ROM reported at final follow up: Forward flexion of 150°-Inlay and 160°- Onlay ($p = 0.60$), Abduction 120°-Inlay and 140°-Onlay ($p = 0.19$), External Rotation 40°-Inlay and 45°- Onlay ($p = 0.66$), Internal Rotation superior in the Onlay ($p = 0.10$). Patient reported outcomes detected good and similar results between the two groups for VAS ($p = 0.32$), DASH ($p = 0.56$), SST ($p = 0.73$), CS ($p = 0.40$), ASES ($p = 0.37$). No complications have been reported.

Conclusions: Telerehabilitation represents a good alternative and a valid support to the traditional physiotherapy. Sars-Cov-2 pandemic emphasized the importance of medical technology development to assist and improve health communication. Although with no statistical significance, Onlay design achieved more satisfactory results and with less time compared to the Inlay prosthesis

IFP.02.04

POSTOPERATIVE SWELLING AFTER ELBOW SURGERY - INFLUENCE OF A NEGATIVE PRESSURE APPLICATION IN COMPARISON TO MANUAL LYMPHATIC DRAINAGE A RANDOMIZED CONTROLLED TRIAL

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Background: Postoperative soft tissue swelling is a significant factor influencing outcome after elbow surgery. It can crucially affect important parameters such as postoperative mobilization, pain, and subsequently the range of motion (ROM) of the affected limb. Furthermore, lymphedema is considered a significant risk factor for numerous postoperative complications. Manual lymphatic drainage is nowadays part of the standardized post-treatment concept, basing on the concept of activating the lymphatic tissue to absorb stagnated fluid from the tissue into the lymphatic system. This prospective study aims to investigate the influence of technical device

assisted negative pressure therapy (NP) on early functional outcome after elbow surgery. NP was therefore compared to manual lymphatic drainage (MLD). Is technical device-based NP suitable for treatment of lymphedema after elbow surgery?

Methods: A total of 50 consecutive patients undergoing elbow surgery were enrolled. The patients were randomized into 2 groups. 25 participants per group were either treated by conventional MLD or NP. Primary outcome parameter was defined as the circumference of the affected limb in cm postoperative up to seven days postoperatively. Secondary outcome parameter was subjective perception of pain (measured via visual analogue scale, VAS). All parameters were measured on each day of postoperative inpatient care.

Results: NP showed an overall equivalent influence compared to MLD in reducing upper limb swelling after surgery. Moreover, the application of NP showed a significant decrease in overall pain perception compared to manual lymphatic drainage on day 2, 4 and 5 after surgery ($p < .05$).

Conclusions: Our findings show that NP could be a useful supplementary device in clinical routine treating postoperative swelling after elbow surgery. Its application is easy, effective and comfortable for the patient. Especially due to shortage of healthcare workers and physical therapists there is need of supportive measures which NP could be.

IFP.02.05

EFFECTS OF HYPNOSIS THERAPY ON PAIN AND OPIOID USE FOLLOWING SHOULDER REPLACEMENT SURGERY

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Background: Patients experiencing severe pain in the perioperative period are at an increased risk of persistent pain and long-term opioid use. It is crucial to find safer, less addictive ways to manage pain, especially after orthopedic surgery. This study sought to determine the feasibility and efficacy of hypnosis therapy (HT) intervention in decreasing perioperative pain and opioid use in individuals undergoing shoulder replacement surgery.

Methods: A randomized prospective study was performed on participants assigned to receive standard care (SC) or video recorded hypnosis therapy (HT) plus SC. Fifty-two participants with an average age of 71 years (55–88) were included. Twenty-eight (21RSA: 7TSA) were assigned to the HT group and 24 (16RSA: 8TSA) to the SC group. Those in the HT group were invited to listen to the recording at least one time per day for a minimum of 7 days before surgery using a web-based platform. The primary outcome measures were maximum and average Numeric Rating Scale (NRS) pain score, and the secondary outcome measure was post-operative Morphine Milligram Equivalents (MME) consumption.

Results: In the preoperative period, participants receiving HT experienced less maximum NRS pain (5vs7, $p < 0.001$) and average NRS pain (4vs5, $p < 0.001$). Postoperatively, the pain severity in the HT group was also less than in the SC group, both for maximum (3vs.4, $p < 0.001$) and average pain scores (2vs3, $p < 0.001$). The total MME consumption in the HT group (978MMEs) was lower than that in the SC group (1,263MMEs). When the highest opioid consumption occurred (postoperative days 1-3), the mean opioid consumption in the HT group was less than half of that in the SC group (mean: 13vs25MME, $p=0.004$). In both groups, peak opioid consumption occurred on the second postoperative day; however, consumption in the HT group (235MME, mean: 18MME) was half of that in SC group (470MME, mean: 36MME). This then decreased considerably after day 3 in both groups.

Conclusions: The results support the feasibility and potential efficacy of a hypnosis therapy (HT) intervention in individuals undergoing shoulder replacement surgery, specifically in decreasing perioperative pain and opioid use.

IFP.02.06

THE EFFECT OF AN EARLY MOBILIZATION REHABILITATION AFTER REVERSE SHOULDER ARTHROPLASTY

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Background: Physical therapy (PT) programs are used to optimize postoperative recovery and function but vary following RSA based on the surgeon preference. The influence of rehabilitation on the outcomes after RSA is significant but no previous studies correlate these directly with outcomes. The purpose of this study was to evaluate the effect of early mobilization PT protocol on outcomes and range of motion (ROM) following RSA.

Methods: A prospective case comparison study was performed of 60 patients who underwent a Reverse Shoulder Arthroplasty by two fellowship trained shoulder surgeons at a single institution. Patients were divided into two groups: Early mobilization (n=23) and Delayed mobilization at week 6 (n=37). Preoperative and postoperative patient-reported shoulder outcomes were collected, including Constant shoulder score (CSS), American Shoulder and Elbow Score (ASES) and Penn Shoulder score (PSS) for pain and function. Functional outcomes included passive and active forward elevation (PFE/AFE) and external rotation (PER/AER). Preoperative and postoperative outcome scores were collected, and the change calculated and compared between the groups.

Results: Preoperatively, there was no difference in demographics between groups. At 6 weeks postoperatively, EM group showed higher ASES function scores (p=0.04), PSS scores (p=0.04), AFE (p=0.04), PFE (p=0.04), and AER (p=0.03). At 3 months postoperatively, the EM group showed lower NRS (p=0.02), higher AFE (p=0.01), PFE (p=0.04) and similar ASES, PSS, SSV, CSS, AER, PER, and IR. There was significant difference in NRS at last follow-up between groups (p=0.02) but no difference in SSV or CSS scores between groups (p>0.05). At 6 weeks post-op there was significantly lower narcotic usage in the EM group compared to DM group (p=0.01). There were 3 complications (2 hematomas, 1 infection) in the DM group and none in the EM group.

Conclusions: The early mobilization rehabilitation protocol achieved better early ROM postoperatively, lower narcotic usage, and lower pain scores following RSA without an increase in complications. When understanding how to optimize patient outcomes and function after RSA, surgeons may consider an earlier mobilization program.

IFP.02.07

PROFILES OF THE POSTOPERATIVE MANAGEMENT OF ARTHROSCOPIC ROTATOR CUFF REPAIRS - ANALYSIS AS PART OF A MULTICENTRIC COHORT STUDY

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Background: Specific rehabilitation protocols exist and vary between clinics. However, little is known about the individual rehabilitation, that patients actually undergo after arthroscopic rotator cuff repair (ARCR). This study seeks to describe the postoperative management after ARCR in Switzerland and identify groups of patients following specific rehabilitation paths.

Methods: As part of a large multicenter Swiss cohort study (ARCR_Pred), patient characteristics, rehabilitation and outcome data were gathered at baseline, six weeks, six months, one and two years after first time ARCR from 19 clinics via patient examination and interviews. Data were categorized and described across clinics. A polytomous latent class analysis (poLCA) was applied to the medication-, immobilization- and rehabilitation management parameters to identify patient rehabilitation groups. The associations between identified groups and the functional Constant Score (CS) and Oxford Shoulder Score (OSS) were explored, respectively.

Results: Data from 942 patients were used. LCA revealed a four-class model for the medication management with a `non-opioid group` (50%), a `non-NSAID/weak opioid group` (27%), a `non-NSAID/potent opioid group` (20%) and a `steroid injection group` (3%). The immobilization management consisted of three classes a `conservative group` (59%), a `delayed progressive group` (28%) and an `early progressive group` (13%). The rehabilitation management had five classes with a `higher frequency group` (40%), a `less therapy group` (25%), a `lower frequency group` (17%), a `early strength group` (12%) and a `water therapy group` (6%). Patients treated with steroid injections showed worse CS and OSS at follow-up. During immobilization the "delayed progressive group" with early passive movements but delayed active movements showed better short-term results at six months and one year. The `early progressive group` with early active movements, however, had some patients at risk for worse outcomes at one and two years.

Conclusions: Rehabilitation paths are highly variable among patients and across clinics. Rehabilitation groups were identified to guide clinicians during clinical practice and be considered in the evaluation of clinical outcomes. Patients receiving steroid injections showed poorer outcomes than other patients. Less immobilization with early movement showed benefits for short-term outcomes, however the role of early active movement must be carefully evaluated.

IFP.02.08

MATCHING PATIENTS' PREFERENCE FOR REHABILITATION DOES NOT INFLUENCE SHOULDER REHABILITATION OUTCOMES: A SECONDARY ANALYSIS OF A RANDOMIZED CONTROLLED TRIAL

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Background: Shoulder exercise rehabilitation delivered by physiotherapists is recommended as a principal component in the management of rotator cuff shoulder pain. However, the effectiveness of different modes of delivery may be affected by individual patient preference. This study aims to investigate if matching the patients' preference for a particular mode of delivery of shoulder exercise rehabilitation influence the improvement of shoulder function.

Methods: Design: A secondary analysis on data from a randomised controlled trial.

Participants: 208 patients referred to physiotherapy rehabilitation after conservative or surgical treatment at a hospital under the diagnosis of rotator cuff related pain.

Intervention: Participants were randomized to one of three types of rehabilitation: group-based exercise rehabilitation, individual exercise rehabilitation or home exercise rehabilitation. They had previously completed a baseline questionnaire with questions about characteristics such as preference for mode of delivery. In this analysis, participants were divided into two groups: "matched" (received their preferred mode of delivery) and "unmatched" (did not receive their preferred mode of delivery).

Outcome measures: Change in pain and function quantified by the Quick-DASH score from baseline to 3 and 6 months.

Results: Adjusted for baseline-scores and pre-trial management, the unmatched group improved their Quick-DASH score with 2,81 (95% CI -2,15 to 7,77) more than the matched-group at 3 months follow-up. At 6 months follow up, the matched group improved their Quick-DASH score with 0,72 (95% CI -5,08 to 6,52) more than the unmatched group. No statistically significant effect was found of the pre-trial management. The majority of patients were overall satisfied with their rehabilitation, regardless of whether their preference was matched or unmatched.

Conclusions: Matching the patients' preference for a particular mode of delivery did not affect the over all improvement of shoulder function. The results was not modified by the patients' pre-trial management, and did not affect patients overall satisfaction with the treatment .

IFP.02.09

COST-COMPARISON OF CONTINUOUS PASSIVE MOTION AND PHYSICAL THERAPY AFTER ARTHROSCOPIC RELEASE OF ELBOW CONTRACTURE: DATA FROM A RANDOMIZED CONTROLLED TRIAL

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Background: This study compared the direct and indirect costs of continuous passive motion (CPM) and physical therapy (PT) following arthroscopic release of elbow contracture.

Methods: A cost-analysis was conducted as part of a randomized controlled trial comparing CPM(n = 24) with PT(n = 27) in patients who underwent arthroscopic release of elbow contracture. Costs due to study treatment included the index procedure, postoperative rehabilitation, and costs due to lost wages(indirect costs). Costs of the index procedure for the CPM group included a 3-day in-hospital stay, whereas for the PT group included only the date of surgery (same-day procedure). Lost wages were estimated for the first 6 postoperative weeks based on patient reported impairment of work activities using the Work Productivity and Activity Impairment(WPAI) Questionnaire. Weekly salaries for all patients were assumed to be the 2020 US median salary based on the US Bureau of Labor Statistics. Recognizing that work impairment after elbow contracture release would not be equal for all occupations, patients were stratified into manual laborers(n=23, 9 CPM and 14 PT) and non-manual laborers(n=28, 15 CPM and 13 PT).

Results: The CPM group had higher average direct costs than the PT group. The higher direct costs of CPM were mainly due to the room and board costs. When excluding all the in-hospital costs from the CPM group, the direct costs of CPM and PT were similar. Across the entire six-week period, the use of CPM resulted in lower impairment of work activities and indirect costs (lower wage loss) than PT. This difference was mainly driven by the manual laborers - those who received PT took longer to recover their wages and had nearly doubled the total wage loss than those who received CPM over the first 6-weeks postoperatively.

Conclusions: The use of CPM was associated with higher direct costs than PT, however, it resulted in lower impairment of work activities which translated to less lost wages and lower indirect costs among manual laborers. An outpatient CPM protocol should be considered as an actionable strategy for cost reduction given that room and board charges were the major driver of higher direct costs of CPM.

IFP.02.10

AQUATIC THERAPY FOLLOWING ARTHROSCOPIC ROTATOR CUFF REPAIR ENABLES FASTER RECOVERY THAN LAND-BASED THERAPY OR SELF-REHABILITATION THERAPY

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Background: The purpose of this study is to compare the clinical and functional outcomes of arthroscopic rotator cuff repair over a period of 2 years using three postoperative rehabilitation modalities: aquatic therapy, land-based therapy, and self-rehabilitation therapy.

The hypothesis was that aquatic therapy would provide faster recovery than land-based therapy or self-rehabilitation therapy.

Methods: The enrolled patients that were scheduled for arthroscopic rotator cuff repair between 2012 and 2017 that met the following criteria: (i) small to medium sized symptomatic supraspinatus and/or infraspinatus tendon tears, (ii) low to moderate tendon retraction according to Patte, and (iii) fatty infiltration stage less or equal to 2.

Patients were allocated to perform either aquatic therapy, land-based therapy, or self-rehabilitation therapy for 2-4 months. Independent observers blinded to the study design collected Constant score, SSV, and patient satisfaction at 2 months, 3 months, 6 months, 1 year and 2 years.

Results: 166 patients were reviewed (54 in the aquatic group, 57 in the land based group, 55 in the self rehab group).

At 2 months follow-up, patients performing aquatic therapy had significantly higher Constant scores ($p < 0.001$) and SSV ($p < 0.001$) compared to those performing land-based therapy or self-rehabilitation therapy.

At 3 months follow-up, patients performing aquatic therapy had significantly higher Constant scores ($p < 0.001$), and SSV ($p < 0.001$), both of which exceeded the respective minimal clinically important differences (MCIDs) of 10.4 and 12.

Patients performing aquatic therapy continued to have significantly higher Constant scores and SSV at 6 months, 1 year, and 2 years.

Conclusions: At 2 to 24 months following arthroscopic rotator cuff repair, patients performing aquatic therapy had higher Constant scores and SSV compared to those performing land-based therapy or self-rehabilitation therapy. The differences in Constant scores exceeded the MCID at 3 months follow-up but diminished thereafter.

Aquatic therapy could enable faster recovery and thereby reduce work incapacity, in addition to improving long-term functional outcomes.

IFP.03.01

WHAT ARE THE PREDICTORS OF RESPONSE TO PHYSIOTHERAPY IN PATIENTS WITH MASSIVE IRREPARABLE ROTATOR CUFF TEARS? GAINING EXPERT CONSENSUS USING AN INTERNATIONAL E-DELPHI STUDY

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Background: Massive irreparable rotator cuff tears are associated with significant disability. Many patients experience worsening pain and weakness in the involved shoulder and have pain and difficulty when raising the affected arm above shoulder height or in some cases above 45°. This can have a profoundly negative impact on quality of life with pain and difficulty during many basic everyday activities.

There is a broad spectrum of treatment options for this patient group from non-operative management with physiotherapy to surgical procedures such as reverse total shoulder arthroplasty. Our review of the literature highlighted that the results for patients undergoing physiotherapy for massive irreparable rotator cuff tears are highly variable. We also found a lack of consensus on what constitutes the best physiotherapy programme. Several studies have attempted to identify factors which may be associated with a successful or unsuccessful response to rehabilitation. However, there are no appropriately designed prognostic studies. This means that we cannot have confidence that these factors are truly predictive of response to physiotherapy in this patient group.

Because of the lack of evidence, expert opinion was sought to gain consensus on factors which may be important in predicting response to physiotherapy in this patient group. Establishing a range of factors that experts agree may be important will then allow us to formally evaluate these factors using a prospective prognostic study nested within a randomised controlled trial.

Methods: An international e-Delphi methodology was used to gain consensus on the factors that orthopaedic surgeons and physiotherapists think are important in predicting either a successful or unsuccessful response to physiotherapy. We also surveyed patients who have experienced massive irreparable rotator cuff tear.

In Round 1, participants were asked to list a minimum of 6 factors that relate to a successful or unsuccessful response to physiotherapy in patients with massive irreparable rotator cuff tear. Physiotherapist and orthopaedic surgeon participants were also asked to indicate if the factors they have listed are modifiable by physiotherapy intervention. Rounds 2 and 3 established convergence of opinion and consensus on the factors.

Results: We are currently collecting the data.

Conclusions: We are currently collecting the data

IFP.03.02

HOLOREACH – REACHING EXERCISES PERFORMING THROUGH AUGMENTED REALITY THERAPY – A FEASIBILITY STUDY

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Background: Immersive technologies such as Virtual or Augmented Reality (VR / AR) have gained substantial attention for therapeutic use. The virtual 3D-environment is already used for the treatment of pain or anxiety [1]. Few applications are found for the treatment of motor control in neuro rehabilitation.

Trunk control and sitting balance are of importance for a wide range of activities that include standing and walking. The therapy of stroke patients could be enhanced by virtual reaching exercises for the training & activation of upper extremities and trunk muscles. The aim of the present study was performing a usability study to identify patient feedback about acceptance, comfort, exertion & safety.

Methods: The augmented reality (AR) technology of the Hololens 2.0 visualises virtual moving objects in 3D-space which could be grasped by hand/fingers. The virtual reaching exercises are combined with sitting on an instable seat, which needs to be actively stabilized by trunk muscles in order to maintain upright position. This combined therapy of reaching and balancing is named "holoreach".

In total 15 patients underwent therapy by the holoreach setting. One training session has been 30 Min; the therapy has been performed 4 times within 3 weeks. Feedback has been collected by focus group meetings.

Results: Totally 60 % of patients and therapists considered the therapy to be useful or more than useful, 55% considered the therapy to support motivation. It is to mention that 41% were slightly to severely exhausted by the therapy. Safety has been rated as adequately sufficient by all participants. For more than 50%, distance and speed of virtual obstacles was adequately chosen.

Conclusions: The therapy holoreach is considered to be applicable by a majority of patients & therapists. Variation of the game(s) could be more versatile to maintain motivation also for a longer therapy setting. The placement of obstacles in the virtual environment allows a measurable and scalable training setting.

[1] Haas, C; Sommer, Bettina B; Karrer, Samuel; Jörger, Matthias; Graf, Eveline S; Huber, Martin; Baumgartner, Daniel; Bansi, Jens; Kool, Jan; Bauer, Christoph M, Surface electromyographic

IFP.03.03

EXPEDITED SLING IMMOBILIZATION PROTOCOL AFTER BICEPS TENODESIS DEMONSTRATES EQUIVALENT RANGE OF MOTION AND PATIENT REPORTED OUTCOMES TO STANDARD PROTOCOL

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Background: The purpose of this study is to characterize pain and range of motion (ROM) outcomes for patients after biceps tenodesis (BT) with standard and expedited sling immobilization protocol following surgery. Expedited protocol following BT is suspected to result in equivalent pain and general function outcomes at one-year follow up.

Methods: This study is a retrospective case series comparing patients who were assigned to use a sling for either 4-6 weeks (standard) or 0-2 weeks (expedited) following a BT procedure without associated labral or rotator cuff repair. Primary endpoints included loss of fixation, surgical revision, abduction, and external range of motion. ROM was analyzed preoperatively and at six, twelve, and twenty-four weeks postoperatively. Secondary endpoints included pre- and post-operative patient reported outcomes (PROs) of pain and function.

Results: The average age of both the standard cohort (n=11) and expedited cohort (n=15) was 46 years. Neither cohort experienced a loss of fixation; however, one patient in the standard group underwent surgical revision. Although external rotation ROM was increased in the expedited group ($55^\circ \pm 20^\circ$ vs. $53^\circ \pm 22^\circ$) at 6 weeks, there were no other significant differences observed. The expedited group did not demonstrate statistically significant differences in PROs of pain or function at any collected timepoints.

Conclusions: Patients who undergo the expedited discontinuation of sling immobilization after BT are not at an increased risk of loss of fixation or adverse perioperative complications and have equivalent pain and function outcomes. Early sling discontinuation allows patients to resume activities of daily living sooner. Physicians may safely consider a shorter period of sling immobilization for patients following an isolated BT procedure as evidenced by equivalent patient outcomes in this study.

IFP.03.04

APPLICATION OF EXTRACORPOREAL SHOCK WAVE THERAPY APPARATUS COMBINED CLOSED CHAIN STABILITY TRAINING IN REHABILITATION OF BOXERS WITH ROTATOR CUFF TEARS

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Background: To explore the effects of extracorporeal shock wave therapy apparatus combined rotator cuff muscles and shoulder joint closed chain stability training in rehabilitation of boxers with rotator cuff tears.

Methods: A total of 36 boxers, 21 male and 15 female, who are members of the national team with rotator cuff tears due to competition training (small tear, conservative treatment), were treated in the Inner Mongolia People's Hospital and Inner Mongolia Sport Hospital from November 2017 to January 2022 were selected and divided into observation group and control group according to treatment plans, with 18 cases in each group. Both groups accepted routine interventions. The control group accepted rotator cuff muscles and shoulder joint closed chain stability training treatment, and the observation group accepted extracorporeal shock wave therapy apparatus on the basis of the control group. After 8 weeks treatment, the visual analogue scale score (VAS), the University of California at Los Angeles shoulder rating score (UCLA) and American Shoulder and Elbow Surgery score (ASES) were compared between two groups.

Results: The total effective rate (89.86%) of observation group was higher than that (62.91%) of control group ($P < 0.05$). After 8 weeks treatment, the average value of VAS score of observation group was significantly lower than that of the control group ($P < 0.05$), the average value of ASES and UCLA scores of both groups were higher than those before treatment, and the observation group were significantly higher than the control group ($P < 0.05$).

Conclusions: Extracorporeal shock wave therapy apparatus combined rotator cuff muscles and shoulder joint closed chain stability training can improve rotator cuff function of boxers with conservative treatment of small rotator cuff tear, restore exercise volume and is worthy of clinical application.

IFP.03.05

PHYSICAL HARMS ASSOCIATED WITH SUPRASCAPULAR NERVE BLOCK INTERVENTIONS IN THE NON-SURGICAL MANAGEMENT OF ACUTE AND CHRONIC SHOULDER PAIN: A SYSTEMATIC REVIEW

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Background: A significant proportion of the global population experience shoulder pain throughout a lifetime. Historically, patients who have exhausted standard care for persistent shoulder pain, or their co-morbidities precluded them, may be offered a suprascapular nerve block (SSNB) or ablation. The utility of the suprascapular nerve block (SSNB) continues to be explored in the non surgical management of acute and chronic shoulder pain, whilst the risks and physical harms have not. This review aims to address that gap to improve shared decision making. AIM: To undertake a systematic review of the physical harms associated with suprascapular nerve block (SSNB) interventions in the non-surgical management of acute and chronic shoulder pain.

Methods: Protocol registered (PROSPERO CRD42022335268) and review reported in line with PRISMA Statement and PRISMA Harms checklist. Search: EBSCO, MEDLINE, EMBASE, CINAHL, AMED, Cochrane Library, Scopus, Web of Science, and PubMed were searched from inception to 22nd December 2022. Study Selection: All study types reporting physical harms with the use of guided/ un-guided SSNB injection/ pulsed radiofrequency/ablation for the non-surgical management of acute or chronic shoulder pain were included. Cadaveric, animal and experimental studies were excluded as well as in-situ catheter, continuous SSNB, and SSNB for peri, intra, or post-surgical intervention. Data extraction and data synthesis: Two independently extracted data. The McMaster Quality Assessment of Harms tool was used to assess the quality of harms assessment and reporting. A narrative synthesis was undertaken.

Results: Within the 111 included studies, Ultrasound guided in-plane SSNB injection was the most common intervention (44 studies). Forty papers across a breadth of shoulder pathology reported 165 physical harms in 5,064 participants. Harm severity ranged from minor post injection pain (n=37) to pneumothorax (n=5). Overall, the quality of harms assessment and reporting across studies was poor.

Conclusions: Assessment and reporting of harms was poor. It is unclear if the absence of reported harm in the excluded studies was due to a failure to assess, report, or if none occurred. Based on the data available SSNB is a low-risk intervention. Future studies should assess and report harms systematically to improve data for the shared decision making process.

IFP.03.06

SHOULDER PAIN MANAGEMENT STRATEGIES AND EARLY FUNCTIONAL OUTCOME AFTER ARTHROSCOPIC ROTATOR CUFF TEAR REPAIR. A RANDOMIZED CONTROLLED STUDY

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Background: The management of acute postoperative pain after rotator cuff surgery can be challenging. To our knowledge, there are no data available in the literature correlating satisfactory pain control with improvement in terms of function. The purposes of the present study were to evaluate: 1) pain pattern after arthroscopic rotator cuff repair in patients operated with two different techniques (transosseous vs transosseous equivalent); 2) safety/efficacy of three different pharmacological pain control strategies; 3) possible relationship between a correct shoulder pain management protocol in the early post-operative period and patients' functional improvement.

Methods: 114 patients underwent rotator cuff tear repair, either with a Transosseus or a Transosseus equivalent technique. They were given one of three different pain management protocols: Paracetamol as needed (max 3 tablets/day) for 1 week (Protocol A), Paracetamol + Codein 1 tablet three times per day for 7 days (Protocol B), or Paracetamol + Ibuprofen 1 tablet two times per day for 7 days (Protocol C). Immediate passive mobilization of the operated shoulder was allowed. VAS and Passive Flexion values were recorded at 7, 15 and 30 days post-surgery. DASH values were recorded at 90 days post-surgery.

Results: At 30 days, in the transosseous group the mean passive flexion values were 165,3° (Protocol A), 180° (Protocol B) and 178,1° (Protocol C), with statistically significant differences between Protocol A vs Protocol B and Protocol A vs Protocol C. In the transosseous equivalent group, the mean passive flexion values were 152° (Protocol A), 180° (Protocol B) and 180° (Protocol C), with statistically significant differences between Protocol A vs Protocol B and Protocol A vs Protocol C. No statistically significant differences were found among the DASH values.

Conclusions: Post-operative pain is influenced by the surgical technique used. Oral anti-inflammatory drugs are a feasible strategy to appropriately control post-operative pain and attaining efficient pain-management could lead to better outcomes.

IFP.03.07

REHABILITATION FOR ATRAUMATIC SHOULDER INSTABILITY IN CIRCUS ARTS PERFORMERS: DELIVERY VIA TELEHEALTH

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Background: The Watson Instability Program (WIP1) is current best evidence for conservative management of atraumatic shoulder instability, but it is unknown if this program can be effectively delivered via tele-consultation. The purpose of this longitudinal pre/post intervention study was to determine the effects of the WIP1 on patient-reported outcome measures, scapular position, shoulder strength, and handstand stability in student circus performers with atraumatic shoulder instability when delivered via tele-consultation.

Methods: Student circus performers aged 15-35 years from the National Institute of Circus Arts with shoulder symptoms for 3.5 years (range 4 months to 11 years) were recruited. A 12-week shoulder exercise program (WIP1) was delivered via tele-consultation during COVID-19 lockdown. The primary outcome measures were the WOSI, MISS and secondary outcomes measures included Orebro Musculoskeletal Pain Questionnaire, Tampa Scale for Kinesiophobia and physical assessment measures including strength via handheld digital dynamometry, scapular position using an inclinometer and handstand stability via center-of-pressure fluctuation. Patient-reported outcomes were collected at baseline and 6-week, 12-week, 6-month, and 9-month time points. Physical outcomes were measured at baseline and 9-month time points. A repeated-measures mixed model (with effect sizes and 95% confidence intervals) was used to analyse patient-reported outcomes, handstand data, strength, and scapular measures. Significance was set at $P < .05$.

Results: 23 student circus arts performers completed the study.

Significant improvements were found in:

- WOSI at 6 and 12 weeks, 6 months and 9 months ($P < .001$)
- MISS at 6 and 12 weeks, 3 months, 6 months and 9 months ($P < .001$)
- Orebro Musculoskeletal Pain Questionnaire scores at all follow-up time points.
- Tampa Scale for Kinesiophobia scores reached significance at 6 weeks and 12 weeks.

Following rehabilitation, we found statistically significant increases in shoulder strength in all positions tested and increased scapular upward rotation measured at end-of-range abduction, as well as during loaded external rotation.

Conclusions: In a group of circus performers with atraumatic shoulder instability, treatment with the WIP1 via telehealth resulted in clinically and statistically significant improvements in shoulder symptoms and physical function (strength and scapular position).

IFP.03.08

S-START TEST AN INNOVATIVE WAY TO ASSESS A POST OPERATIVE SHOULDER AFTER AN ARTHROSCOPIC LATARJET PROCEDURE

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Background: Bone stabilization of the shoulder using the arthroscopic Latarjet technique has been known since 2007. We want to evaluate in an innovative and objective way the postoperative state of the patient by analyzing the shoulder according to the S-START method, making it possible to validate the return to sport after stabilizing surgery of the shoulder. The main objective of this study is to evaluate the satisfaction of the patients after the realization of this test.

Methods: We performed a retrospective single-center study from 2018 to 2022 including 58 arthroscopic Latarjet, performed by 1 senior surgeon, using 1 technique. We included 58 patients who underwent an arthroscopic procedure and were referred to our team of sports physicians and physical therapists for an in-depth study of their shoulder using the S-Start (Shoulder-SanTy Athletic Return To Sport) method. The S-START combines an analysis of the psychological component, the dominant/non-dominant ratio of maximal IR strength, the dominant/non-dominant ratio of maximal RE strength, the dominant/non-dominant ratio USSPT (%) (Unilateral Seated Shot Put Test in Rehabilitation), ER/RI ratio on the operated side, UQYBT (The Upper Quarter Y-Balance Test) dominant/non-dominant ratio, CKQUEST (Closed Kinetic Chain Upper Extremity Stability Test) analysis, and the endurance index resulting in a total score out of 100.

Results: We had 100% arthroscopic Latarjet, an average age of 28.9 years 75% male, 45.8% right side, 73% operated on the dominant side.

On average our patients felt 71% psychologically ready to return to risk sports and had a total score of 66/100.

Regarding our main objective, 92% of our patients felt satisfied with the test with 94% who would do the test again, 90% who reported a benefit and 88% who found it suitable for their situation.

Conclusions: We have a 92% satisfaction score with this test, which provides a reliable and objective indication allowing us to authorize a return to risk sports with peace of mind. further studies are needed and we would like to carry out a prospective study to evaluate the benefits of the S-start indications in the short term.

IFP.03.09

IS PAIN DURING ARM ELEVATION CAUSED BY SUBACROMIAL IMPINGEMENT IN PATIENTS WITH ROTATOR CUFF TEARS?

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Background: Subacromial impingement is believed to be one of the mechanisms that cause pain during arm elevation in patients with rotator cuff tears, which is traditionally called "painful arc". However, it remains unclear whether the mechanical contact between the acromion and subacromial tissues is associated with pain. The purpose of this study was to determine whether pain is caused by subacromial impingement in patients with rotator cuff tears.

Methods: Shoulder kinematics were assessed in 32 patients (38 shoulders) with rotator cuff tears during active arm elevation in the scapular plane. All patients had at least 100° of active arm elevation. The shoulders were classified as presence or absence of pain during arm elevation: 23 symptomatic and 15 asymptomatic shoulders. Humerothoracic and glenohumeral elevation angles were measured with an electromagnetic tracking device with the arm where (1) the superior facet of the greater tuberosity was immediately beneath the anterior tip of the acromion (acromion-GT position), which was confirmed by ultrasonography, and (2) the pain initially occurred (painful position). At the acromion-GT position, acromiohumeral distance was also measured on ultrasound images.

Results: There were no significant differences in humerothoracic and glenohumeral elevation angles and acromiohumeral distance at the acromion-GT position between the symptomatic ($50.4 \pm 10.2^\circ$, $37.3 \pm 8.9^\circ$, and 5.2 ± 1.5 mm, respectively) and asymptomatic ($43.5 \pm 15.0^\circ$, $34.1 \pm 10.6^\circ$, and 5.5 ± 1.5 mm, respectively) shoulders. In the symptomatic shoulders, humerothoracic and glenohumeral elevation angles at the painful position ($82.1 \pm 25.5^\circ$ and $61.7 \pm 21.5^\circ$) were significantly greater than those at the acromion-GT position ($P < .001$). The pain occurred with the arm beyond the acromion-GT position in 83% of the symptomatic shoulders.

Conclusions: Most of the patients with rotator cuff tears have pain after the greater tuberosity has passed beneath the acromion during arm elevation. This finding suggests that pain during arm elevation may be due to other mechanisms such as internal impingement. The prevalence of pain caused by subacromial impingement might be less than traditionally believed.

IFP.03.10

UTILIZING SCAPULA RETRACTION EXERCISES WITH/WITHOUT GLENOHUMERAL ROTATIONAL EXERCISES WITH A GRADUAL PROGRESSION: A DOUBLE-BLIND RANDOMIZED CONTROLLED TRIAL FOR SUBACROMIAL PAIN SYNDROME

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Background: Although exercise interventions are recommended in the management of subacromial pain syndrome (SPS), there is a lack of data regarding the exercises focusing on principal biomechanical deficiencies that cause symptoms. The aim of this study was to investigate the effect of utilizing scapula retraction exercises (SRE) with or without glenohumeral rotation exercises (GRE) at gradual shoulder elevation angles into a scapular stabilization program on symptoms and acromioclavicular distance (AHD) in patients with SPS.

Methods: Thirty-three patients were randomly assigned to either SRE or SRE+GRE. Both groups received a 12-week supervised rehabilitation program, including manual therapy and exercises (stretching and progressive scapula stabilization exercises). Additionally, the SRE+GRE group performed GRE exercises at gradual elevation angles. From 12 to 24 weeks, patients performed exercise programs less frequently (3 times per week). Disability (Shoulder Pain and Disability Index (SPADI)), AHD (at five active abduction angles), pain intensity (Visual Analogue Scale (VAS)), and patient satisfaction were recorded at baseline, 12 weeks, and 24 weeks. Sixteen healthy individuals were recruited as a control group to compare the AHD values. Data were analyzed using mixed model ANOVAs.

Results: A statistically significant group-by-time interaction was found for AHD values ($F_{4,92} = 6.38$; $p=0.001$), a significant group-by-time interaction for SPADI-disability ($F_{1,33}=5.148$; $p=0.012$), SPADI-total ($F_{1,32}=4.172$; $p=0.025$), and for pain during activity ($F_{2,62}=3.204$; $p=0.047$). However, no significant group-by-time interaction for SPADI-pain ($F_{1,33}=0.533$; $p=0.483$), for pain at rest ($F_{1,31}<0.001$; $p=0.991$) and at night ($F_{1,32}=2.166$; $p=0.15$). Yet, significant time effect was observed.

Conclusions: The present findings demonstrate that progressive SRE and GRE in the scapula stabilization program lessens symptoms and improves AHD values in patients with SPS. Moreover, that program could preserve outcomes and further increase AHD when applied less frequently. Therefore, we suggest that utilizing SRE and GRE in the scapula stabilization program at gradual shoulder abduction angles provides better rehabilitation outcomes.

IFP.04.01

SHOULDER HEALTH PROFILE AND THE EFFECT OF STROKE SPECIALITY IN ADOLESCENT COMPETITIVE SWIMMERS

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Background: Swimming may lead to adaptations in shoulder joint. The aim of this study was to examine the shoulder health profile in adolescent swimmers by evaluating the adaptations caused of competitive swimming on shoulder joint and to analyze effects of swimming strokes on shoulder health profile.

Methods: The swimmers were asked that included multiple questions regarding their primary strokes, stroke distances of competition and swimming training details. Shoulder and scapular muscle strength, scapular dyskinesia, shoulder range of motion, joint position of sense, posterior shoulder capsule tightness and the KJOC-TR questionnaire were applied. A total of 28 adolescents (control group, CG) who are not interested in overhead sports as professional or recreational and 48 professional adolescent swimmers (swimmers group, SWG) between age of 13 and 18 were included in this study muscle strength of glenohumeral (GH) and scapular muscles, range of motions of GH joint (GH ROM), observational scapular dyskinesia, active joint position sense, pectoralis minor muscle length (PML), posterior shoulder tightness were evaluated for two groups and scores of Kerlan Jobe Orthopaedic Score (KJOC) was evaluated only for SWG.

Results: Findings in the evaluation of GH, scapular muscles strength and PML are significantly higher in SWG than CG ($p < 0.05$). When the GH ROM were evaluated in two groups, SWG's internal rotation ROM is significantly lower than CG; SWG's external rotation and total rotation ROM were significantly higher than CG ($p < 0.05$). Statistically significant difference in the evaluation of active joint position sense and posterior shoulder capsule tightness between the two groups were not detected ($p > 0.05$). Statistically significant difference evaluation of all methods between the swimming strokes were not detected ($p > 0.05$).

Conclusions: This study found no significant correlation between stroke speciality and shoulder health profile in professional adolescent swimmers. Consequently, it was determined that sport specific adaptations can be occurred in shoulder complex in the adolescent swimmers. Early detection of these adaptations and developing specific injury prevention programs by determining athletes are at risk would be extremely important for future of adolescent swimmers.

IFP.04.02

RETURN TO SPORT AND RETURN TO PERFORMANCE AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR IN THE OLYMPIC VOLLEYBALL PLAYERS

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Background: The decision-making process and predicting the time to return to sport and performance in the treatment of rotator cuff tears seen in Elite Volleyball Players competing at the Olympic level are difficult issues. The aim of the study is to evaluate the results of arthroscopic supraspinatus repair and to report the return time to the sport and the return time to the performance after specific protocol of rehabilitation.

Methods: Seventeen elite athletes who underwent arthroscopic rotator cuff repair for partial and full-thickness supraspinatus tears who met the inclusion criteria were included in our study.

We evaluated the clinical results of arthroscopic rotator cuff repair after a specific rehabilitation protocol at twelve months, which was performed on athletes whose complaints did not improve despite conservative treatment. We compared the athletes' preoperative, six months and twelve months Kerlan-Jobe Orthopedic Clinic scores with the Visual Analogue Scale score measured after the competition. We also evaluated and compared postoperative six months and twelve months kinematic analyses. The athletes' return to sport and return to performance times were recorded.

Results: Athletes reached their pre-injury level. While the preoperative mean Kerlan-Jobe Orthopedic Clinic score was thirtyone, it was found to be eighty-nine in the sixth month and ninety-six in the twelfth month. Preoperative mean Visual Analogue Scale was eight while at twelve months was 0.1. The mean period of return to sport was seven months and the mean period of return to performance was fourteen months. Excellent results were obtained according to Kerlan-Jobe Orthopedic Clinic and Visual Analogue Scale scores, and kinematic evaluations in all athletes who underwent surgery for supraspinatus tears.

Conclusions: All of the athletes returned to pre-injury level sports with excellent clinical results. arthroscopic rotator cuff repair is an ideal option for elite volleyball players who do not benefit from conservative treatment. Considering that the mean Return To Sport is seven months and the mean Return To Performance is fourteen months, the athletes can plan surgical period to return to the best performance.

IFP.04.03

CHARACTERISTICS OF THE UPPER AND LOWER EXTREMITY MUSCLE STRENGTH IN HIGH-SCHOOL BASEBALL PITCHERS WITH AND WITHOUT THROWING-RELATED SHOULDER AND ELBOW INJURIES

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Background: Weakness of the upper and lower extremity muscles is thought to lead to a break in the kinetic chain, resulting in throwing-related shoulder and elbow injuries. However, little has been known about the difference in the upper and lower extremity muscle strength between pitchers with and without the shoulder and elbow injuries. The purpose of this study was to determine the relationship between the upper and lower extremity muscle strength and the shoulder and elbow injuries in high-school baseball pitchers.

Methods: Seventy-eight high-school baseball pitchers were enrolled in this study. The pitchers were assigned to either one of the two groups: the injury group (n = 41) and the control group (n = 37). Muscle strength was measured bilaterally using a dynamometer for shoulder abduction, shoulder external rotation, shoulder internal rotation, scapular retraction, hip abduction, hip external rotation, and hip internal rotation. Strength deficit for each measurement was calculated using the formula (dominant-nondominant/nondominant*100). Each variable was compared between the injury and control groups.

Results: Shoulder abduction strength on the dominant side was significantly weaker in the injury group than in the control group (106 N vs 116 N, P = .028). Strength deficit for shoulder abduction was significantly greater in the injury group than in the control group (-10% vs 1%, P = .009). Shoulder internal rotation strength on the dominant side was significantly greater in the injury group than in the control group (98 N vs 91 N, P = .045). Hip abduction strength on the dominant side (142 N vs 117 N, P = .012) and hip external rotation strength on both sides (dominant, 169 N vs 146 N, P = .002; nondominant, 165 N vs 132 N, P < .001) were significantly greater in the injury group than in the control group.

Conclusions: High-school baseball pitchers with throwing-related shoulder/elbow injuries had weaker shoulder abduction strength and greater shoulder internal rotation, hip abduction, and hip external rotation strengths. The characteristics of muscle strength may be associated with shoulder/elbow injuries.

IFP.04.04

CHARACTERISTICS OF SHOULDER MOTION IN BASEBALL PLAYERS WITH THORACIC OUTLET SYNDROME SYMPTOMS

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Background: Narrowing of the intercostal space is one cause of thoracic outlet syndrome (TOS). Shoulder abduction and external rotation, which occurs during the cocking phase of pitching, can cause narrowing of the intercostal space. Therefore, repetition of this motion may lead to the development of TOS. However, in patients with TOS, the kinematics of shoulder including the clavicle during shoulder external rotation in abduction is unknown. The purpose of this study was to determine the differences of shoulder kinematics between controls and the patients with TOS in baseball players.

Methods: Ten baseball players with TOS diagnosed by an expert orthopaedic doctor and 15 healthy baseball players were recruited. The criteria for the TOS group were baseball players with shoulder and/or elbow pain, tenderness along the interosseous space of the oblique muscle or subclavian nerve run, and the symptomatic location was directly above the ulnar nerve or in the QLS. When throwing shoulder was externally rotated at 90 degrees of abduction with passive eccentric manner in the sitting position, clavicular, scapular, thoracic, and humeral motions were measured with a three-dimensional magnetic tracking device. The angles of the thoracoclavicular, scapulothoracic, thoracohumeral, and glenohumeral joints at the maximum external rotation were calculated. Statistical analysis was performed using unpaired t-tests. The significance level was set at 5%.

Results: Range of thoracohumeral external rotation was not significantly different between the control and TOS groups ($p = 0.692$). Similarly, there were no significant differences between the two groups in scapular internal rotation ($p = 0.211$), upward rotation ($p = 0.842$), and posterior tilt ($p = 0.288$) in the maximum external shoulder rotation position. Retraction in the thoracoclavicular joint ($p = 0.007$) and horizontal extensions in the thoracohumeral ($p = 0.003$) and glenohumeral joints ($p = 0.029$) in the patients with TOS were significantly greater than those in the healthy baseball players.

Conclusions: Kinematic characteristics during eccentric shoulder external rotation in baseball players with TOS appeared to be greater clavicular retraction and horizontal extension in the thoracohumeral and glenohumeral joints. These kinematic characteristics could be a cause of TOS or compensatory change due to TOS.

IFP.04.05

CONSERVATIVE TREATMENT FOR THROWING ELBOW WITH ULNAR NEUROPATHY; A PROSPECTIVE CASE SERIES STUDY

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Background: Ulnar neuropathy is present among approximately 25% of the throwing athletes with medial elbow pain. The baseball players with medial elbow pain during maximum external rotation (MER) of pitching increase cross-sectional area of ulnar nerve. Thus, baseball players with ulnar collateral ligament (UCL) injuries and ulnar neuropathies need to be treated conservatively. The purpose of this study is to clarify the outcome conservative treatment for baseball players with ulnar neuropathy.

Methods: Eighteen high school and college baseball players with UCL injury were participated in this study. Inclusion criteria were those with medial elbow pain on MER, a positive ulnar nerve stretch test, and motor or sensory ulnar neuropathy. The cross-sectional area of ulnar nerve and the ulnohumeral joint space were measured using ultrasonography (US). Treatment of the ulnar nerve included US-guided manual therapy around the ulnar nerve and ulnar nerve mobilization. Other common treatments included ROM exercises of elbow, strength training of the flexor pronator muscles and exercises for the shoulder joint, scapulothoracic joint performed. The players were allowed to return to throwing (RTT) when ulnar nerve cross-sectional area ratio less than 126% (noda 2022) and elbow could be fully extended. The players were allowed to return to play (RTP) when they were deemed to be asymptomatic of ulnar nerve symptoms and without pain. The period from the start of rehabilitation to RTT and RTP, and the return rate were calculated.

Results: The number of subjects consisted of 10 national-level players and 8 regional-level players. The return rate for RTT was 100%, and the time to return was 2.2 ± 1.4 weeks. The return rate for RTP was 88.9%, and the time to return was 9.4 ± 3.8 weeks.

Conclusions: RTP rates in previous studies of professional baseball players varied among studies, between 42 and 85%. The ulnar nerve has not received attention and has been treated conservatively, focusing on UCL injuries. The conservative treatment focused on the ulnar nerve, which enabled an early RTP. UCL injuries with ulnar neuropathy in high school and college baseball players can be successfully treated nonoperatively in most cases.

IFP.04.06

PSYCHOLOGICAL FACTORS AFFECT RETURN TO SPORT FOLLOWING SURGERY FOR SHOULDER INSTABILITY: A SYSTEMATIC REVIEW

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Background: Shoulder instability is a common cause of missed time from sport, and identification of the multifactorial influences associated with successful return to sport (RTS) is of significant utility. Recent advances have begun to identify non-physical factors associated with RTS, yet little is known regarding these factors following surgery. The objective of this study was to determine if psychological factors were associated with RTS, identify those which may have the greatest impact, and assess the currently available psychological metrics.

Methods: Systematic review of PubMed, EMBASE, and Cochrane databases was performed. Two independently screened and included studies reporting on psychological determinants of RTS after shoulder instability surgery. Demographic, clinical, methodological, and psychometric properties were extracted, and patients were pooled for weighted analysis.

Results: 969 studies were identified, with 24 (2.5%) studies included. Of the 2135 included patients, the mean age was 26.0 (17.4-35.5), and 1809 (84.7%) were male. There were 20 studies ($n = 1784$ patients) that reported RTS rates. Mean time for RTS was 6.8 (3.7-11.9) months. There was a 76.3% rate of RTS, and of these patients, 25.2% were unable to perform at their prior level. Of the 423 patients who did not RTS, 360 (85.1%) cited a psychological reason. Fear of reinjury was the most common reason (154, 42.8%); other factors included lack of confidence in their shoulder (46, 12.8%), anxiety (45, 12.5%), depression (44, 12.2%), psychosocial factors (48, 13.3%), and lack of interest in playing (23, 6.4%). The Shoulder Return to Sport after Injury, Western Ontario Shoulder Instability Index, Quick Inventory of Depressive Symptoms Self Report, Degree of Shoulder Involvement in Sports, Tampa Scale of Kinesiophobia-11, and the Veterans Rand, were reported measures for assessing the influence of psychology on RTS.

Conclusions: Psychological factors play an important role in RTS after shoulder instability surgery with fear of reinjury being the most commonly reported impediment. The psychological characteristics identified through this review may be incorporated into future RTS protocols seeking to address resilience and non-physical factors associated with RTS. Future prospective trials regarding shoulder instability may consider incorporation of psychometric questionnaires among their study outcomes.

IFP.04.07

IS THE SHORT-FORM SHOULDER INSTABILITY RETURN TO SPORT AFTER INJURY (SIRSI-5) VALID AND CAN IT PREDICT RETURN TO SPORT IN A NEW ZEALAND POPULATION?

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Background: The Shoulder Instability-Return to Sport after Injury (SIRSI) is a reliable and valid measure of psychological readiness in people who are returning to sport after a shoulder instability episode. The SIRSI-5 is a shortened 5-item version of the SIRSI that has been validated in a post-operative Argentinian population and has been associated with return to sport. It is unknown if the SIRSI-5 is valid in a New Zealand population of operative and non-operative people who are returning to sport after a shoulder instability event or subsequent surgery. Furthermore, it is unknown if the SIRSI-5 will correctly classify those who have returned to sport in a New Zealand population.

Methods: Seventy-nine participants were included. The SIRSI-5 and SIRSI-12 total scores were calculated. Validity was assessed with Intraclass correlation coefficients (ICCs) and Pearson's correlations. The discriminative ability of SIRSI-5 cutpoint score (>54/100) to determine participants who had returned to sport to pre-injury level was assessed through logistic regression. In addition, the discriminative ability of a multi-variable model including age, sex, time since injury, SIRSI-5, surgery, contact/non-contact to predict return to pre-injury level sport was assessed through logistic regression. The Youden index was calculated to assess the models' performance. A Youden index above 0.5 suggests a reasonable prediction accuracy.

Results: The SIRSI-5 and SIRSI-12 were highly correlated ($r > 0.9$) and presented with high levels of agreement (ICC: 0.90; 95%CI: 0.76-0.95). Only 32% (n=25) of participants had returned to pre-injury level sport. The prediction accuracy of the SIRSI-5 cutpoint score model was 66% (Youden index:0; Sensitivity:4%; Specificity:94%). The prediction accuracy of the multi-variable model was 71% (Youden index:0.2; Sensitivity:32%; Specificity:89%).

Conclusions: The SIRSI-5 is a valid measure of psychological readiness and results in less patient-burden than the SIRSI. However, in a operative and non-operative New Zealand population, the SIRSI-5 with a cutpoint of >54/100 has low levels of prediction accuracy (66%). Multi-variable modelling increased the prediction accuracy of return to sport (71%). Further investigations are required to establish whether the inclusion of other variables or different modeling approaches could provide a more accurate classification model for return to sport.

IFP.04.08

USEFULNESS OF A NOVEL PHYSICAL EXAMINATION "RELEASE PUSH TEST" FOR THROWING SHOULDER INJURY

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Background: In the management for baseball player with throwing shoulder pain, it is important to differentiate mechanisms of pain during throwing. Physical examinations are useful to detect pain with loading at specific shoulder positions such as maximum external rotation in abduction. However, physical examinations at various shoulder positions are necessary because the shoulder continuously moves during throwing. The purpose of this study was to determine usefulness of a novel physical examination "release push test (RPT)" simulating ball release position during throwing in baseball players with throwing shoulder pain.

Methods: Fifty-five baseball players with throwing shoulder pain were recruited. All the players were asked if they had the shoulder pain in cocking phase and/or thereafter (acceleration and follow-through phases). In the RPT, the players pushed the tester's hand at the simulated hand position of ball release during throwing. Full can test, empty can test, internal impingement test, Neer impingement sign, Hawkins impingement sign, and O'Brien test were also performed. All tests indicated positive when shoulder pain was provoked during the test. Statistical analysis was performed to compare positive rates among all the tests.

Results: The highest positive rate was shown in the RPT (51%), followed by the internal impingement test (38%). The positive rate of the RPT was significantly higher than full can test ($P<0.001$), empty can test ($P<0.001$), Neer impingement sign ($P=0.014$), Hawkins impingement sign ($P<0.001$). Number of positive only on the RPT was 10, which was equally the most to the internal impingement test. The players who showed positive on the RPT reported significantly more shoulder pain after cocking phase of throwing compared to the players who showed positive on the Internal impingement test and reported more shoulder pain in the cocking phase.

Conclusions: This study suggested that the RPT may be useful as the pain provocation test to judge the start or strength change of throwing because the RPT showed high positive rate and could detect specific pain in players with throwing shoulder pain.

IFP.04.09

EFFECTS OF BASEBALL EXPERIENCES AND POSITION ON MEDIAL ELBOW JOINT SPACE AND HUMERORADIAL JOINT MOBILITY WITH ELBOW VALGUS STRESS

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Background: Baseball players may increase their medial elbow joint space due to elbow valgus stress during throwing motion. A previous study reported that humeroradial joint geometry is related to medial elbow joint space; however, the effect of valgus stress on the humeroradial joint is unclear. This study aimed to investigate whether baseball experience and position cause changes in the medial elbow space and humeroradial joint mobility.

Methods: Thirty healthy men participated in this study. The participants were divided into three groups (pitcher, fielder, and no baseball experience [control] groups), with 10 participants in each group. The participants underwent an elbow valgus stress test in the supine position and 30° flexion of the elbow joint. The distance of the medial elbow joint space and distance between the radial head and lateral epicondyle with valgus stress were measured using ultrasonography. The amount of movement before and after the stress was determined and defined as the medial elbow joint space and humeroradial joint mobility, respectively. One-way analysis of variance with the Bonferroni method was used for comparison between the three groups.

Results: The medial elbow joint space was 2.24 ± 1.06 mm, 1.48 ± 0.64 mm, and 0.92 ± 0.23 mm for the pitcher, fielder, and control groups, respectively; the pitcher and fielder groups had significantly higher values than the control group ($p < 0.05$). The humeroradial joint mobility was 0.47 ± 0.18 mm, 0.78 ± 0.37 mm, and 1.26 ± 0.17 mm in the pitcher, fielder, and control groups respectively; the pitcher and fielder groups had significantly lower values than the control group ($p < 0.05$).

Conclusions: This study suggested that regardless of position, repetitive throwing motion can cause increased medial elbow joint space and decreased the humeroradial joint mobility. The pronation movement of the forearm decreases the medial elbow joint space. Additionally, a throwing motion decreases the elasticity of the pronator teres, thereby limiting the humeroradial joint valgus mobility. Therefore, the pronator teres may be involved in increasing the medial elbow joint space and decreasing the humeroradial joint mobility.

IFP.04.10

PREVENTION FOR THROWING INJURIES IN YOUTH BASEBALL PLAYERS: TO BE COMPATIBLE WITH BOTH THE PREVENTION AND PERFORMANCE ENHANCEMENT

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Background: Throwing injuries of the shoulder and elbow are common among youth baseball players. A randomized study in youth baseball players showed a reduction of throwing injuries by half after practice of 9 stretching and strengthening exercises. However, that study was not designed to evaluate the effect for baseball performance. The purpose of this randomized controlled trial was to investigate the effectiveness of a prevention program on the incidence of throwing injuries of the shoulder and elbow and the enhancement of baseball performance in youth baseball players.

Methods: The randomized 6 youth baseball teams consisting of 268 players aged 8 to 11 years into an intervention group (3 teams, 122 players) and a control group (3 teams, 146 players). The intervention program consisted of all balance exercise, multiple squat exercises, and skip exercises performed during warm-up. Both groups were followed up for 10 months, during which the incidence of shoulder and elbow injuries was recorded. In addition, ball speed and ball spin ratio during pitching, and swing speed during batting as performance-related factors were measured during the pre- and postintervention periods. Variables of physical function (single leg balance, chest expansion length, and thoracic kyphosis angle) were assessed during the pre- and postintervention periods.

Results: The incidence of shoulder and elbow injuries in the intervention group (23/122, 18.9%) was significantly lower than that in the control group (55/146, 37.7%) (hazard ratio, 45.6%; $P = .02$). The factors related to performance, as assessed by swing speed, tended to increase in the intervention group as compared with the control group ($P = .001$). The program also improved single leg balance ($P = .047$), chest expansion length ($P = .001$), and the thoracic kyphosis angle ($P = .047$).

Conclusions: A prevention program decreases throwing injuries of the shoulder and elbow and enhances the parameter of baseball performance in youth baseball players.

IFP.05.01

THE EFFECT OF VIBRATION EXERCISES IN DIFFERENT SHOULDER POSITIONS ON THE ACTIVATION OF THE SHOULDER COMPLEX MUSCLES

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Background: The use of flexi-bar, which is a type of vibration device, increases muscle activation compared to traditional resistance training methods during various exercises. Knowing which muscle is more activated at which degree of movement can be a guide in terms of planning a targeted and optimal treatment.

This study aimed to evaluate and compare the effects of flexi-bar use in different shoulder positions on electromyographic (EMG) activity of upper trapezius(UT), lower trapezius(LT), infraspinatus(IS), middle deltoid(MD), and serratus anterior(SA) muscles in healthy people.

Methods: Ten healthy volunteers, who did not have weakness or pain in diagnostic tests, were assessed with ultrasonography for any shoulder pathologies.

Average peak muscle activity (% maximum voluntary isometric contraction) was calculated in the shoulder muscles during 3 different positions; in arm adducted position, 90-degree-elevation in the scapular plane and 90-degree-flexion in the sagittal plane. Participants were asked for shaking the flexi-bar in these positions. At the same time, the effects were compared to small-amplitude and large-amplitude vibration in different shoulder positions. A repeated measures test was used for statistical analysis.

Results: There was a significant difference between all shoulder positions only for the MD muscle ($p < 0.05$). For SA muscle, a significant decrease was found in arm adducted position compared to other positions ($p < 0.05$).

While the activation of the SA and MD muscles were low in arm adducted position, moderate-high muscle activations were observed in the scapular and sagittal planes.

Higher activation was observed in the SA (29.51% MVIC) and MD (41.42% MVIC) muscles during large-amplitude in the scapular plane.

In the scapular plane, there was a significant increase in the activation of all muscles from small-amplitude to large-amplitude ($P < 0.05$).

Conclusions: In early rehabilitation, where higher SA activation in scapular plane is desired, exercises could be performed with large-amplitude. MD exercises may be started in arm adducted position, then progress to sagittal plane, and progress to scapular plane. It may be started with a small-amplitude and progressed with a large-amplitude.

According to our results, the muscles activations were increased during performed small-amplitude/large-amplitude and in the different shoulder positions.

It may be chosen different exercises, for the targeted muscle activation.

IFP.05.02

A SYSTEMATIC REVIEW OF THE EFFECTS OF NON-ELASTIC AND ELASTIC SHOULDER TAPING IN THE OVERHEAD ATHLETES

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Background: Taping is a popular approach and different taping methods are frequently used in clinical practice. Although elastic and rigid taping techniques are widely used as an intervention, there is little or limited evidence about their benefits and differences between different materials. Therefore, the aim of this study was to evaluate the current literature regarding the effects of different taping techniques in overhead athletes.

Methods: Literature search was performed in PubMed and Web of Science entries related to rotational range of motion (RoM), posterior shoulder tightness (PST), kinematics, muscular activity, acromiohumeral distance (AHD), proprioception, strength, and performance. Only studies investigating immediate effects of elastic or rigid taping in overhead athletes were included. Eligible studies were selected and the risk of bias was evaluated. Study characteristics, taping technique, outcome measures evaluated in the study, and the results were extracted.

Results: Twenty studies were eligible. Eight studies used rigid taping (RT), nine studies used elastic taping (ET) and three studies investigated and compared both taping methods. Majority of the applied taping methods were scapular and humeral head repositioning taping. There was limited evidence to support ET use in improving glenohumeral IR RoM, scapular kinematics during arm elevation, AHD, scapular proprioception, and shoulder rotational strength in overhead athletes. There was only limited evidence showing acute benefits of humeral head repositioning RT for passive glenohumeral RoM. Two of the three studies compared the two taping methods had results in favor of ET in strength and total rotational ROM, while one study that evaluated scapular kinematics, there was no difference between the groups.

Conclusions: Based on our findings, there is moderate to limited evidence to support the effectiveness of taping for acute gains in glenohumeral rotational RoM, AHD, scapular proprioception, and scapular kinematics in overhead athletes, which is mostly supported when ET is applied. In the management of the athlete shoulder, taping-only approaches should not be focused on, and taping can be integrated in a more comprehensive approach for the overhead athletes.

IFP.05.03

POSITIONING EFFICACY AND COMFORT PROFILE OF SHOULDER SUPPORT BRACES: A RANDOMIZED REPEATED-MEASURES STUDY USING THREE-DIMENSIONAL KINEMATIC ANALYSIS

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Background: Shoulder bracing is very common in musculoskeletal rehabilitation. In this study, the positioning efficacy of shoulder support braces was investigated by analyzing their three-dimensional kinematic properties, as well as their perceived comfort was investigated with user ratings.

Methods: Seventeen asymptomatic participants were included. Scapular, humeral, and thoracic kinematics for all participants were measured using an electromagnetic tracking device in 6 experiments in randomized order: no brace, neutral brace, abduction brace, internal rotation brace, 15-degree external rotation brace (ER15-B), and 30-degree external rotation brace (ER30-B). Also, comfort ratings were obtained during each session.

Results: Internal rotation brace achieved a mean of 29.34° of humerothoracic internal rotation while providing increased scapular internal rotation and upward rotation ($p < 0.05$). Abduction brace achieved a mean of 45.39° of humerothoracic and 39.58° of glenohumeral elevation coupled with increased scapular upward rotation, posterior tilt, and humeral internal rotation ($p < 0.05$). 30-Degree external rotation brace achieved a mean of 33.25° of glenohumeral external rotation and resulted in increased scapular external rotation, upward rotation, posterior tilt, and humeral external rotation ($p < 0.05$). Abduction brace, internal rotation brace, ER15-B, and ER30-B moved the thoracic spine into a more axial rotation in the contralateral direction. Internal rotation brace, ER15-B, and ER30-B were rated more uncomfortable when compared with the no brace condition, with no significant differences observed among the braces.

Conclusions: The positioning efficacy was enhanced when an abduction pillow and external rotation wedge were applied. Selection of commercially available shoulder support braces should involve consideration of whether it can achieve the desired position and orientation as well as its comfort profile.

IFP.05.04

CLINICAL OUTCOME OF ULTRASOUND-GUIDED ACCELERATED REHABILITATION AFTER THE MANIPULATION UNDER ULTRASOUND-GUIDED CERVICAL NERVE ROOT BLOCK FOR FROZEN SHOULDER: CASE-SERIES STUDY

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Background: Recently, shoulder manipulation under ultrasound-guided cervical nerve root block (MUC) has been performed to treat person with frozen shoulder, however, rehabilitation after MUC is rarely discussed. We have performed ultrasound-guided accelerated rehabilitation from the acute phase after MUC, which promote repair of invasive tissues such as the inferior glenohumeral capsule (IGC) and achieve earlier range of motion in the shoulder. The purpose of this case-series study is clarified outcome of the accelerated rehabilitation after MUC for frozen shoulder.

Methods: Twenty persons who were performed accelerated rehabilitation after MUC for frozen shoulder were participated in the study. Acute phase after MUC, ultrasound-guided injection of the physiological saline was performed for following structures: (1) IGC and axially nerve, (2) coracohumeral ligament complex, (3) superior scapular nerve, (4) myofascia of the subscapularis. The same structures were treated with ultrasound-guided manual therapy after injection. During the first week after MUC, injections and physiotherapy were performed 4 days a week. In addition, weekly injections, and physiotherapy twice a week were given until 1 month after MUC. The range of motion of shoulder flexion, abduction, external and internal rotation, and the numerical rating scale (NRS) of the motion pain was assessed before and one month after MUC. Moreover, the thickness of the IGC was assessed using ultrasound image at the intersection of the line between the surgical neck and the anatomical neck with the capsule before and one month after MUC. Difference outcome between before and one month after MUC were compared using paired t-test.

Results: Shoulder range of motions (flexion $165.3\pm 7.9^\circ$, abduction $161.5\pm 15.7^\circ$, external rotation $55.8\pm 9.2^\circ$, and internal rotation 9.4 ± 2.3) one month after MUC were significantly increased those of before MUC (flexion $107.3\pm 13.5^\circ$, abduction $84.5\pm 19.3^\circ$, external rotation $23\pm 13^\circ$, and internal rotation 2.3 ± 1.3) ($p < 0.05$). The motion pain NRS significantly decrease one month after MUC (8.7 ± 1.6 to 2.1 ± 1.4) ($p < 0.05$). IGC thickness before MUC (2.5 ± 0.9 mm) demonstrated significantly decreased one month after MUC (1.8 ± 0.7 mm) ($p < 0.05$).

Conclusions: Ultrasound-guided accelerated rehabilitation after MUC, consisting of both injection and manual therapy for the same structure, can improve range of motion earlier without compromising healing of IGC.

IFP.05.05

EFFECT OF THE RADIAL PRESSURE WAVE THERAPY IN STRETCHING POSITION ON STIFFNESS TERES MINOR MUSCLE WITH FROZEN SHOULDER

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Background: Physiotherapy for the frozen shoulder suffers from increasing the muscles stiffness, and the effective treatment needs to develop. Recently, the extra corporeal shock wave therapy has the possibility to decrease muscle stiffness in chronic musculoskeletal disorders (Luan S. 2019, Manafnezhad J. 2019). However, the effects of the radial pressure wave therapy (RPWT) on muscle stiffness remain unclear. Furthermore, there is no evidence for RPWT in any patient position. The purpose of this study is to clarify the effects of the PWT in stretching position on stiffness of the teres minor (Tm) for frozen shoulder.

Methods: The study was designed as a Double-blind control trial. Forty-five patients with the frozen shoulder were divided at random into three groups according to the position of the shoulder exposed to the RPW: the 0-degree group (group0), the 90-degree flexion group (group90), and the 90-degree flexion and maximum internal rotation group (group IR). All patients had been performed the RPWT (3barr 2000 shots, 12Hz) for the Tm after confirmed ultrasound imaging by a physiotherapist. The shear wave velocity (SWV) of the Tm was assessed using ultrasound elastography by the other tester before and after RPWT. The Percent of SWV after RPWT divided by the SWV before it was defined as the change of RPWT. The difference SWV of Tm and change of the RPWT among three groups were assessed using one-way ANOVA with Turkey test.

Results: The SWV was no significant difference among three groups in before RPWT (group0: 3.4 ± 0.7 m/s, group90: 3.5 ± 0.8 m/s, group IR: 4.3 ± 0.5 m/s). After RPWT, SWV was no significant difference among three groups in before RPWT (group0: 2.8 ± 0.8 m/s, group90: 2.65 ± 0.6 m/s, group IR: 2.7 ± 0.3 m/s). The change of RPWT of group IR ($64.5 \pm 13.3\%$) demonstrated significantly larger than that of the group90 ($75.2 \pm 17.7\%$) and group0 ($87.9 \pm 23.8\%$) ($p=0.02$).

Conclusions: The RPWT in the stretching position for the Tm has a possibility to decrease the muscle stiffness in the frozen shoulder.

IFP.05.06

PATIENT'S PERCEPTIONS AND UTILIZATION OF PHYSICAL THERAPY AFTER ORTHOPAEDIC SURGERY

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Background: Formal Physical Therapy (PT) traditionally has been a critical part of postoperative recovery after orthopaedic surgery but due to recent cost containment efforts in health care and bundle payments, the coverage for formal PT has become limited. As access to physical therapy is threatened, alternatives to formal PT have been proposed, including telerehabilitation, internet-based PT, and even home-based physician-guided PT. The purpose of this study was to understand patient perceptions of PT, the benefits, perception of improvements, access to PT and alternative forms of PT after shoulder surgery.

Methods: This cross-sectional study used an anonymous survey of 80 orthopedic surgery shoulder patients at a single institution. The variables collected included demographics, access to PT, number of PT sessions, insurance, copayment, patients' perceptions of improvement, and their opinion about internet-based PT (IBPT). Answers were designed using Likert-scale or multiple-choice questions. Descriptive statistics were used to report survey data. Analyses were performed based on demographic variables using independent t-test, chi-square tests, and an analysis of variance (ANOVA).

Results: Patients attended an average of 16 ± 13.8 PT sessions with a perceived $65\% \pm 32.2$ average improvement attributed to their sessions. The average copay was $\$18 \pm 20.8$ per session, which 56.14% agreed or strongly agreed that it was reasonable. Sixty five percent of patients perceived improvement in their condition attributable to their physical therapy sessions and 94.8% of patients agreed or strongly agreed their therapist took the time to educate them. When asked about IBPT, 52.5% disagreed that successful PT could be achieved by IBPT. There were also 68.6% of patients who responded that they would not consider using IBPT even after a few in-person sessions.

Conclusions: Patients have a positive perception of their therapist, cost, number of sessions, and utility of PT to impact their improvements following orthopedic shoulder surgery. As cost containment remains a priority, it seems that for internet-based PT to be a viable alternative this will require integration and close engagement of a physical therapist, given patient's perception and values on the impact of in person formal PT.

IFP.05.07

CONSERVATIVE TREATMENT FOR IDIOPATHIC FROZEN SHOULDER, IS SUPERVISED NEGLECT THE ANSWER? A SYSTEMATIC REVIEW

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Background: Although many reports have described the success of conservative treatment when dealing with idiopathic frozen shoulder (FS), there is a lack of information regarding which type of various conservative treatment results in the most superior outcome. This study aims to describe the most beneficial conservative treatment for idiopathic frozen shoulder.

Methods: After registered on PROSPERO, we searched PubMed, Embase, and Scopus databases using Medical Subject Headings terms and boolean operation. This study measured clinical outcomes using the improvement of active range of motion (ROM) and patient-reported outcome measures (PROMs). Numerical data analysis was calculated based on weighted means based on the number of patients involved in each study. We report this systematic review according to Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines.

Results: A total of 10 articles consisting of seven level 1B and three level 2B studies were included, including 498 idiopathic frozen shoulder cases. The patient's mean duration of symptoms was 22.5 weeks before intervention. From current literature, supervised neglect resulted in the highest percentage of ROM improvement in all planes, followed by physiotherapy modalities.

Conclusions: Although according to the present literature, supervised neglect is the most beneficial conservative therapy in improving ROM and clinical outcomes, prospective trials with an equal baseline are highly recommended to validate this finding. However, physiotherapy has been proven to provide an adequate range of motion and clinical outcome improvement.

IFP.05.08

PAIN VS. STRENGTH: WHICH OUTCOME IS MORE RESPONSIVE TO PERCEIVED IMPROVEMENTS AFTER PHYSICAL THERAPY FOR SHOULDER PAIN?

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Background: Pain and weakness are common impairments that negatively impact arm function, lifting, and exercise tolerance in patients with shoulder pain. Here we measured whether changes in shoulder pain and strength can discriminate patients who report symptom improvements after physical therapy for shoulder pain.

Methods: We recruited 16 patients (8 females, age: 55.0 ± 19.0 years, BMI: 26.4 ± 3.9 kg/m²) undergoing physical therapy for shoulder pain. The same tester evaluated patients at baseline and discharge. We measured pain intensity during movement-evoked pain (MEP): participants performed five standardized upper-arm tasks (comb hair, raise the arm overhead, cross-reach, reach behind their back, and raise the arm overhead with 1.36 kg weight) and rated their shoulder pain while performing these activities (0-10, 0 no pain). Using a handheld dynamometer, we measured shoulder maximal isometric strength in elevation, external rotation, and internal rotation. At discharge, we used the Global Rating of Change scale (GROC) to dichotomize patients into two groups: "improved" (GROC greater than 5) and "not improved" (GROC less than 5). We used the area under the receiver operating characteristic curves (AUC) to evaluate whether changes in MEP and shoulder strength (between baseline and discharge) discriminated between patients who improved and those who did not. We calculated the MCID based on the cut-off point of the receiver operating characteristic curves that maximized sensitivity and specificity.

Results: 10 patients were classified into the improved group. The changes in the numeric pain rating scale during the MEP tasks did not discriminate patients based on self-reported improvement ($AUC < 0.6$, $p > 0.05$). The change of shoulder strength demonstrated acceptable to excellent discriminating abilities for self-reported improvements (elevation: $AUC = 0.83$, $p = 0.02$, MCID: 0.68 kg; ER: $AUC = 0.88$, $p < 0.01$, MCID: 0.68 kg; IR: $AUC = 0.79$, $p = 0.02$, MCID: 0.45 kg).

Conclusions: Gains in shoulder strength discriminated patients who felt improved after physical therapy, but the reduction in pain intensity during MEP did not. Treatment that maximizes shoulder strengthening may benefit patients with shoulder pain. An assessment and treatment approach considering factors beyond pain reduction is crucial for optimal patient care.

ICSES E-POSTERS

Shoulder Basic Science

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TOXIC EFFECTS OF LOCAL ANESTHETICS ON RAT FIBROBLASTS: AN IN-VITRO STUDY

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Background: Infusion catheters are often utilized to control pain after arthroscopic shoulder surgery, facilitating a controlled infusion of local anesthetic into the subacromial space. Although infusion of anesthetic can provide efficacious pain control, the potential effects on fibroblasts, which promote tendon healing, are unknown. This experiment sought to assess the toxicity of varying local anesthetics to fibroblasts and the potential impact on tendon repair.

Methods: Rat synovial fibroblasts were cultured in 12-well plates. Dilutions of the appropriate drug were prepared in a solution containing reduced-serum media and 0.9% sodium chloride in 1:1 concentration. Each well was treated with 500µl of the appropriate anesthetic dilution or normal saline control for 15 or 30 minutes. Anesthetic dilutions included: 0.5% ropivacaine HCl, 0.2% ropivacaine HCl, 1% lidocaine HCl and epinephrine 1:100,000, 1% lidocaine HCl, 0.5% bupivacaine HCl and epinephrine 1:200,000, and 0.5% bupivacaine HCl. This was replicated three times. Cell viability was determined using propidium iodide, and viable cells were counted with flow cytometry. Dilution of each local anesthetic whereby 50% of the cells were unviable (Lethal dose 50 [LD50]) was analyzed.

Results: LD50 was reached for most local anesthetics, with toxicity increasing in the following order: ropivacaine 0.5% (toxic at 30 minutes), lidocaine 1% with epinephrine (toxic at 30 minutes), lidocaine 1% (toxic at 15 and 30 minutes), bupivacaine 0.5% (toxic at 15 and 30 minutes), and bupivacaine 0.5% with epinephrine (toxic at 15 and 30 minutes). Cells treated with ropivacaine 0.2% did not reach LD50, remaining viable at 15 and 30 minutes of treatment. Overall, increased duration of exposure to each anesthetic resulted in an increased deleterious impact on cell viability.

Conclusions: Pain pumps have become popular given their efficacy and ease of placement, which are key in when performing outpatient shoulder surgery. However, our findings suggest that local anesthetics are toxic to rat fibroblasts in-vitro, thus may prohibit fibroblast promotion of healing such as in the setting of rotator cuff repair. Should a continuous infusion of local anesthetic be used, our data supports ropivacaine 0.2%.

EP.01.002

A RAT MODEL TO STUDY POSSIBLE MECHANISMS UNDERLYING PAINFUL SMALL ROTATOR CUFF TEAR

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Background: In daily clinical practice, we frequently encounter patients suffering from refractory shoulder pain caused by small rotator cuff tear (sRCT). To clarify underlying mechanisms of this pain, we have developed a novel rat model that mimics subacromial impingement phenomenon in human sRCT.

Methods: At first, sRCT was created by hollowing out the origin of left supraspinatus and infraspinatus tendon with a 3mm bone biopsy needle (N=10, T group). Then, 100-times scratch were added to the torn tendon using a rasp (N=10, S+ group). A sham model was also created by splitting deltoid muscle and tendon exposure (N=10, Sham). Pain-related behavior was evaluated by weight distribution of forelimbs during 5-minutes free gait using a special device (Dynamic Weight Bearing system, Bioseb) at 2,4,6, and 8 weeks. Area of scar tissues around the torn tendon, infiltration of inflammatory cells, and severity of tendon degeneration (modified Bonar score) were histologically assessed at 4 and 8 weeks. To identify a reaction of pain-associated neural systems, we evaluated expressions of calcitonin gene-related peptide (CGRP) in dorsal root ganglion (DRG) neurons of C4/5/6 at 4 and 8 weeks.

Results: The weight distribution ratio (ipsilateral /contralateral side) was significantly decreased in the S+ group until 4 weeks compared with its baseline and T group ($P<0.05$), but the T group showed no significant difference compared with Sham. Area of scar formation and density of inflammatory cells within the scar were not significantly different between T and S+ group in each period. By contrast, the modified Bonar score of the torn tendon and expression of CGRP-immunoreactive DRG neurons were significantly higher in the S+ group compared with T group and Sham at 4 and 8 weeks ($P<0.05$).

Conclusions: Our sRCT model did not provoke pain by itself. The scratch model was extremely simple but enabled us to evaluate effects of repeated mechanical stimuli to the torn tendon, resembling a condition following subacromial impingement in human. Interestingly, scratching altered not only local tissues but also pain-associated neural systems even if the size of torn tendon is small.

EP.01.003

BIOMECHANICAL COMPARISON OF A DYNAMIC, SELF TENSIONING SUTURE WITH COMMON SUTURE TYPES

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Background: We compared the biomechanical performance of a suture with proposed self-tensioning properties (Dynacord) against 3 commonly-used high tensile sutures by evaluating suture loop length changes, responses to cyclic loading, and failure testing with saline soaks. We hypothesized that the Dynacord suture would contract when exposed to saline, a property relevant to loop security and maintaining construct integrity after rotator cuff repair.

Methods: Six knots each of 4 different No. 2 sutures were tied around a stainless-steel dowel from the Fundamentals of Arthroscopic Surgery Training (FAST) module: 3 commonly-used high-tensile sutures (Orthocord, FiberWire, Ethibond), and a newer, dynamically self-tensioning suture (Dynacord). The loop length was then measured by applying a 0.1N force on a tensile test machine (Insight 5). The knots were then soaked in a 37°C saline bath for 24 hours. The loop lengths were re-measured before testing. Knots were then pre-conditioned with a 10N load for 1 minute, and cyclic load testing was performed for 200 cycles from 10-45N at 35 N/s. Knots were then soaked in the saline bath for another 24 hours. Cyclic load testing was repeated before each knot was pulled to failure at 0.5 mm/s, with maximum load and stiffness being recorded. Values were compared using non-parametric comparative statistical tests.

Results: Dynacord loop length decreased by 28.4% after first soak ($p=0.002$), whereas the other sutures demonstrated no change ($p>0.05$ for all). After the second soak, Dynacord's loop length was still significantly reduced compared to its initial length ($p=0.03$), while all other suture loops had elongated. Dynacord and FiberWire maintained similar cyclic elongation in each iteration, whereas Ethibond ($p=0.03$) and Orthocord ($p=0.005$) had significantly less cyclic elongation during the second cyclic load test. Ethibond had the lowest peak load to failure compared to all other suture types ($p=0.002$). FiberWire had the greatest stiffness ($p=0.006$).

Conclusions: Compared to other suture types, Dynacord showed dynamic properties-- demonstrating an initial decrease in loop length after soaking followed by maintenance of this loop security after a second soak despite increased loop length during interval cyclic loading. This has implications in construct stability after arthroscopic rotator cuff repair.

EP.01.004

THE RELATION BETWEEN AGE AND FATTY INFILTRATION IN THE NON-TORN ROTATOR CUFF MUSCLES BY MRI-DIXON TECHNIQUE

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Background: It is important to evaluate correctly the fatty infiltration(FI) in rotator cuff muscles(RCMs) of patients with rotator cuff tears(RCTs) because it is related to the treatment strategy and the postoperative outcome. In recent years, MRI using the DIXON method has made it possible to quantitatively evaluate FI in muscle. It is necessary to know the fat fraction(FF) in the non-torn RCMs at an age to provide a basic index for various FF evaluations in RCMs. The purpose of this study was to measure the FF of males and females in each RCM using the DIXON method in patients without RCTs and to examine the relation with age.

Methods: 62 patients and 62 shoulders without RCTs were included in the study. 29 males and 32 females were included and the mean age was 46.8(16-75) years in males and 48.9(15-73) years in females. 3.0T MR system was used to images by the DIXON method. The region of interest was defined as each RCM on the most lateral slice of the scapula Y view in oblique sagittal images by the ImageJ software. The FF was calculated as (signal intensity of fat image)/(signal intensity of in-phase image) x 100 (%). We evaluated the relation between the FF in each RCM and the age using Pearson's correlation coefficient(CC). A value of $P < 0.05$ was considered statistically significant.

Results: The mean FF in each RCM was 22.9/21.8% for the subscapularis(SSC), 18.6/18.6% for the supraspinatus(SSP), 16.9/18.1% for the infraspinatus(ISP), and 15.1/14.9% for the teres minor(TM) in the males/females groups. The CC(P) for each RCM with age was 0.50(0.007)/0.35(0.055) for the SSC, 0.42(0.027)/0.63(<0.001) for the SSP, 0.36 (0.056)/0.66(<0.001) for the ISP, and 0.36(0.053)/0.33(0.069) for the TM in the males/females groups.

Conclusions: The FI in the SSP and ISP in females especially may change with age. Quantitative evaluation of the FI in RCMs by the DIXON method in patients with RCTs has been reported to be more accurate than the qualitative Goutallier classification, and its development is expected. The results of this study may provide a basic index for examining the FI in RCMs quantitatively.

EP.01.005

IDENTIFICATION OF RARE CANDIDATE PREDISPOSITION VARIANTS FOR ROTATOR CUFF TEARING IN HIGH-RISK PEDIGREES

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Background: Multiple common genetic variants have been associated with rotator cuff tearing. Rare, highly penetrant variants associated with a risk for tearing have not been previously identified. The purpose of this study was to identify strong candidate rare variants using an affected cousin pair design in pedigrees at high-risk for rotator cuff tears requiring surgical repair.

Methods: We analyzed genetic sequence data for 9 affected cousin pairs (first or second cousins) where all cousins had undergone arthroscopic surgery for repair of a full thickness rotator cuff tear and who were members of pedigrees exhibiting a significant excess of individuals undergoing full thickness rotator cuff tear surgery. Validation of association of the candidate variants identified with risk for rotator cuff tearing was accomplished utilizing data from the UK Biobank.

Results: A total of 82 rare (minor allele frequency <0.005) genetic variants were identified as shared in at least one cousin pair affected with full thickness rotator cuff tearing (mean age at diagnosis 68 years). Of the rare variants identified, one variant was identified in the gene Runt-related transcription factor 1 (RUNX1), one in the gene Disintegrin and metalloproteinase domain-containing protein 12 (ADAM12), one in the gene Transforming growth factor beta receptor 2 (TGFB2), one in Amyloid Precursor Protein-Binding Protein (APBB1) and two separate genes in the mitogen activated protein kinase (MAPK) pathway (MAP3K4, MAP3K1). Of the 82 rare candidate variants, 39 were observed in UK Biobank data. Analysis of these variants in the UK Biobank data identified one significant association in the APBB1 gene (OR=2.37, $p=0.007$, uncorrected).

Conclusions: This unique analysis of closely related individuals with confirmed full thickness rotator cuff tears from high-risk pedigrees has identified a strong set of 82 rare candidate genetic predisposition variants which should be pursued in independent studies. Among these rare variants, variants in APBB1, RUNX1, ADAM12, TGFB2 as well as several MAPK pathway genes were identified, all with potential biologic roles in the development of rotator cuff tears. Further clinical and animal testing and extension of the high-risk pedigrees identified is required to confirm the role of these genes in rotator cuff tearing.

EP.01.007

ANALYSIS OF CLINICAL OUTCOMES OF COMBINATORIAL EFFECT OF BMAC AND PRP ON ROTATOR CUFF TENDINOPATHY

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Background: In recent, the possibilities of Orthobiologics as potential regenerative therapeutics have been extensively explored. Orthobiologics are relatively highly safer choice over various therapeutics. Use of the Orthobiologics to treat musculoskeletal disorders in continuously increasing. Autologous blood-derived products such as platelet-rich plasma (PRP), bone marrow aspirate (BMA) and BMA concentrate (BMAC), have been extensively reported for their beneficial effect in post-surgery healing. Although several studies attempted to validate the effectiveness of these therapeutics, however, a standardized and reproducible protocols are missing. Several reports on efficacy of PRP for the treatment of cartilage, bone and muscle tissues are established, however the role in Rotator Cuff Tear is still doubtful. BMAC has generated optimistic results as regenerative therapy, its applicability in clinical trials is relatively newer in comparison to PRP.

Methods: This study is focused on clinical evaluation of BMAC+PRP injection to the RCT patients. This study was conducted on 96 patients, divided in three groups 1) control group with 33 patients, received placebo; 2) combination therapy group with 33 patients, received BMAC+PRP; 3) PRP groups included 30 patients. The mean age of the groups was 58, 59, and 52 of Control, BMAC+PRP and PRP respectively.

Results: Based on clinical symptom and pain score the efficacy of the study groups were evaluated. For logical inference discuss the results from the study groups, the previous researches on BMAC and PRP were considered. A comparative study of the neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), and Mean Platelet Volume (MVP) among the study groups were also evaluated to correlate the healing effect of BMAC. The combination of the PRP with BMAC has been found to be more effective and the respective CBC data also support the same.

Conclusions: The study concludes that BMAC+PRP injection showed a significant improvement in healing of RCT.

EP.01.008

DEEP TRANSFER LEARNING APPROACH FOR SHOULDER ABNORMALITIES DETECTION USING X-RAY IMAGES

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Background: The detection of shoulder abnormalities through X-ray images can be challenging and time consuming. Deep learning (DL) has shown great performance on several tasks including X-ray image application which is also employed for shoulder fracture detection. DL requires a large amount of data to perform well which is the reason that previous methods showed low performance in shoulder abnormality detection. Furthermore, Transfer Learning (TL) from publicly available large dataset ImageNet is typically used to solve data scarcity issue which was proven ineffective due to mismatch between colour features of ImageNet and gray-scale X-ray images. Thus, the aim of this study is to propose a novel TL approach for detection of shoulder abnormalities using X-ray images.

Methods: Our study proposes a novel double TL approach to detect shoulder abnormalities using X-ray images. The proposed TL is based on training seven pre-trained models of ImageNet on a large number of X-ray images from different parts (e.g., elbow, finger, forearm, hand, humerus, and wrist) to update learned features and then fine-tune them on target dataset of shoulder X-ray images. The proposed approach alleviates domain mismatch problem. The feature fusion technique has been used by combining extracted feature with seven deep neural network models (Xception, Inception-ResNet V2, MobilNet, V2, EfficientNetb0, DenseNet201, ResNet101, NasNetlarge) to train several machine learning classifiers.

Results: The proposed method of double TL was an effective approach, making use of feature fusion provided fully descriptive features to distinguish between classes. Our proposed method achieved an accuracy of 99.2%, F1 score of 99.2%, and Cohen's kappa of 98.5% in detecting shoulder abnormalities from X-ray images. Additionally, the accuracy of the results from our method was validated using three visualisation tools to ensure that the trained deep learning model was looking at the shoulder joint while classifying abnormalities from plain radiographs, making its use in clinical context more trustworthy. These included a gradient-based class activation heat map (Grad CAM), activation visualization, and locally interpretable model-independent explanations (LIME).

Conclusions: Deep Learning could be used as an efficient tool to automatically detect shoulder abnormalities using X-ray images.

EP.01.009

TONIC-CLONIC SEIZURE BURDEN INFLUENCES GLENOID VERSION IN EPILEPTIC PATIENTS.

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Background: Patients with epilepsy may suffer from a vast spectrum of different shoulder injuries, with a high frequency posterior dislocations. Increased glenoid retroversion has been noted in patients with posterior instability, but it is unclear whether bony changes are adaptive. During a tonic-clonic seizure, the humeral head is drawn cranially and posteriorly against the glenoid fossa by muscular contraction. This force may either dislocate the humerus posteriorly or cause plastic deformations, which may have a relevance especially in the developmental age. The aim of this study was to evaluate if the frequency of tonic-clonic epileptic seizures affects the glenoid version angle.

Methods: Patients referred to a tertiary epilepsy centre suffering from various forms of epilepsy presenting tonic-clonic episodes (generalized tonic-clonic and bilateral tonic-clonic seizures) were enrolled. The duration of epilepsy and the frequency of tonic-clonic seizures were recorded and the glenoid version according to Friedmann as well as the humeral posterior subluxation were measured on axial MRI reconstructions. The cumulative tonic-clonic seizure burden (TCSB) was calculated multiplying the duration of epilepsy by the number of yearly tonic-clonic seizures to compare patients with a low TCSB (< 50) with those with a high TCSB (>50).

Results: Clinical and radiological data were collected for 56 epileptic patients. 37 patients had a low TCSB and 19 a high TCSB (age: 33 ± 10.95 versus 37.63 ± 12.02 , p : n.s.; TCSB: 13.2 ± 14.7 versus 274 ± 225 , $p < 0.0001$). High-TCSB patients had a significantly greater glenoid retroversion than low-TCSB patients (right shoulder: $7.45 \pm 7.06^\circ$ versus $3.31 \pm 4.97^\circ$, $p = 0.02$; left shoulder: $6.37 \pm 4.90^\circ$ versus $1.51 \pm 4.51^\circ$, $p = 0.001$). No significant differences were encountered in the subluxation index between the two groups (right shoulder $55 \pm 7\%$ versus $53 \pm 5\%$, p : n.s.; left shoulder: $55 \pm 5\%$ versus $53 \pm 5\%$, p : n.s.).

Conclusions: Epileptic patients suffering frequent tonic-clonic seizures show a higher glenoid retroversion as compared to patients with rare tonic-clonic episodes. This could be the effect of a plastic deformation of the glenoid during growth caused by repeated posteriorly directed powerful muscular contraction during tonic-clonic seizures.

EP.01.010

SUTURE DEBRIS FROM HIGH-TENSILE SUTURES IS A SIGNIFICANT CONTRIBUTOR TO PARTICLE-INDUCED TISSUE RESPONSE IN SHOULDER HEMIARTHROPLASTY

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Background: Humeral head hemiarthroplasty (HHA) is an established arthroplasty option for multiple indications when there is limited glenoid erosion. We previously reported on periprosthetic tissue responses to implant debris in total shoulder arthroplasties (TSA) and found significant macrophage and giant cell reactions indicative of osteolysis responding to polyethylene (UHMWPE) debris. Hemiarthroplasties were considered unlikely to exhibit similar responses due to the absence of a polyethylene glenoid. We analyzed implant and tissue retrievals from HHA and hypothesized there would be a lack of both polyethylene debris and tissue responses to UHMWPE.

Methods: We analyzed nine retrieved HHA. All were painful, four exhibited aseptic loosening, one septic loosening, and one with instability. Periprosthetic membrane tissue was taken for histologic analysis. The metal bearing and stem and head taper surface damage were graded with a stereomicroscope. Periprosthetic tissue was evaluated for debris and graded for immune cell presence. Histopathological findings were compared to those of anatomic and reverse TSA using Mann-Whitney tests.

Results: Component damage was minimal to mild and not significantly different compared to aTSA and rTSA. UHMWPE suture debris was present in 7 cases. Particles were mostly found within or around macrophages. The mean macrophage score was 3.0 ± 0.7 which was lower ($p=0.023$) compared to our previous findings for aTSA (3.6 ± 0.7), but the same as found for rTSA. The mean foreign- giant cell score was 2.2 ± 1.0 which was also lower ($p=0.017$) compared to aTSA (3.2 ± 1.0), and the same ($p=0.53$) as found previously for rTSA (2.5 ± 1.2). There was, on average, no significant lymphocyte or neutrophil presence except in the septic case.

Conclusions: Surprisingly, this cohort of retrieved HHA exhibited considerable macrophage and FBGC responses. Our hypothesis, that the absence of a polyethylene glenoid component would prevent a particle induced tissue response, was rejected. While the overall tissue response appears milder than that in aTSA, it is comparable to that of rTSA. The multiple high tensile UHMWPE sutures used in shoulder arthroplasty for subscapularis repair are thought to be a significant cause of wear debris and a potential driver of the biologic response which requires future study.

EP.01.011

IN SILICO ANALYSIS OF RIB FORCE DISTRIBUTION IN POST SCAPULOTHORACIC FUSION MODEL

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Background: Patients suffering from Facioscapulothoracic Muscular Dystrophy (FSHMD) can have impaired quality of life due to their dysfunctional shoulder joint. Scapulothoracic fusion is carried out by fixing the ventral scapula wall to the dorsal faces of ribs to achieve fixation. A biomechanical analysis of this rare procedure has not been conducted in the literature and, thus, for the first time, this study investigates the finite-element calculated glenohumeral-applied load distributions on the ribs for different fixation scenarios.

Methods: Using the Visible Human Dataset, the ribcage, scapula, and clavicle geometries of an adult female are segmented and converted into a solid shoulder joint model. The scapula is then bent conformally to contact the 2nd to 7th ribs, replicating the fusion. The model is then transferred to finite element analysis software (ANSYS Inc., Canonsburg, PA, USA) for the simulation of the biomechanical loads. Three loading directions on the glenohumeral joint are designated, which are dorsal-ventral (horizontal abduction-adduction), superior-inferior (vertical abduction-adduction), and medial-lateral (push-pull on shoulder) and for each loading, the 2nd to 7th ribs reaction forces are recorded. The simulations are repeated by removing a rib contact to observe the distributions in case of missing contact or failed fusion. A scenario is tested to mimic clavicle osteotomy and the resultant forces recorded. The resultant force distributions are expressed as % of applied load.

Results: Across all fixations and loading cases, 2nd rib carries the least magnitude of forces (average, 16%), closely followed by 7th (average, 20%). Conversely, 3rd rib carried the highest magnitude of loads (average, 64%). The total reaction forces for 2nd to 7th ribs are the lowest for pure medial-lateral loading (average, 80%) while highest for superior-inferior loading (average, 193%); total dorsal-ventral reaction forces are close to inferior-superior (average, 188%). The highest clavicle fixation point reaction force is observed for dorsal-ventral (average 113%) and lowest for medial-lateral loading (average 32%). When the clavicle is free, the reaction forces sharply increased. The highest average increase is observed in dorsal-ventral (596%), followed by medial-lateral (123%), and inferior-superior loading (61%).

Conclusions: The most critical ribs for fusion are determined to be 3rd and 6th. Clavicle osteotomy dramatically increases the forces on the ribs, thus can be interpreted as having a higher risk of failure.

EP.01.012

THE DOUBLE CIRCLE DOUBLE ANGLE RADIOGRAPHIC METHOD

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Background: Shoulder radiographs are utilized for evaluation and treatment of various pathologies. The delineation of diagnoses of these pathologies is appreciated by the alteration of the normal humeral head and its registry to the glenoid. Quantification of these changes in registry does not currently exist. The purpose of this study is to introduce a coordinate system of one circle relative to another such that relative measurements will be able to quantify the impact of primary GHOA and CTA from a normal shoulder.

Methods: Sixty-nine shoulders with Grashey view radiographs were obtained in 23 normal shoulders, 21 GHOA shoulders, and 25 CTA. Next a perfect circle method was used on the humeral head to define the Circle of the Humeral Head (cHH). Next a circle of best fit is created of the glenoid (cG) which is created at the center point of the of the glenoid surface. The circle is then enlarged (keeping that a line from the origin to the center of the glenoid is perpendicular to the surface of the glenoid) to the point the circle reaches the undersurface of acromion. The relationship between cHH and cG is defined by measuring the angle between two circles (the Beta angle) in the horizontal plane and the angle in the vertical plane the Theta angle. These angles were then compared by diagnosis.

Results: The relationship of the circles in the normal shoulder had an average Beta angle of 68.0 ± 6.2 degrees and a Theta angle of 119 ± 4.26 degrees. In shoulders with GHOA, the average Beta angle was 65.3 ± 7.2 degrees and average Theta angle was 160 ± 23.3 degrees. In the CTA group, the average Beta angle was 92.3 ± 16.7 degrees and the average Theta angle was 136 ± 18.4 degrees. When comparing the Beta and Theta angles by diagnosis, there was a significant difference between all combinations ($p < 0.001$), except when comparing the Beta angle of normal shoulder to GHOA.

Conclusions: Together, the Beta and Theta angles distinguish between a normal shoulder, GHOA, and CTA. These angles change by the pathology of the glenohumeral joint and will allow for a simple method of quantification of different pathological entities.

EP.01.013

EXPRESSION ANALYSIS OF TENDON-DERIVED MARKERS IN HUMAN ROTATOR CUFF-DERIVED CELLS IN THREE-DIMENSIONAL CULTURE

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Background: Rotator cuff tears affect more than 40% of patients over the age of 60, and large and massive tears are difficult to treat due to high reports of re-tears. Since most re-tears occur within the first three months after surgery, it is important to promote biological healing of the repaired rotator cuff and increase strength in the early postoperative period to prevent re-tears. In addition, spheroids produced in three-dimensional culture have better differentiation and viability than cells produced in two-dimensional culture. Therefore, in this study, we hypothesized that spheroids of human rotator cuff-derived cells obtained in three-dimensional culture would have higher anabolic marker levels of gene expression and protein concentration involved in rotator cuff regeneration and healing than cells obtained in two-dimensional culture.

Methods: Eight patients who underwent surgical treatment for rotator cuff tears were included. Tissue was harvested during arthroscopic rotator cuff repair, and rotator cuff-derived cells were isolated and cultured. The following two groups were set up. (1) 2D group (Cells grown in two-dimensional culture) (2) 3D group (Cells grown in three-dimensional culture). TASCL (Tapered Stencil for Cluster Culture, Cymms-bio. Ltd.) was used for three-dimensional culture. mRNA expression of COL1A1, COL2A1, Tenomodulin (Tnmd), Scleraxis (SCX), and Hypoxia Inducible Factor 1 (HIF1) was evaluated by real-time PCR 48 hours after cell seeding. The expression of SCX and HIF1 was also assessed by fluorescent immunostaining. In addition, intracellular protein expression of SCX was measured by Enzyme-linked immunosorbent assay.

Results: Using TASCL, the formation of spheroids of human rotator cuff-derived cells was confirmed. The mRNA expressions of COL1A1, SCX, Tnmd, and HIF1 in the 3D group were significantly higher than in the 2D group ($p < 0.05$). Fluorescent immunostaining showed the expression of SCX and HIF1 in both spheroid and 2D cells. Intracellular protein expression of SCX was significantly higher in the 3D group in ELISA ($p < 0.05$).

Conclusions: This study showed that Spheroids of rotator cuff-derived cells increase tendon markers and intracellular protein expression of SCX. Spheroids of rotator cuff-derived cells have the potential to promote tendon repair.

EP.01.014

A SURVEY AND BIOMECHANICAL ANALYSIS OF THE FEASIBILITY OF THE THUMB TEST FOR DETERMINING THE CANCELLOUS BONE QUALITY FOR STEMLESS SHOULDER PROSTHESIS

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Background: The effect of the thumb test (TT) for assessing cancellous bone quality at the resection plane of proximal humerus on determining the application of a stemless shoulder prosthesis remains unclear. This study was conducted to survey the current utilization of TT among surgeons and to investigate biomechanical features of TT with a focus on preferred compression techniques.

Methods: A survey among shoulder surgeons who had experience with stemless prostheses was conducted to investigate the current utilization of preoperative assessments and the intraoperative TT in order to determine the presence of a sufficient bone quality when applying stemless prosthesis. Eight examiners performed TT using artificial bone models simulating cancellous bone at the resection plane. The compression force, contact pressure and area were measured using a flexible force sensor. According to the preliminary survey, three compression techniques were assessed: compression perpendicular to the surface with the thumb pad (P-pad technique) or tip of the thumb (P-tip technique), or compression in the vertical direction simulating compression along the longitudinal axis of the humeral shaft with the tip-pad of the thumb (H-axis technique). The contact area was separated into three subregions (proximal, middle and distal) to assess the distribution of contact pressure.

Results: Thirty-eight surgeons from among the 95 institutions participated. Most surgeons adopted preoperative radiologic assessments, while 66% utilized TT intraoperatively. The P-pad technique was more frequently applied than the P-tip or H-axis techniques (80%, 4% and 16%, respectively). Biomechanical assessments showed wide variation among the examiners. The P-pad technique showed a significantly larger contact area and less compression force than the P-tip technique. Among the three techniques, the P-pad technique provided no significant localized differences in the mean contact pressure on the compressed plane, whereas the P-tip and H-axis techniques showed significant differences among subregions.

Conclusions: This study demonstrated relatively frequent application of TT on determining the application of stemless shoulder prosthesis. Biomechanically, the P-pad technique for TT can be used with consistent distribution of compression force. Regardless of the pressure techniques, however, TT continues to hinder objective reproducibility among examiners. A further investigation to identify feasible assessments of the bone quality is therefore required.

EP.01.015

EFFECT OF POLYDEOXYRIBONUCLEOTIDE AND POLYNUCLEOTIDE ON HEALING AND FATTY DEGENERATION OF ROTATOR CUFF IN HYPERCHOLESTEROLEMIC RAT MODEL

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Background: The aim of this study to explore the effects of polydeoxyribonucleotide (PDRN) and polynucleotide (PN) on tendon healing and reversal of fatty degeneration in hypercholesterolemic rat model with chronic rotator cuff tear.

Methods: Fifty six male SD rats were randomly assigned to four groups (14 rats per group: 6 for histological evaluation and 8 for mechanical and blood testing): one normal rat group (saline+repair: NSR), three hypercholesterolemic (HC) diet-induced HC rat groups (saline+repair: HSR, PDRN+repair: HPR, and PN+repair: HPNR). The right shoulder was used for experimental interventions, and the left served as a control. Four weeks after detaching the infraspinatus, the torn tendon was repaired with administration of saline, PDRN, or PN into the repair sites. And 2 weeks after repair, same materials were injected, again. Histological and mechanical evaluation was performed at 4 weeks after repair and the plasma levels of growth factors were checked at repair, 2 and 4 weeks after repair.

Results: At 4 weeks after repair, the mean load-to-failures of the right shoulders of HPR and HPNR groups (24.64 ± 10.76 and 20.42 ± 6.21) are higher than that of HSR group (14.33 ± 6.52), but there were no statistically significant differences ($p=.086$ and $p=.528$, respectively). The HPR group had more parallel and continuous collagen fibers ($p=.028$ and $p=.028$, respectively) and fewer adipose cells in Oil Red O and H&E stains ($p=.012$ and $p=.020$, respectively) than the HSR group. And HPNR group had fewer adipose cells than the HSR group, also ($p=.012$). The HPR and HPNR groups had fewer CD68 stains cells than the HSR groups ($p=.023$ and $p=.025$, respectively). The mean plasma vascular endothelial growth factor (VEGF) at 2 weeks after repair showed a significant difference between HSR and HPR groups ($p=.031$). The mean plasma VEGF at 4 weeks after repair showed a significant difference between HSR and HPNR groups ($p=.008$). The mean plasma fibroblast growth factor at 2 weeks after repair showed a significant difference between HSR and HPR, and HSR and HPNR groups ($p=.018$ and $p=.025$, respectively).

Conclusions: PDRN and PN might improve tendon healing and decrease fatty degeneration after cuff repair in hypercholesterolemic state.

EP.01.017

A METHOD FOR MEASURING THE HUMERAL BONE MINERAL DENSITY.

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Background: There is no established method for measuring the bone mineral density of the proximal humerus. The primary purpose of this study is to establish a protocol to assess the areal bone mineral density at the proximal humerus using dual-energy X-ray absorptiometry. The secondary purpose is to investigate the correlation between the bone mineral density of the proximal humerus and that of the lumbar spine and femur, in order to predict the bone mineral density of the proximal humerus from that of the lumbar spine and femur.

Methods: The inclusion criteria were an age over 60 years females; a diagnosis of osteoporosis by dual-energy X-ray absorptiometry. The bone mineral density of the proximal humerus was calculated in seven regions of interest: the head of the bone, lesser tubercle, greater tubercle in two locations, and proximal metaphysis in three locations. The intra- and inter-examiner reliability in dual-energy X-ray absorptiometry imaging and regions of interest modifications were examined by intraclass correlation coefficients (1, 1) and (2, 1). The correlation of the bone mineral density was assessed by Spearman's correlation coefficient.

Results: The intra-examiner and inter-examiner reliability were 0.997 and 0.948, respectively. There was a positive correlation between the bone mineral density of each region of interest of all parts of the humerus and that of the lumbar spine and proximal humerus.

Conclusions: This study demonstrates that the bone mineral density of the proximal humerus can be estimated based on the bone mineral density of the lumbar spine and proximal femur.

EP.01.018

IN VITRO OSTEOPOROSIS MODEL OF MINIPIG: BIOMECHANICAL STUDY WITH ALL SUTURE ANCHOR AND CONVENTIONAL SCREW TYPE ANCHOR

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Background: The minipig has been used for research in various fields of medicine, even in orthopedics. Though previous studies have already suggested other methods to create osteoporotic bone, those methods had some disadvantages for taking time and efforts. Therefore, we aimed to generate osteoporotic proximal humerus and proximal femur of minipig using EDTA solution, and validate their osteoporotic biomechanical properties.

Methods: Six minipigs were used. Out of a total of 12 proximal humerus (PH) and 12 proximal femurs (PF), 6 PH and 6 PF were used as the experimental group and the opposite side as the control group. The experimental group and the control group were compared by performing biomechanical test using two types of suture anchors. In vitro decalcification with Ca-chelating agents (0.5M EDTA solution, pH 7.4) was used. Decalcified group and non-decalcified group were compared. Area BMD (aBMD) was measured using dual-energy x-ray absorptiometry, Volumetric BMD (vBMD), and microstructure were measured using micro-CT scanning. Universal testing machine (UTM) was used to measure ultimate load to failure and gap displacement of anchors (all-suture anchor and conventional screw type anchor) in biomechanical test.

Results: There were significant difference in aBMD and vBMD between the decalcified group and the non-decalcified group (aBMD: decalcified group, $0.433 \text{ g/cm}^2 \pm 0.073$, non-decalcified group, $0.962 \text{ g/cm}^2 \pm 0.123$, $p < 0.001$; vBMD: decalcified group, $0.360 \text{ g/cm}^3 \pm 0.115$, non-decalcified group, $0.481 \text{ g/cm}^3 \pm 0.075$, $p = 0.03$). In the case of all-suture anchor, the pull-out strength (ultimate load to failure) was significantly lower in the experimental group (decalcified group, 176.6 ± 74.2 ; non-decalcified group, 307.7 ± 116.5 , $p = 0.003$). In the case of conventional screw type anchor, there was no significant difference between the experimental group and the control group (decalcified group, 265.1 ± 96.0 ; non-decalcified group, 289.4 ± 114.5 , $p > 0.05$).

Conclusions: Creating the osteoporotic minipig bone using EDTA method was a reproducible and reliable method. Furthermore, according to our anchor-related biomechanical experiments for developed osteoporotic minipig bone, conventional screw type anchor would be appropriate in osteoporotic bone, rather than all-suture anchor.

EP.01.019

REGENERATIVE EFFECT OF EXOSOME ISOLATED FROM ADSCS ON TENDON HEALING AND REMODELING OF MATRIX.

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Background: Exosome, is extracellular vesicle secreted by various cells, containing a powerful cocktail of epigenetic regulators. The contents of exosome have potentials to reprogram the residents cells and can regulate cell cycle, promote differentiation, and induce the matrix remodeling. In this study, we explore the possibilities with exosome in tendon healing. As it is well understood, that the healing of degenerative tendinopathy, is very difficult due its complex structure and lowered vascularization, and limited/absence of resident cells which may reprogramed to proliferate in tenocyte.

Methods: Thus, in this study the potentials of Exosome as cellular reprogramming and matrix remodeling was evaluated. In this study, we isolated exosome from adipose-derived stem cells (ADSCs) and evaluated their ability to promote tendon regeneration. We also compare the dose and efficacy of the exosome with collagen and piroxicam (NSAID). Our results indicated that ADSC-EVs significantly enhanced the proliferation and migration of tenocytes in vitro. To further study the roles of ADSC-exosomes in tendon regeneration, ADSC-Exosome were used in tendon repair in rat model. The Bonar's scores, based on histopathological data, was used as degree of healing.

Results: It was observed that ADSC-Exos promote proliferation and migration of tenocytes significantly. The In-vivo study showed that ADSC-Exos induces early healing of injured tendons. Rats treated with ADSC-Exos had better fiber arrangement and histological scores at the injury site. After 6 weeks, the ADSC-Exo group had higher Bonar's scores. A lower fibril density, and a larger collagen diameter was also observed in comparison to the groups treated with piroxicam and collagen treated rats. ADSC-Exo also stimulated the proliferation and migration of tenocytes and improved the tendon cellularity and ECM remodeling relatively.

Conclusions: These results suggest that ADSC-Exos could be a promising therapeutics to treat tendon injuries, however requires clinical data to validate the same.

EP.01.020

EFFECT OF MICROBEAD CONTAINING TGF BETA 1 ON THE SUSTAINED DRUG DELIVERY IN A RAT MODEL

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Background: The objective of this study was to evaluate the effect of magnetic microbead, which was developed for letting the drug staying on the desired location by a magnetic force, on the sustained transforming growth factor beta 1 (TGF-b1) delivery using a rat rotator cuff repair model.

Methods: A total of 24 rats were randomly allocated into 3 groups after making acute supraspinatus tear in both shoulder: supraspinatus repair alone (n=8) (A), repair + TGF-b1 local injection on the repair site (n=8) (B), and repair + TGF-b1 laden magnetic microbead local application on the repair site (n=8) (C). For the Group C, an micro-magnet was implanted into the humeral head near the greater tuberosity in all rats to pull the magnetic microbead on the repair site by magnetic force. One and 7 days after surgery, the supraspinatus tendon of the left shoulder and the en-block bone-to-tendon repair site of the right shoulder were harvested. The PCR and western blot analyses were performed using the supraspinatus tendon of the left shoulder, and immunohistochemical analysis was performed in the en-block bone-to-tendon repair site of the right shoulder.

Results: The expression of TGF-b1 was significantly higher both in the group B and C compared with the group A, and, there was no difference between group B and C, in day 1. However, in day 7, the group C showed significantly higher expression of TGF-b1 expression compared with the group B ($p=0.027$) as well as the group A ($p=0.005$). The Immunohistochemistry for TGF-b1 showed higher staining intensity in the group C compared with the group A and B, and the location of stained TGF-b1 was throughout the repair site, that is, not only on the repair site or in the supraspinatus, but also inside the humeral head.

Conclusions: The TGF-b1 laden magnetic microbead applied on the rotator cuff repair site could keep the TGF-b1 around the repair site sustainedly up to 7 days. The use of a magnetic microbead may be a possible option for the sustained drug delivery exactly to the target site, further to improve healing after rotator cuff repair.

EP.01.022

THE EFFECT OF ROTATOR CUFF DENERVATION ACCORDING TO THE COLLIN CLASSIFICATION ON EX-VIVO SHOULDER BIOMECHANICS

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Background: Rotator cuff tears are often associated with pain and disability. The Collin classification of rotator cuff tears was developed to evaluate the effect of tear pattern on shoulder function. To date, this classification has not been evaluated biomechanically; therefore, the purpose of this study was to assess the effect of rotator cuff denervation according to the Collin classification on shoulder biomechanics using an ex-vivo shoulder motion simulator.

Methods: An ex-vivo shoulder motion simulator was used to simulate scapular plane elevation (SPE), forward flexion (FF), and internal/external rotation (IER) in eight cadaveric specimens (56 ± 6 years). Motion was performed for seven rotator cuff states: intact, supraspinatus denervation, and five rotator cuff denervation states according to Collin classification types A through E. Muscle denervation was simulated by releasing tension on the muscle tendon. Repeated measures analysis of variance was used to evaluate the effect of rotator cuff state on joint kinematics and muscles forces.

Results: For SPE, all denervation models excluding types D and E had total deltoid forces greater than the intact state ($P < .05$) and type B had higher anterior deltoid forces than all states except type C ($P < .05$). Teres minor forces were greater for type D than all other states ($P < .001$), and type A had higher inferior subscapularis forces than all other states except the intact state ($P < .01$). For FF, all denervation states required higher total deltoid forces than the intact state ($P < .05$) and type A had higher inferior subscapularis forces than all other states ($P < .01$). Types C, D, and E achieved less elevation than the intact state ($P < .05$), and type B was more external rotated than all other states ($P < .001$). During IER, type B was significantly more externally rotated ($P < .01$) and type E was significantly more internally rotated ($P < .001$) than all other states.

Conclusions: This study presents the first biomechanical evaluation of the Collin classification and shows there is a significant effect of tear pattern on joint kinematics and muscle forces. These findings provide insight to better understand why some tear patterns result in function loss while others do not.

EP.01.023

DOES THE WALCH TYPE B SHOULDER HAVE A TRANSVERSE FORCE COUPLE IMBALANCE? A VOLUMETRIC ANALYSIS OF SEGMENTED ROTATOR CUFF MUSCLES IN OSTEOARTHRITIC SHOULDERS

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Background: The etiology of the Walch type B shoulder remains unclear. We hypothesized that a scapulohumeral muscle imbalance, due to a disturbed rotator cuff transverse force couple (TFC), may have a role in the pathogenesis of the type B morphology. The purpose was to determine whether there is a TFC imbalance in the Walch type B shoulder using an imaging-based 3D volumetric and fatty infiltration assessment of rotator cuff muscles.

Methods: CTs of 33 Walch type A and 60 Walch type B shoulders with complete scapula and humerus were evaluated. The 3D volumes of subscapularis, supraspinatus, and infraspinatus-teres minor (Infra-Tm) were manually segmented and analyzed. Additionally, anthropometric parameters including glenoid version, inclination, posterior humeral head subluxation, and humeral torsion were measured. The 3D muscle analysis was then compared with the anthropometric parameters using the Wilcoxon rank sum and Kruskal-Wallis tests.

Results: There were no significant differences ($P > .200$) in muscle volume ratios between the Infra-Tm and the subscapularis in Walch type A (0.93) and type B (0.96) shoulders. The fatty infiltration percentage ratio, however, was significantly greater in type B shoulders (0.94 vs. 0.75, $P < .001$). The Infra-Tm to subscapularis fatty infiltration percentage ratio was significantly larger in patients with $>75\%$ humeral head subluxation than in those with $60\%-75\%$ head subluxation (0.97 vs. 0.74, $P < .001$) and significantly larger in patients with $>25^\circ$ of retroversion than in those with $<15^\circ$ of retroversion (1.10 vs. 0.75, $P = .004$). The supraspinatus fatty infiltration percentage was significantly lower in Walch type B shoulders than type A ($P = .004$). Walch type A shoulders had mean humeral retrotorsion of 22 ± 10 whereas Walch type B had humeral retrotorsion of only 14 ± 9 relative to the epicondylar axis ($P < .001$).

Conclusions: The TFC is in balance in the Walch type B shoulder in terms of 3D volumetric rotator cuff muscle analysis; however, the posterior rotator cuff does demonstrate increased fatty infiltration. Posterior humeral head subluxation and glenoid retroversion, which are pathognomonic of the Walch type B shoulder, may lead to a disturbance in the length-tension relationship of the posterior rotator cuff, causing fatty infiltration.

EP.01.024

THE RELATION BETWEEN 'AGE AND FATTY INFILTRATION IN THE NON-TORN SUPRASPINATUS MUSCLE' AND 'AGE AND MUSCLE ATROPHY IN IT' BY MRI-DIXON TECHNIQUE

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Background: It is important to evaluate correctly the fatty infiltration(FI) and the muscle atrophy(MA) in supraspinatus muscles(SSPs) of patients with rotator cuff tears(RCTs) because it is related to the treatment strategy and the postoperative outcome. In recent years, MRI using the DIXON method has made it possible to quantitatively evaluate FI in muscle. It is necessary to know the quantified FI and MA in the non-torn SSPs at an age to provide a basic index for various quantified FI and MA evaluations in SSPs. The purpose of this study was to measure the quantified FI and MA of males and females in SSPs using the DIXON method in patients without RCTs and to examine the relation with age.

Methods: 62 patients and 62 shoulders without RCTs were included in the study. 29 males and 32 females were included and the mean age was 46.8(16-75) years in males and 48.9(15-73) years in females. 3.0T MR system was used to images by the DIXON method. The region of interest was defined as SSP and supraspinatus fossa according to Thomazeau's method on the most lateral slice of the scapula Y view in oblique sagittal images by the ImageJ software. The fat fraction(FF) was calculated as (signal intensity of fat image)/(signal intensity of in-phase image) x 100 (%). The percentage of MA was calculated as (area of SSP)/(area of supraspinatus fossa) x 100 (%). We evaluated the relation between 'the age and FF in SSP' and 'the age and percentage of MA in it' using Pearson's correlation coefficient(CC). A value of P<0.05 was considered statistically significant.

Results: The mean FF in SSP was 18.6/18.6% in the males/females groups. The mean percentage of MA was 69.2/61.3% in the males/females groups. The CC(P) for the FF in SSP with age was 0.42(0.03)/0.63(<0.001) in the males/females groups. The CC(P) for the percentage of MA in it with age was -0.48(0.01)/-0.66(<0.001) in the males/females groups.

Conclusions: The FI and MA in the SSP in females especially may change with age. The results of this study may provide a basic index for examining the FI and MA in SSPs quantitatively.

EP.01.025

ANTIOXIDANTS REDUCE OXIDATIVE STRESS AND ACCELERATE TENDON-TO-BONE HEALING AFTER ROTATOR CUFF REPAIR

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Background: Oxidative stress inhibits tendon-to-bone healing after rotator cuff repair. Regulation of oxidative stress can promote the healing, but the mechanism remains unclear. Therefore, we aimed to investigate the effects of reducing oxidative stress by applying antioxidants, such as N-acetylcysteine (NAC) and vitamin C (VC), on rotator cuff repair in a rat rotator cuff repair model.

Methods: Forty-eight Sprague Dawley rats underwent bilateral surgery to repair the infraspinatus tendon to its insertion site 1 week after detachment. Rats were assigned to either the NAC group, VC group, or control group. Histological evaluation was performed by hematoxylin-eosin HE/toluidine blue staining, and oxidative stress was assessed by dihydroethidium intensity and protein carbonyl concentration at 3 and 6 weeks. Superoxide dismutase (SOD) 1, SOD2, SOD3, peroxiredoxin 5, collagen type I (COL1), COL3, matrix metalloproteinases (MMP)-1, MMP-3, and MMP-13 expression and SOD activity were determined at 3 and 6 weeks. Biomechanical tests were performed at 6 and 12 weeks.

Results: Histological evaluation showed that the number of chondrocytes in the NAC group at 6 weeks and in the VC group at 3 and 6 weeks, the area of fibrocartilage at 6 weeks in the VC group, and collagen fibers at 6 weeks in the NAC and VC groups were significantly increased compared with those in the control group. Dihydroethidium intensity at 3 and 6 weeks and protein carbonyls at 6 weeks in the NAC and VC groups were significantly decreased. SOD1 expression and SOD activity at 3 weeks in the VC group and peroxiredoxin 5 expression at 6 weeks in the NAC group were significantly upregulated than in the control group. COL3 expression was significantly upregulated at 6 weeks in the VC group, and MMP-13 expression was significantly decreased at 3 and 6 weeks in the NAC and VC groups. The biomechanical strength showed no significant difference.

Conclusions: Antioxidant treatment, through NAC or VC administration, reduced oxidative stress in the rotator cuff repair site and accelerated healing.

EP.01.026

ANALYSIS OF SHOULDER MOTION WITH INERTIAL SENSORS IN POLAND SYNDROME PATIENTS

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Background: Poland syndrome (PS) is a rare congenital malformation characterized by agenesis or hypoplasia of pectoralis muscles. Most patients live a normal life and practicing sports. There is a limited literature on how the anatomic anomalies of PS may impact the movement of the shoulder both functionally and biomechanically. In this study we analyze the effects of the absence of the pectoralis major and minor muscles on the kinematic of glenohumeral and scapulothoracic joints by motion sensors acquisitions and clinical evaluation.

Methods: This study enrolled twenty-four patients affected by PS. Clinical evaluation was performed analyzing range of motion (ROM), stability of the shoulder, rotator cuff disease and internal-rotation strength. In all patient we used wireless inertial sensors to analyze the scapular motion patterns in three degrees of freedom: medium-lateral rotation, posterior tilting and protraction-retraction. The same analysis was performed by dividing the patients into 2 groups by age (<18yo/>18yo) to evaluate the presence of age-related alterations.

Results: No differences in ROM between the pathological side and the healthy side were observed. All patients were positive for posterior instability tests. No significant differences in strength in internal rotation were observed with average +6,91% (s= 2,14) on the healthy side's strength. Kinematic Analysis showed higher values of scapular medium-lateral rotation and anticipation of retraction of the pathological side during both anterior flexion and abduction. Reduced scapular Tilt in under 18yo was found.

Conclusions: The absence of the pectoralis major and minor muscles seems not to affect the ROM. The increased rotation of the scapula on the medium-lateral axis is probably due to the absence of humeral insertion of the pectoralis major and the absence of the scapular insertion of the pectoralis minor. The increased retraction in abduction it can be explained by a hypercontraction of the scapular stabilizers. The reduced Tilt in under 18yo is influenced by the lack of adaptation by the muscle groups involved. Further analysis will help define the muscles involved in compensation.

EP.01.027

BIOMECHANICAL CONSEQUENCES OF GLENOID AND HUMERAL LATERALIZATION IN REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: The objective of our study was to quantify the biomechanical effectiveness of lateralization in RTSA with respect to glenoid and humeral component configurations.

Methods: Eight cadaveric shoulders were tested in a custom shoulder testing system. Three parameters, including the glenosphere thickness, humeral tray offset and insert thickness, were accessed by implanting eight configurations on each specimen. Humeral position, maximum internal rotation, and maximum external rotation (ER) before impingement were quantified at 0°- and 30°-abduction. The adduction angle at which the humeral component contacted the inferior scapular neck and the abduction angle where acromial notching occurred were also measured. The simulated active range of motion, including abduction and ER capability, was tested by increasing the loading applied to the remaining posterior cuff and middle deltoid. Stability was evaluated by the forces that induced anterior dislocation at 30° abduction.

Results: The thicker glenosphere affected only lateralization, whereas the centric humeral tray and thicker insert significantly affected humeral lateralization and distalization simultaneously. Greater adduction and ER angles were found in the more lateralized humerus. A significant positive correlation between humeral lateralization and ER capability was observed; however, lateralization did not significantly improve implant stability in this cadaveric testing system.

Conclusions: Lateralization is achievable at both the glenoid and humeral sides but has different effects, therefore lateralized implant options should be selected according to patients' needs. Lateralization is an effective strategy for reducing abduction notching while increasing ER capability. Thicker glenospheres only affected humeral lateralization. The centric humeral tray would be selected for less distalization to avoid over-lengthening, whereas an eccentric humeral tray is the most effective for distalization and medialization in reducing abduction notching to the acromion and for patients of pseudoparalysis.

EP.01.028

THE INFLUENCE OF GREATER TUBEROSITY AND ACROMION BONY MORPHOLOGY ON DYNAMIC SUBACROMIAL SPACE NARROWING DURING 3D MOTION CAPTURE

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Background: The bone morphology of the greater tuberosity and lateral acromion plays a central role in subacromial impingement syndrome. The critical shoulder angle (CSA) and greater tuberosity angle (GTA) are two-dimensional measurement parameters that have been validated to evaluate it radiologically. These markers are however static and do not take into account the dynamic effect of glenohumeral motion. The aim of this study was to propose a better understanding of the biomechanics in subacromial impingement with a dynamic simulation based on a validated 3D anatomical model coupling motion capture and 3D reconstructed computed tomography.

Methods: Sixty-one patients were included: 44 with degenerative rotator cuff tears, 17 with glenohumeral instability. Patients with previous surgeries, traumatic cuff tears or cuff tear arthropathies were excluded. CSA, GTA, and impingement-free range of motion of the glenohumeral joint in scaption (ROM) were calculated. Pearson (r) was used to determine correlation between ROM and CSA, GTA, and combined CSA and GTA values. T-test was used to compare group means.

Results: CSA and GTA were significantly higher in the rotator cuff tear group ($P = 0.001$ and <0.001), while ROM was significantly higher in the instability group ($P = 0.001$).

There was no overall correlation between CSA and GTA ($r = 0.02$, $P = 0.8$). There was a weak to moderate negative correlation between GTA and ROM ($R = -0.5$, $p < 0.001$) and CSA and ROM ($R = -0.4$; $p < 0.001$). There was a high correlation between combined values of GTA and CSA with ROM ($R = -0.7$, $P < 0.001$).

Conclusions: Subacromial space narrowing during scaption is highly influenced by the cumulative value of GTA and CSA. These findings suggest that subacromial impingement and degenerative rotator cuff tears are caused by the combined bony morphology of the lateral acromion and the greater tuberosity. Combination of tuberoplasty and acromioplasty could be more efficient to restore impingement-free range of motion.

EP.01.029

VALIDATION OF AN ITERATIVE LEARNING OPEN-LOOP TENDON EXCURSION CONTROL ARCHITECTURE FOR SIMULATED EX-VIVO SHOULDER MOTION

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Background: Ex-vivo shoulder motion simulators are powerful research tools capable of expanding our understanding of shoulder function, pathology, treatment, and rehabilitation. Current simulators have been used to perform simple planar motions at quasi-static speeds; however, many functional shoulder movements performed during daily tasks are not quasi-static and have complex trajectories. Therefore, the objective of this study was to develop and validate an ex-vivo shoulder motion simulator to perform faster and more complex motions than what has been previously reported.

Methods: A shoulder motion simulator was developed that used an open-loop tendon excursion controller with iterative learning to control joint orientation by prescribing the tendon excursions of eight shoulder muscles. Initial tendon excursions calculated from specimen-specific tendon excursion maps were played in an open-loop fashion. An iterative learning algorithm adjusted the prescribed excursions after the motion was complete to improve kinematic tracking accuracy for subsequent iterations of the same motion. To evaluate the simulator's performance, scapular plane elevation (15 to 50 degrees of glenohumeral elevation), forward flexion (15 to 45 degrees of glenohumeral elevation), internal/external rotation (-40 to 0 degrees of external rotation), and circumduction were simulated in nine cadaveric specimens (57 ± 5 years) with a glenohumeral rotation speed of 10 degrees/second. Kinematic tracking accuracy was assessed using maximum absolute error (MAE) and root mean square error (RMSE). The simulator's repeatability was assessed by calculating the average standard deviation (ASD) for five repeated circumduction motions.

Results: RMSE was less than 0.5, 0.7, and 0.8 degrees for elevation, plane of elevation, and axial rotation, respectively for all simulated motions. MAE error was less than 1.0, 1.6, and 1.7 degrees for elevation, plane of elevation, and axial rotation, respectively for all simulated motions. ASD across five simulated circumduction motions was 0.1 for all three joint angles.

Conclusions: This study presents the validation of a novel shoulder motion simulator that uses open-loop excursion control to achieve high accuracy and repeatability when simulating multiplanar motions. With this functionality, the shoulder motion simulator can be used to simulate functional shoulder movements and can provide new insights into current understandings of shoulder biomechanics.

EP.01.030

THE DIRECT EFFECT OF NANOFIBER-BASED VITAMIN D SHEET ENGINEERED WITH 3D PRINTING FOR TENDON-TO-BONE HEALING AND MUSCLE REGENERATION AFTER REPAIR IN A CHRONIC ROTATOR CUFF TEAR MODEL OF RABBIT

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Background: To compare the efficacy between the effect of nanofiber-based vitamin D sheet (VTD sheet) and vitamin D supplementation (VTDS) as diet on tendon-to-bone healing and muscle regeneration after repair in a chronic rotator cuff tear model of rabbit

Methods: A total of 64 rabbits were randomly allocated into 8 groups (A,A':VTDS only, B,B':Normal diet + sheet without vitamin D, C,C':Normal diet + VTD sheet, D,D':VTDS + VTD sheet, n = 8 each). The supraspinatus tendons were repaired in transosseous manner. A, B, C, and D were extracted at 4weeks, while A', B', C', and D' were extracted at 12 weeks after repair. Serum 25-OH vitamin D level was checked. The expression of genes from tendons including COL1, COL3, BMP-2, SCX, SOX9 and ACAN was assessed. The histological and biomechanical evaluations of tendon-to-bone healing were done at 12 weeks after repair. Rotator cuff muscle cross-sectional areas(CSA) were measured. ELISA was done to calculate vitamin D level in muscle at 12 weeks after repair.

Results: Serum vitamin D level of D and D' was highest among groups at the time of repair and extraction ($p < 0.001$). At 4 weeks after repair, mRNA expression of COL1 in D was highest among groups($p = 0.046$). At 12 weeks after repair, D' showed most dense collagen density($p = 0.037$), and had highest load to failure among groups($p = 0.024$). The CSA of muscle fiber was largest in D and D'($p < 0.05$) with highest vitamin D level of muscle by ELISA at 12 weeks after repair($p = 0.003$).

Conclusions: The use of nanofiber-based vitamin D sheet may promote tendon-to-bone healing and regenerate rotator cuff muscle after repair in a chronic rabbit rotator cuff tear model.

EP.01.031

ROTATOR CUFF TENDON HEALING USING HUMAN DERMAL FIBROBLASTS IN PLACE OF HUMAN TENOCYTES

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Background: Tenocytes derived from tendons have been reported to be effective in the treatment of rotator cuff tears through the expression of extracellular matrix (ECM) proteins. Human dermal fibroblasts known to express collagen I and III like tenocytes are likely to substitute for tenocytes in healing the rotator cuff tears. The purpose of this study was to demonstrate the capability of human dermal fibroblasts to heal rotator cuff tears

Methods: The growth properties were compared between human dermal fibroblasts and tenocytes. In both cell types, a series of ECM proteins such as collagen I/III, fibronectin and elastin were analyzed along with MMP-1, -2 and TIMP-1, -2 involved in the collagenolytic system. 35 rabbits were allocated into 5 groups: normal (n=2), saline control (n=9), fibrin control (n=9), low dose (HF-LD, n=9), and high dose of human fibroblasts (HF-HD, n=6). Cells were injected into the sutured lesions in 6 weeks after bilateral rotator cuff tears, followed by histological and biomechanical analyses in another 12 weeks.

Results: Human fibroblasts exhibited a protein expression pattern similar to that of tenocytes. More specifically, the expression levels of collagen I and III were comparable between fibroblasts and tenocytes (Figure 1). The histological analyses on 30 surviving rabbits showed that collagen fibers are more continuous and better oriented with more matured interfaces between tendon and bone in the sutured lesions in HF-LD and HF-HD (Figure 2). Most importantly, the biomechanical strength measured by the load-to-failure at the injection site was increased by two folds ($P = .0003$) over the saline control to display 58.8 ± 8.9 N/kg in HF-HD.

Conclusions: Human dermal fibroblasts showing cellular properties comparable to tenocytes, are effective in healing chronic rotator cuff tears in rabbits.

EP.01.032

THE DIFFERENCES OF SHOULDER KINEMATICS DURING EXTERNAL ROTATION WITH ABDUCTION BETWEEN STANDING AND SUPINE POSTURES

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Background: The shoulder kinematics, including humerus and scapula, was significantly different between the postures in previous studies. But former analyses during external rotation were not compared between the postures. In clinical setting or motion analysis, the familiarity of quantitative change between postures is essential for the evaluation. The purpose of this study is to evaluate the kinematic differences during external arm rotation with abduction between standing and supine postures, using high accurate three-dimensional motion analysis.

Methods: Total 31 healthy volunteer shoulders (17 males and 14 females) were enrolled in this study. The humeral head translation and scapular orientation during external rotation at 90 degrees abduction were analyzed using three-dimensional to two-dimensional model-image registration techniques. First, the fluoroscopic images were acquired from both standing and supine postures. And three-dimensional bone models were created from computed tomography. Then, each shape of bone model was matched on each image with analysis software. Two-way repeated analysis of variance and post-hoc test was performed to compare kinematic data between postures. As a reference of humeral head translation, the transverse diameter of the glenoid was measured.

Results: The mean transverse diameter of the glenoid was 25.6 (95% CI: 24.5 – 26.7) mm. The humeral head in supine was significantly shifted more posteriorly than that in standing: 0.7mm translation at maximum external rotation. Among scapular rotations, posterior tilt in standing significantly leaned more than that in supine at maximum external rotation.

Conclusions: Considering the glenoid track based on this result, the standing posture might narrow the width derived from the humeral head translation. These implied a remarkable situation that glenoid track might be affected by the posture.

EP.01.033

THERAPEUTIC STRATEGIES FOR TENDON-TO-BONE HEALING BY NANOPARTICLE MEDIATED DELIVERY OF BMP-2 GENES

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Background: The early healing of tendon-to-bone junction is usually slow and the rate of re-tear is high after repairing. BMP-2 gene may improve tendon-to-bone healing. However, the mediation of target gene is lack of ideal vector. The purpose of this study is to measure effects of BMP-2 gene mediated by nanoparticles on tendon-to-bone healing in rats, and to verify whether the nanoparticles / plasmid complex can be used as an ideal vector.

Methods: The PLGA nanoparticle/BMP-2 plasmid complexes were prepared and characterized in vitro and vivo. 54 male rats were randomly divided into three groups: A. Control group: the supraspinatus tendons were sutured by Kessler suture without any intervention; B. NP-Neg group: after surgical repair, the nanoparticles / pEGFP-N1 plasmid complexes were injected into tendon-to-bone junction; C. NP-BMP-2 group: Nanoparticle/pEGFP-BMP-2 plasmid complexes were injected into tendon-to-bone junction after surgical repair. The rats were killed at 2 and 4 weeks, and the quality of tendon-to-bone healing was studied by biomechanical test, related protein expression, transfection efficiency, histological staining and immunohistochemical analysis.

Results: It was found that PLGA nanoparticles / plasmid complexes had high transfection efficiency in vivo and vitro, and could effectively transfer BMP-2 gene to tendon-to-bone junction. At 2 and 4 weeks, in terms of biomechanical results, the ultimate strength and stiffness of NP-BMP-2 group increased significantly compared with other groups; in terms of immunohistochemical analysis and Western blotting, the expression of BMP-2 at tendon-to-bone junction in NP-BMP-2 group increased compared with other groups; in terms of histological evaluation, the collagen orientation, organization and cell maturity of tendon-to-bone junction in NP-BMP-2 group were better than those in other groups.

Conclusions: Nanoparticles / plasmid complexes can effectively transfer BMP-2 gene into tendon-to-bone junction. Nanoparticle mediated BMP-2 gene can significantly promote tendon-to-bone healing of rotator cuff in rats.

EP.01.034

SUBPECTORAL MORPHOLOGY FOR BICEPS TENODESIS PROCEDURES: A COMPUTED TOMOGRAPHY ANATOMICAL ANALYSIS

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Background: Subpectoral biceps tenodesis is a common procedure to treat biceps tenosynovitis, SLAP tears, and other shoulder pathologies. A devastating, but rare complication, is a proximal humeral fracture through the tenodesis site. A unicortical tunnel may lead to a stress riser with decreased torsional stress of the bone. Eccentric malpositioning of a tunnel may lead to further decrease in torsional strength of the humerus. Better understanding of the anatomy in this region may help prevent technical errors which could lead to this complication. The purpose of our study is to evaluate the proximal humeral morphology at the subpectoral region and to assess safe regions and angulation for placing cortical tunnels that would avoid potential risk of fracture.

Methods: Eight fresh frozen cadaveric upper extremity specimens were tagged with a marker at the subpectoral region. A CT scan of each specimen was undertaken with 0.625 mm slices. The slice at the typical tenodesis site, as well as the slice 1 cm above and below this were analyzed. Cortical thickness at the floor of the bicipital groove as well as throughout the humerus was measured. Additionally, the maximum angled trajectory for a 7 mm reamer to not violate the inner cortex was assessed.

Results: The mean anterior-posterior distance from the floor of the bicipital groove was $2.11\text{cm} \pm 0.27\text{cm}$. The maximum cortical thickness was at the 10:30 position. At this level the thickness was $3.83\text{mm} \pm 1.32\text{cm}$. The measured trajectories from the deepest portion of the bicipital groove to the furthest medial and lateral aspects of the intramedullary canal was found to be $2.17\text{cm} \pm 0.4\text{cm}$ at an angle of $29.2^\circ \pm 6.0^\circ$ and $1.90\text{cm} \pm 0.34\text{cm}$ at an angle of $21.6^\circ \pm 10.6^\circ$, respectfully relative to the coronal plane.

Conclusions: Our results demonstrate that the thickest regions of cortex in the subpectoral humeral shaft are the ridges of the bicipital groove. Surgeons should limit deviation from the perpendicular to no more than 23° relative to the coronal plane medially and 11° relative to the coronal plane laterally. The general humeral morphology at the subpectoral region has not been well characterized and our work presents a useful inquiry into optimal trajectory of cortical tunnels for subpectoral biceps tenodesis.

EP.01.035

NOVEL X-RAY TECHNIQUE FOR ASSESSING BONE QUALITY PRE OP AND UP TO 17 YEARS POST STEMLESS METAPHYSEAL REVERSE SHOULDER ARTHROPLASTY

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Background: New stemless reverse shoulder prostheses are being introduced recently. Concerns over primary fixation strength and longevity of the implant due to poor bone quality in osteoporotic patients are still debated.

The first stemless-metaphyseal reverse TSAs were introduced in 2005 (Verso, IDO; TESS, Biomet).

The aim of this study is to introduce and validate a novel X-ray based technique for assessing bone quality preoperatively and measure the effect of a metaphyseal implant on bone quality up to 17 years postoperatively.

Methods: Between 2005 - 2012, 207 consecutive patients (51M/156F) underwent rTSA with stemless metaphyseal rTSA (Verso, IDO). Pre-operative Computed Tomography (CT) and standard X-ray were obtained in all patients. 30 Patients were measured in this study. Average Hounsfield Units (HU) of the metaphyseal proximal humerus were measured in the axial, sagittal and coronal planes. Standard shoulder antero-posterior X-rays were analysed by a professional digital photo program to measure the average grey value (pixel density) of the base of the coracoid. A similar measurement was carried out preoperatively in the humeral metaphysis and postoperatively in 5 standard positions around the implant (2 medial, 1 inferior, 2 lateral). The "Grey Value Ratio" (GVR) was calculated as a ratio between the measured point in the humerus and the base of the coracoid used as a constant for each X-ray.

Results: Preoperative HU of the proximal humerus in the axial, sagittal and coronal planes was 62.8, 65.3 and 75.5, respectively (mean 67.9). GVR in AP X-ray was 0.67, and in axillary view 0.76. Immediate postoperative AP X-ray measured a mean GVR of 0.82 (range 0.62-0.90). At 1 year follow-up mean GVR was 0.74 (range 0.54-0.83) and at final follow-up mean GVR 0.76 (range 0.52-0.88).

Conclusions: Introduction of a novel and easily applicable tool for assessing both preoperative and postoperative bone quality. Immediate postoperative increased bone density due to the bone impaction technique used intraoperatively. The GVR remains stable and higher than preoperative levels, in all positions measured, up to 17 years postoperatively, attributed to the good load transfer through the stemless metaphyseal implant unique design.

EP.01.036

EFFECT OF BICEPS REROUTING TECHNIQUE TO RESTORE GLENOHUMERAL JOINT STABILITY FOR LARGE IRREPARABLE ROTATOR CUFF TEARS: A CADAVERIC BIOMECHANICAL STUDY

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Background: The concept of stabilizing the humerus has taken on an important role in the treatment of irreparable cuff tears, and the biceps rerouting (BR) method is considered one of the most effective treatments in this field. The study aimed to evaluate the biomechanical effects of BR for large irreparable rotator cuff tears (LICTs).

Methods: A total of 8 cadaveric shoulders were used for testing under 5 conditions: intact shoulder, LICT, partial repair (PR), BR, and biceps rerouting with side-to-side repair (BRSS). Total rotational range of motion was measured at 40, then 20, and finally 0 of glenohumeral (GH) abduction. Superior humeral translation and subacromial contact pressure were measured at 0, 30, 60, and 90 of external rotation at each abduction angle. Repeated-measures analyses of variance with Tukey post hoc tests were used for statistical comparisons.

Results: The superior humeral translation was significantly decreased in the BR and BRSS conditions compared with the LICT and PR conditions at 0 and 20 of GH abduction ($P < .001$). BR and BRSS significantly reduced subacromial contact pressure compared with LICT and PR at 0 of GH abduction ($P < .001$). There was no significant decrease in the total rotational range of motion after BR at any abduction angle.

Conclusions: BR biomechanically restored shoulder stability without over-constraining range of motion in an LICT model.

EP.01.037

POST-SURGICAL CORACOBRACHIALIS AND SHORT HEAD OF BICEPS KINEMATICS IN LATARJET SHOULDERS

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Background: Latarjet has been widely accepted for reducing recurring anterior dislocations of shoulders. This involves transferring the tip of the coracoid to the anterior glenoid. This process also transfers the coracobrachialis (CBR) and short head of biceps (SHB) changing their lines of action. Post-Latarjet biomechanics of CBR and SHB has not been studied. In this study, we aim towards compared these muscles' moment arms and lengths between native and latarjet shoulders.

Methods: We used the Newcastle Shoulder Model (NSM) to create 15 native shoulder models. These models were further modified using tendon transfer to create the latarjet models. The CBRs and SHB were transferred to the anterior glenoid. Using these models, muscle moment arms and muscle lengths of CBR and SHB were calculated. Moment arms were measured using the tendon excursion method and muscle lengths were calculated as the distance between the muscles' origin and insertion points. These values were measured during 0°-150° of abduction, forward flexion, scapular plane elevation, and -90 to 60° of external-internal rotation with the arm at 20° and 90° of abduction. Statistical comparison between native and RTSA groups was analysed using spm1D.

Results: All the observed differences in moment arms and muscle lengths were significantly different ($p < 0.05$). During abduction, both native shoulders had lower adduction moment arms compared to latarjet shoulders. During forward flexion, native shoulders had predominantly elevation moment arms while latarjet shoulders had extension moment arms. Latarjet shoulders had slightly higher depression moment arms compared to native shoulders during scapular plane elevation. With the arm at 20° abduction, SHB had higher internal rotation moment arms in native shoulders compared to latarjet shoulders and the opposite was true for CBR. Increasing the arm abduction angle to 90°, SHB had higher internal rotation moment arms in latarjet shoulders compared to native shoulders. At 90° abduction, CBR had external rotation moment arms in native shoulders and internal rotation moment arms in latarjet shoulders. Post-latarjet reduction in length was the highest at the beginning of motions by 27% (CBR) and 10% (SHB).

Conclusions: Latarjet reduces CBR and SHB length and might aid in stabilising the joint during internal rotation.

EP.01.038

QUANTIFYING THE DIFFERENCE IN GLENOID COMPONENT POSITION BETWEEN TOTAL SHOULDER ARTHROPLASTY AND REVERSE SHOULDER ARTHROPLASTY

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Background: Revision of Anatomic Total Shoulder Arthroplasty (TSA) implants to Reverse Shoulder Arthroplasty (RSA) is becoming increasingly common as the number of arthroplasties in younger patients rises.

Different convertible shoulder systems have been proposed to revise a TSA to RSA. However, switching from TSA to RSA is not possible in all cases given high variability of glenoid and humeral components' size and shape. To the best of our knowledge, there is limited literature comparing glenoid component positioning for shoulder arthroplasty. The purpose of this study was to quantify difference between optimal TSA and RSA glenoid implant positioning on 3-Dimensional (3D) segmented models.

Methods: 25 patients who underwent primary RSA procedures were recruited for this study. A 3D preoperative planning software (REFLECT COMPLEXTM, Akunah, Australia) was used to reconstruct 3D models of scapula and humerus from CT scans for each patient. Retrospectively, TSA and RSA glenoid components were positioned on each patient's scapulae with same planning software by a subspecialist orthopaedic shoulder surgeon and an orthopaedic fellow. Small, medium, and large sized generic TSA glenoid implants were available. The scapulae were split into three groups according to glenoid size.

Simulated guidewires were drafted based on implant position and orientation, along with projected guidewire entry point on glenoid surface. The superior-inferior distance between projected TSA and RSA guidewire entry points was compared for each scapula.

Results: Small, medium and large glenoid groups consisted of 6, 9 and 10 scapulae respectively, with a 72% agreement rate with the second rater. Correlating average glenoid width and height (w x h) for each group was 23.2mm x 32.3mm, 31.6mm x 38.1 mm and 33.5mm x 43.3mm.

Mean (\pm SD) superior-inferior distance from TSA to RSA guidewire entry position is 3.0mm \pm 0.4mm, 5.1mm \pm 1.3mm and 6.1mm \pm 1.7mm respectively for small, medium and large glenoids when compared to 25mm RSA baseplates.

Conclusions: In this study, we quantify variation between implant position for TSA and RSA glenoid components and investigate subsequent effect of the glenoid and implant size. Larger glenoids present more disparity between TSA and RSA implant position which is minimally affected by increasing RSA implant size.

EP.01.039

CLINICAL SIGNIFICANCE OF NEUTROPHIL-TO-LYMPHOCYTE RATIO (NLR), PLATELET-TO-LYMPHOCYTE RATIO (PLR) FOR S4608 (ROTATOR CUFF TEAR): AN ANALYSIS FROM EPIDEMIOLOGICAL BIG-DATA (2012-2022)

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Background: Analysis of Epidemiological big-data can provide a better insight on evidence-based medicine and their impact on patients health. Orthopedic conditions are influenced by various intrinsic and extrinsic actors as well as age of patients. This study is to design a model using 10 years of follow-up data during 2012-2022. This study examined the relationship between neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), Mean Platelet Volume (MPV) and chronic rotator cuff tear (RCT) disease, to establish a correlation among the NLR, PLR, and RCT activity in terms of Postoperative pain in post-surgery follow-up. Although there have been extensive investigations on NLR, PLR and MPV in many diseases, their roles in S4608 (Rotator Cuff Tear) remain unclear. Therefore, an age-wise and gender-wise analysis of NLR, PLR and MPV will evaluate in S4608 patients and explore their clinical significance.

Methods: In this study the predictability of postoperative pain through the NLR, PLR and MPV, as indicators of inflammation and successive healing. In addition, the correlation of parameters such as operative time, tear size, age and gender with postoperative pain was evaluated. The ethnicity of the patients was Korean. Patients, undergo for surgical process for rotator cuff repair, were considered in this study. Multivariate linear regression analysis was used to correlate postoperative NRS scores with multiple independent factors, including preoperative NLR, PLR, MPV, sex, age, tear size, repair type, operative time, block time, postoperative analgesic intake and length of hospital stay.

Results: The data from 377 patients were used in this study, the characteristics of sample includes, average age of 59.0 years with 53% male population. The mean tear size range, the mean operative time, the mean duration of block and the mean length of hospital stay (range, 1-3 days) was major criteria for response analyses. The preoperative NLR, PLR and MPV were found to be a strong predictor of postoperative NRS. The preoperative NLR was found to be a strongest factor predicting high acute pain levels after the rotator cuff surgery. NLR was significantly higher in the RCT group.

Conclusions: Meta-analysis showed that the NLR and PLR were significantly higher in the patients with S4608.

EP.01.040

TELOCOLLAGEN INJECTION SIGNIFICANTLY IMPROVES MECHANICAL STRENGTH AND HISTOLOGICAL OUTCOMES IN A RODENT ROTATOR CUFF TEAR MODEL

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Background: Healing rates after surgical repair of torn rotator cuff tendons have been variable. Currently available exogenous collagen products are prepared from xenograft sources and have had their terminal telopeptides enzymatically removed (atelocollagen). They had been used, as patch or injectable, to enhance tendon healing. Because the telopeptides have a high degree of non-homology across species compared to the main collagen triple-helix, cleaving the telopeptides were thought to increase the yield of the main collagen and to decrease immunogenicity. However, telopeptides are important for the normal function of tendons, by enhancing mechanical strength. This study aims to evaluate whether post-surgical injections of exogenous allogeneic telocollagen, containing intact telopeptides, will improve the healing rate and repair quality after surgery.

Methods: A total of 36 male adult Sprague-Dawley rats underwent bilateral detachment and transosseous repair of the supraspinatus tendon (72 shoulders). Every shoulder was randomized to a series of three injections (either saline vs. atelocollagen vs. telocollagen) into the subacromial space immediately after surgery, postop day 7, and day 14. Animals were subsequently euthanized for biomechanical or histological analysis at 30 or 60 days post-surgery. For each of the treatment groups, eight shoulders were used for mechanical testing and four were used for histologic scoring.

Results: At day 30, the mechanical testing showed no difference in the maximum load the telocollagen treated tendons could withstand. In contrast, at day 60, the telocollagen treated tendons could support significantly higher failure loads than the saline-treated tendons ($p = 0.004$), supporting 150% of the load achieved by saline-treated tendons. Atelocollagen performed no differently than the saline controls.

The histological data generally showed worse scores at day 30 compared to day 60 without differences between groups. At day 60, the experimental group showed excellent repair of the tendon and good remodeling of the defect compared to the control groups. A statistically significant difference was found between the experimental group and the other two groups in the histologic scores.

Conclusions: Histological and mechanical tests showed statistically better results in the telocollagen-treated tendons compared to saline and atelocollagen after surgical repair in a rodent model of full-thickness supraspinatus tendon tears.

EP.01.041

OPTIMIZATION OF ALLOGENIC GRAFTING OF TDSCS FOR TENDON REGENERATION AND MATRIX REMODELING APPLICATION

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Background: Stem Cell Therapy and their products are considered as a better option, among various available therapies. However, cost of stem-cell therapy is one of major challenges, while making it available to all. It is required to develop an appropriate procedure to make stem cell therapy more unified and affordable option. TDSC have showed promising results in animal model studies. TDSC are target of great interest when considering tendon related disorders. The allografting of stem-cell transplant could provide solution. However, graft failure is major complication of such transplantation, which severely affect the success and efficiency of the graft.

Methods: We investigated whether allogeneic Tendon Derived Stem Cell from healthy donors can improve tendon healing in the rats with degenerated tendons. An optimized protocol for TDSCs is required, for in-vitro studies as well as allografting. We have optimized the protocol for TDSCs isolation from SD rat. In this study, we optimized effective cell concentration, and effect of the growth factor, cytokine, and exosome on adaptation of the allograft. The injected TDSCs concentration was varied between 1.0×10^5 to 1.0×10^8 . The perilipin A, CD34 and VEGF detection will perform to evaluate the level of healing and vascularization, while CD4/CD8 ratio will use to evaluate the lymphocytotoxicity. This study will also to analyze the risk factors and outcomes of allografting. Effect of secretomes such as growth factors, cytokines and exosomes on adaptation, proliferation, and differentiation of grafted TDSCs.

Results: After 10th passage the most of cells belongs to tenocyte lineage. The efficacy of banked cell was better and 20-25 % cell viability was observed in banked cell. Most of cell population expres of tenocyte associated marker which showed efficiency of isolation protocol. The aged, seven days or longer culture showed district defiltration in cell population, and spindle shaped cell were appeared in the plate. The grafting experiment is ongoing so result will be shared during conference. However, there were no significant toxicity was observed, however, CRS profiling is being required.

Conclusions: Overall, it is anticipated that study could be helpful to develop allografting for TDSCs for regeneration of tendon, however clinical assessment will decide the fate of therapy.

EP.01.042

ESTROGEN AND TESTOSTERONE SUPPLEMENTATION IMPROVES TENDON HEALING AND FUNCTIONAL RECOVERY AFTER ROTATOR CUFF REPAIR IN A MURINE MODEL

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Background: Failure of healing after rotator cuff repair (RCR) is common. The purpose of the current study was to evaluate the effect of systemic estrogen or testosterone supplementation on tendon healing after RCR in a murine model.

Methods: 72 adult male mice were utilized for all experiments. The supraspinatus tendon was transected and repaired with 6-0 Prolene suture on the left shoulder of 51 animals. Mice were segregated into 3 groups postoperative and treated with sex hormones or vehicle: 1) vehicle group (VG, n=18), 2) estrogen group (EST, n=17), and 3) testosterone group (TST, n=16). A Wild-Type (WT, n=21) group did not have surgery. Three of each VG, EST, and TST mice were sacrificed at 2 and 8 weeks postoperative and used for RNA-seq (2 weeks) and histological analysis (8 weeks). Three WT mice were sacrificed at 8 weeks for histological analysis. At 8 weeks postoperative, WT (n=18), VG (n=12), TST (n=10), and EST (n=11) mice (\pm RCR) underwent activity testing. Nine WT and all the VG, TST and EST mice that underwent activity testing were biomechanically tested.

Results: At 8 weeks post-RCR, TST and EST supplementation improved the overall structure of the repaired enthesis site including a restoration of the structure of the calcified fibrocartilage and organizing fibers comparable to controls. No differences in ultimate failure loads or stiffness were detected between VG, EST and TST groups after biomechanical testing. RCR caused a reduction in wheel activity compared to WT and supplementation with TST restored wheel activity. RNA-seq analysis indicated that estrogen regulated TGF-beta and Hippo signaling, osteoclast differentiation, and ECM-receptor interaction and testosterone regulated Notch signaling, with the two overlapping in pathways involved in inflammation and immune cell regulation.

Conclusions: Supplementation with estrogen and testosterone improved the structure of the repaired tendon enthesis and significantly regulated expression of diverse pathways regulating multiple biological processes. Testosterone administration following RCR restored wheel activity without having a detrimental impact on biomechanical strength.

EP.01.043

COMPARISON OF SHOULDER RANGE OF MOTION BETWEEN THOSE ESTIMATED USING MOBILE PHONE (2D) AND MOTION CAPTURE (3D)

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Background: Quantifying shoulder function is critical to establish interventional efficacy. To track progress, shoulder range of motion (RoM) requires regular objective assessment that is easy to perform in a clinical setting and / or at home. Developed methods that identify key landmarks from videos captured on a mobile phone during shoulder movements potentially match these requirements. However, a comparison against 3D motion capture (Mocap) is lacking.

Methods: Seventeen individuals with normal shoulder function (mean (standard deviation), age; 31 (7) years, height; 1.72 (0.10) m, weight; 68 (13) kg, 8 female) performed 3 repetitions of: full range abduction, flexion, and extension.

Data were recorded concurrently using 3 iPhones at 0.9m height using mymobility(R) Zimmer Biomet video Skeletal Tracking RoM Assessment (STRA) software and an 8-camera motion capture system (Mocap, Vicon). Video based thoraco-humeral angle was determined as the angle between lines from the midpoint of the hips to midpoint of shoulders and shoulder to ipsilateral elbow.

Mocap based thoraco-humeral angle was determined according to the International Society of Biomechanics conventions. Each upward/downward movement repetition was divided in 7 sections within which the mean of shoulder angle from both systems was determined. Linear mixed models were used to compare systems.

Results: Compared to Mocap, STRA overestimated shoulder range: upward abduction by 13° (6°) at the beginning and end range, and by 20° (6°) mid-abduction; downward abduction by 10° (7°) across the range; upward flexion by 13° (7°) across the range, and downward flexion by 8° (7°) across the range.

STRA underestimated upward/downward extension at low range by 5° (5°) and overestimated towards end range by 7° (7°).

STRA and Mocap correlated well, the variance accounted for were all greater than 97%.

Conclusions: Differences in overestimation between upward/downward motions are likely due to thoracic contribution to shoulder RoM that is greater during upward than downward motions. As the 'thorax' reference frame is more generally defined (between pelvis and shoulders) in STRA, thorax contribution to shoulder movements is unlikely to be detected. Despite some differences, STRA-based shoulder motion is closely related to Mocap and can be clinically utilised.

EP.01.046

TREATMENT OF PRIMARY SHOULDER STIFFNESS: RESULTS OF A NATIONAL SURVEY ON SURGEON PRACTICE PATTERNS AND DEVELOPMENT OF A NATIONAL CONSENSUS.

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Background: Shoulder stiffness is a condition of restricted glenohumeral range of motion (ROM), which can arise spontaneously or as consequence of a known cause, including surgical procedures on the shoulder. Several treatment options are available and currently no consensus has been obtained on which treatment algorithm represents the best choice for the patient. The aim of this study was to investigate surgeon practice patterns in Italy regarding treatment of primary shoulder stiffness.

Methods: A review of the literature was performed to identify randomized controlled trials reporting results of shoulder stiffness treatment. From the analysis of the available evidence, the following controversial or critical points in the treatment of primary shoulder stiffness were identified: modalities of physical therapy; indication for oral corticosteroid; indication and frequency for injective corticosteroid; technique and site of injection; indication, timing and technique for surgery. A survey composed by fourteen questions was created and administered to the members of a national association specialized in orthopaedics and sports traumatology (SIAGASCOT).

Data obtained from the completed questionnaires were entered into a spreadsheet for analysis. Categorical variables are expressed in numbers of cases and frequencies. Response rates were summarized in terms of proportions of respondents.

Results: 204 completed questionnaires were collected. Physical therapy was recommended by 98% of the interviewed. The use of oral corticosteroids was considered by 51% of the interviewed, and injections of corticosteroids by 72%. The posterior injection approach was the one preferred and the number of three was considered the upper limit for repeated injections. Injective therapy with local anaesthetics and hyaluronic acid was considered by more than 20% of the interviewed surgeons. Hydrodilatation and manipulation under anaesthesia were considered, respectively, by 13% and 35% of the surgeons. No consensus on timing for surgical treatment, and surgical approach was obtained. 30% of the interviewed subjects do not treat shoulder stiffness surgically.

Conclusions: Several approaches to shoulder stiffness have been proposed and high-level evidence is available to analyze and discuss their results. However, several controversial points emerged both from literature reviews and from this national survey. A Delphi-based consensus is in development to define current treatment indications.

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POST-SURGICAL CORACOBRACHIALIS AND SHORT HEAD OF BICEPS KINEMATICS IN RTSA SHOULDERS

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Background: Reverse total shoulder arthroplasty (RTSA) alters the biomechanics of muscles around the glenohumeral joint (GHJ). These changes are well documented for muscles like deltoids, but limited research has been performed on post-RTSA biomechanics of coracobrachialis (CBR) and short head of biceps (SHB). In this study, using computational models, we compared muscle moment arms and lengths of CBR and SHB between native and RTSA shoulders.

Methods: The Newcastle Shoulder Model (NSM), a pre-validated upper extremity musculoskeletal model was used for this study. The NSM was modified with bone geometries obtained from 3D reconstructions of 15 non-diseased shoulders, constituting the native shoulder group. Delta XTEND prosthesis, with a glenosphere diameter of 38mm and polyethylene thickness of 6mm, was virtually implanted in all the models creating the RTSA group. Moment arms were measured using the tendon excursion method and muscle lengths were calculated as the distance between the muscles' origin and insertion points. These values were measured during 0°-150° of abduction, forward flexion, scapular plane elevation, and -90 to 60° of external-internal rotation with the arm at 20° and 90° of abduction. Statistical comparison between native and RTSA group was analysed using spm1D.

Results: Forward flexion moment arms had the greatest increase between RTSA (CBR: 25.3±4.7 mm; SHB: 24.7±4.5 mm) and native groups (CBR: 9.6±5.2 mm; SHB: 10.2±5.2 mm). CBR and SHB were longer in the RTSA group by a maximum value of 15% and 7% respectively. Both muscles had larger abduction moment arms (CBR: 20.9±4.3 mm; SHB: 21.9±4.3 mm) in RTSA compared to the native group (CBR: 19.6±6.6 mm; SHB: 20.0±5.7 mm). Abduction moment arms were observed earlier in RTSA (CBR: 50°; SHB: 45°) compared to the native group (CBR: 90°; SHB: 85°). In the RTSA group, both muscles had elevation moment arms until 25° of scapular plane elevation motion, whereas in the native group, the muscles only had depression moment arms. Both muscles had small rotational moment arms which were significantly different between RTSA and native shoulders during different stages of the motion.

Conclusions: RTSA makes CBR and SHB early abductors and strong forward flexors. The surgery increases their length which might increase tension on conjoint tendon.

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EFFECTS OF GLUTAMINASE 1 INHIBITOR ON ROTATOR CUFF DERIVED CELLS

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Background: Glutaminase 1 (GLS1), which degrades glutamate into glutamine and ammonia, is required for the survival of human senescent cells, and GLS1 inhibitors are expected to contribute to the improvement of various pathological conditions associated with aging. It is also reported that GLS1 expression is increased in synovial cells of rheumatoid arthritis (RA) patients, and that administration of a GLS1 inhibitor to RA model mice showed improvement in arthritis. In this study, we hypothesized that GLS1 inhibitors would improve rotator cuff degeneration and inflammation, and evaluated the effects of GLS1 inhibitors on human rotator cuff derived cells.

Methods: Twelve patients who underwent surgical treatment for rotator cuff tears were included. The cases of reoperations, traumatic tears and RA were excluded. Tissue was harvested during arthroscopic rotator cuff repair, and rotator cuff-derived cells were isolated and cultured. The following four groups were set up. (1) Control group (without IL-1 β and GLS1 inhibitor), (2) IL-1 β (-)/GLS1 inhibitor(+), (3) IL-1 β (+)/GLS1 inhibitor(-), (4) IL-1 β (+)/GLS1 inhibitor(+). Cell viability was evaluated by WST assay and mRNA expressions of aging markers (GLS1 and p16) and inflammation marker (IL-6) and tendon markers (Scleraxis and Mohawk) were evaluated by real-time PCR at 48 hours after treatment. The expression of p16 and Scleraxis (SCX) were also evaluated by fluorescent immunostaining.

Results: Cell viability was significantly decreased by IL-1 β loading and increased by GLS1 inhibitor. The mRNA expressions of GLS1, IL-6, and p16 were decreased by GLS1 inhibitor with and without IL-1 β . The mRNA expressions of tendon markers; Mohawk and SCX were increased by GLS1 inhibitor and the increase was more remarkable without IL-1 β . Fluorescent immunostaining showed the expression of p16 was increased by IL-1 β loading, decreased by GLS1 inhibitor and the expression of SCX was decreased by IL-1 β loading, increased by GLS1 inhibitor.

Conclusions: This study showed that administration of the GLS1 inhibitor decreased inflammation and aging markers while increasing cell viability and tendon markers in rotator cuff derived cells. GLS1 inhibitors may have anti-inflammatory effects against synovitis in rotator cuff tears, prevent age-related degeneration of the rotator cuff, and promote tendon repair.

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QUANTITATIVE EVALUATION OF FATTY INFILTRATION IN ROTATOR CUFF MUSCLE BY BINARIZATION OF MR IMAGES

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Background: The Goutallier classification, which is a qualitative evaluation method, is commonly used to assess the fatty infiltration of the rotator cuff muscles on MR images, but its inter- and intra-examiner reliability is low. The MRI-Dixon method has been reported as a quantitative evaluation method with high inter- and intra-examiner reliability. The purpose of this study was to compare the MRI-Dixon method with a new method for quantifying fatty infiltration by processing T1 and T2-weighted images that can be obtained at general facilities using the ImageJ software.

Methods: 116 shoulders were enrolled in this study. 3.0T MR system was used for images. The region of interest (ROI) was defined as each rotator cuff muscle on the most lateral slice of the scapula Y view in oblique sagittal images by the ImageJ software. The fat fraction by the MRI-Dixon method was calculated as (signal intensity of fat image)/(signal intensity of in-phase image) x 100 (%). Simple T1-weighted and T2-weighted images of the same slice were converted to black-and-white images in ImageJ using Otsu's binarization method. The percentage of area occupied by white color in the ROI of each rotator cuff muscle was compared with fat fraction measured by the MRI-Dixon method using Pearson's correlation coefficient (CC).

Results: The CC between the percentage obtained from T1 / T2-weighted images and the fat fraction measured by the MRI-Dixon method were 0.20 / 0.87 for the subscapularis, 0.34 / 0.91 for the supraspinatus, 0.34 / 0.91 for the infraspinatus muscle, and 0.22 / 0.88 for the teres minor, respectively.

Conclusions: Simple T2-weighted images showed a higher correlation with the MRI-Dixon method than simple T1-weighted images. Our new method of quantitative evaluation of MR images using binarization may be used as a substitute for the MRI-Dixon method.

EP.01.050

ANATOMIC ASSESSMENT OF GLENOID AND CORACOID DIMENSIONS THROUGH 3D PRINTED BONE MODELS IN THE CONTEXT OF ANTERIOR SHOULDER INSTABILITY SURGERY.

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Background: Assessment of glenoid and coracoid graft size is essential in planning a Latarjet procedure for anterior shoulder instability. Measurement of bone dimensions can be performed through 3d printed bone models nowadays. We aimed to evaluate glenoid and coracoid process dimensions obtained in 3D printed bone models, assess differences between genders and compare the results with previously published anatomical studies.

Methods: We performed the measurement of glenoid length and height; and coracoid length, height and thickness; in 39 3D printed bone models from unaffected shoulders. The measurements were compared by gender and also correlation between coracoid thickness and glenoid width was calculated.

Results: We recorded a mean glenoid length (GlenAP) of 28.03 mm (SD = 0.45) and mean glenoid height (GlenSI) of 37,18 mm (SD = 0,55). The mean glenoid dimensions differ significantly between male and female gender ($p=0,002$ and $p=0,001$, respectively). The coracoid mean length was 22,35 mm (SD=0.47), mean coracoid width was 14,97 mm (SD=0,30), mean coracoid height was 9,51 mm (SD=0,22), and those measures also differ significantly between genders. The observed mean values were similar to those previously reported in other anatomical studies.

Conclusions: Gender differences of coracoid and glenoid dimensions must be considered for Latarjet procedure. Our results suggests that 3d printed bone models may be used for such evaluation with good degree of reproducibility of the measurements observed in anatomic studies.

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THE NEW MUSCLE COORDINATION FOLLOWING A LATARJET PROCEDURE INCREASES JOINT STABILITY: A THEORETICAL STUDY

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Background: The surgical Latarjet procedure aims to stabilise the glenohumeral joint (GHJ) after traumatic anterior dislocations. Stability is believed to be exclusively regained via blocking effects, i.e., the transferred coracoid acting as a bony block and the conjoint tendon of the coracobrachialis and short head of the biceps acting as a sling during humeral elevation and rotation. Despite restoring joint stability, the procedure introduces changes in muscle insertions and their lever arms which likely modify the whole shoulder dynamics. Currently, these altered muscular functions and their dynamic implications are unclear. The current work aims to predict changes in muscle lever arms, muscle forces and joint forces following Latarjet surgery, during planar motions by using a computational musculoskeletal (MSK) modelling approach.

Methods: A young and healthy volunteer was recruited to perform six planar shoulder movements in a motion capture laboratory, i.e., abduction, flexion, internal and external rotations, horizontal flexion and extension. A previously validated upper-limb MSK model was selected. The model was scaled and utilised in two configurations, i.e., a baseline model simulating normal joint, and a Latarjet model simulating altered muscular attachments after Latarjet. The Latarjet model removed the pectoralis minor and transferred the conjoint tendon to the anteroinferior glenoid rim through the subscapularis muscle. Muscle lever arms were studied midway through each motion. The differences in muscle and joint forces between the two models were computed based on experimental motion and a static optimisation technique.

Results: Lever arms of the transferred muscles were substantially changed depending on the movement, becoming shoulder depressors instead of elevators originally. Computed forces of the transferred muscles varied between -11% and 6% of the weight. Computed total glenohumeral joint force increased by up to 44% of the weight after Latarjet. These changes were explained mainly by an increase in compression.

Conclusions: Our simulations suggested that the altered muscular attachments and lever arms undergone during a Latarjet procedure change the overall muscle coordination of the shoulder during planar movements and greatly contribute to the stability of the GHJ after Latarjet by increasing joint compression.

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EFFECTS OF RECONSTITUTED HDL ON APOPTOSIS AND WOUND HEALING IN HUMAN ROTATOR CUFF FIBROBLASTS UNDER HYPOXIA

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Background: Hypoxia has been proposed as a potential cause of rotator cuff tendon degeneration. Hypo-high-density lipoproteinemia has been reported as a risk factor for both rotator cuff tear and retear after repair. There is growing evidence of a positive association between HDL and ischemia-driven angiogenesis, which is essential for wound healing. However, there has been little research on whether reconstituted HDL (rHDL) has cytoprotective effects on RCF and stimulates wound healing under hypoxia. This study aimed to determine whether rHDL exerts cytoprotective effects against hypoxia-induced human RCF apoptosis and promotes wound healing.

Methods: Sixth passage human RCFs were used for this study. The human RCFs were divided into the study groups of normoxia, rHDL, hypoxia, and rHDL-hypoxia. The hypoxia inducer was 1000 μ M CoCl₂. Expressions of HIF-1 α and HO-1, rates of cell viability, intracellular reactive oxygen species (ROS) production, and apoptosis, and expressions of cleaved caspase-3, cleaved PARP-1, VEGF-b, and MMP-2, and wound healing ability were evaluated.

Results: Expressions of HIF-1 α and HO-1 were significantly higher in the hypoxia group than in the normoxia group ($p < 0.001$). Cell viability was significantly lower in the hypoxia group than in the normoxia group ($p < 0.001$). Rates of intracellular ROS production and apoptosis, and expressions of cleaved caspase-3, cleaved PARP-1, VEGF-b, and MMP-2 were significantly higher in the hypoxia group than in the normoxia group ($p < 0.001$). The area of the wound was significantly larger in the hypoxia group than in the normoxia group ($p < 0.001$). All these responses were significantly attenuated by pretreatment with rHDL ($p < 0.05$).

Conclusions: rHDL reduces hypoxia-induced ROS production and apoptosis of RCF, and facilitates wound healing under hypoxic conditions.

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ASSESSMENT OF CONCOMITANT SUBSCAPULARIS TENDON REPAIR IN REVERSE TOTAL SHOULDER ARTHROPLASTY AND SUPERIOR MIGRATION OF REATTACHMENT: A CADAVERIC BIOMECHANICS STUDY

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Background: The assessment of the effect of concomitant subscapularis (SSC) repair in reverse total shoulder arthroplasty (RTSA) is controversial, and there is some consideration about reattachment site. As the SSC reattachment site are all moved below the center of rotation after RTSA, the vector of SSC moves perpendicularly and the muscle action changes. Therefore, we aimed to find out effect of concomitant SSC repair in RTSA and whether the superior repair of SSC (SR-SSC) can improve abduction and reduce the internal rotation overwhelming effect compared to original repair of SSC (OR-SSC).

Methods: A total of eight fresh frozen cadaveric shoulders (4 right and 4 left) were prepared, and two different implants (medialized humerus and lateralized humerus) were used. To mimic anatomical muscle balance of glenohumeral joint, rotator cuffs and shoulder muscles were loaded to match the vector. Abduction and rotation were measured by increasing mid-deltoid loading (10~20N) in 6 conditions depending on SSC repair site (unrepair (SU)/OR-SSC/SR-SSC) and whether teres minor (TM) were loaded or not.

Results: There were statistical differences between the abduction of SR-SSC and SU at 12.5, 15, and 20N ($p=0.0010, 0.0013, <0.0001$), and abduction of SR-SSC and OR-SSC at 12.5, 15, and 17.5N ($p=0.0443, 0.0258, <0.0001$). SU requires the least deltoid load to reach the maximum abduction among the three different SSC repair conditions. Regardless of SSC repair condition, internal rotation seemed to improve in those with repair than those without. Abduction of SR-SSC was significantly larger than those of OR-SSC in all mid-deltoid loadings. Notably, as the mid-deltoid loading increased, internal rotation decreased more rapidly in SR-SSC than in OR-SSC, and decreased to a lower value. Implant design and TM condition had no significant effect on both abduction and internal rotation.

Conclusions: SR-SSC restores some of native vector of the SSC, improving the abduction and reducing the internal rotation overwhelming effect compared to OR-SSC, in all TM conditions and implant designs. Therefore, concomitant superior SSC repair in RTSA is recommended to be considered regardless of the posterior cuff condition and implant design.

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THE EFFECT OF ATELOCOLLAGEN-INSERTED HYALURONIC ACID-BASED POROUS POLYMER SCAFFOLD ON THE HEALING OF CHRONIC ROTATOR CUFF TEAR MODEL OF RABBIT

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Background: The atelocollagen and hyaluronic acid were known to be effective on rotator cuff tears. However, as those are liquids, the injection materials cannot be maintained at the repaired site. Furthermore, there are lack of studies on the synergistic effect of mixing these two materials. Thus, the purpose of this study was to compare the effect of atelocollagen-inserted hyaluronic acid-based porous polymer scaffold (Atelocollagen HA scaffold) on the healing of chronic rotator cuff tear model of rabbit.

Methods: A total of 32 rabbits were randomly allocated into four groups (n=8 each). The torn supraspinatus tendons, which were detached and left for 6 weeks, were repaired in a transosseous manner with the injection of saline (Group A), with coverage of HA scaffold on the repaired site (Group B), with the injection of atelocollagen (Group C), or with coverage of atelocollagen HA scaffold on the repaired site (Group D). The expression (relative ratio to control) of genes including type 1 collagen (COL1), type 3 collagen (COL3), SOX9, and scleraxis (SCX) was assessed at 12 weeks after repair. The histological and biomechanical evaluations of tendon-to-bone healing were done 12 weeks after repair.

Results: Five rabbits died before the evaluation (Group A, B, C; n = 2, 2, 1, respectively). In Group D, the expression of COL1 was highest, and the expression of COL3 was lowest compared to that of other groups ($p > 0.05$). In the histologic evaluation, the collagen continuity and maturation of tendon-to-bone interface were the best in Group D ($p = 0.084$, and 0.376 , respectively). The mean load-to-failure was highest in Group D (Group A: 138.6 ± 38.7 N, Group B: 164.5 ± 49.5 N, Group C: 158.4 ± 76.1 N, Group D: 191.3 ± 101.4 N, $p = 0.762$). The stiffness of the repaired tendon was highest and showed a significant difference in Group D (Group A: 22.8 ± 6.9 N, Group B: 21.5 ± 3.9 N, Group C: 31.2 ± 10.8 N, Group D: 42.2 ± 7.5 N, $p = 0.005$).

Conclusions: The atelocollagen HA scaffold enhanced the healing of repaired tendon of the chronic rotator cuff tear model of rabbits.

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RELATIONSHIP BETWEEN CEREBRAL OXYGEN DESATURATION AND POST-OPERATIVE COGNITIVE DECLINE FOLLOWING SHOULDER SURGERY IN THE BEACH CHAIR POSITION

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Background: Patients undergoing shoulder surgery in the beach chair position (BCP) may be at increased risk for serious neurocognitive complications due to cerebral desaturation events (CDE). The purpose of this research was to examine the relationship between, and factors associated with, CDE and post-operative cognitive decline (POCD) for patients undergoing surgery in the BCP.

Methods: 200 patients requiring surgery in the BCP were recruited in this prospective cohort study. Cerebral oximetry measured with both INVOS™, FORE-SIGHT®, in addition to other physiological parameters, were simultaneously and continuously recorded during the operation. To assess change in cognitive performance, participants completed a battery of neuropsychological assessments both pre-operatively, and at 1 day, 2 weeks, 6 weeks and 12 weeks following surgery. POCD was defined as a >1.96 decrease in cognitive composite score from baseline. Logistic regression was performed to identify associations with potential surgical and demographic predictors.

Results: 186 patients had a complete intraoperative recording and were included in the analysis. The correlation between INVOS™ and FORE-SIGHT® was very highly or highly positive in 52.1% and moderately positive in 27.4% of patients. Regional cerebral oxygen saturation was not highly correlated with mean arterial pressure.

14% of participants experienced an intra-operative CDE, defined as a 20% decrease from baseline cerebral oxygen saturation. CDE incidence was found to be significantly associated with BMI ($p < 0.01$), with obesity (BMI >34) found to significantly increase risk of event (odds ratio 7.435, $p < 0.001$). Age, chair angle and surgery length were not found to be significant risk factors. 82 participants (44%) experienced POCD. CDE incidence was not found to be associated with POCD in this study, nor were other demographic and surgical risk factors.

Conclusions: POCD in this was comparable to that reported in literature for other surgical populations. Obese patients were found to be at increased risk of experiencing CDE during shoulder surgery in the BCP, irrespective of surgery length or chair angle. Given the increasing burden of obesity, continuous intra-operative monitoring of cerebral perfusion should be standard care for BCP surgery in all hospitals.

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TENASCIN C DELETION IMPAIRS TENDON HEALING AND FUNCTIONAL RECOVERY AFTER ROTATOR CUFF REPAIR IN A MURINE MODEL

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Background: Failure of healing after rotator cuff repair (RCR) is common. Genetic variants in the extracellular matrix protein Tenascin C are associated with impaired tendon healing. The purpose of the current study was to evaluate the effect of deletion of the Tenascin C gene in a murine rotator cuff repair model on tendon healing after rotator cuff repair (RCR).

Methods: The supraspinatus tendon was transected and repaired with 6-0 Prolene suture on the left shoulder of 24 12-14 week old male mice. The mice included in the repairs were Wild-Type (WT) and Tenascin C null mice (Tnc-). Histologic, activity testing and RNA-seq analyses were performed on operated (WT-RCR, Tnc-RCR) mice. The unoperated, contralateral shoulder of WT-RCR and Tnc-RCR mice was used for histologic controls. WT-RCR (n=3) and TNC-RCR (n=3) were sacrificed at 8 weeks postoperative and used for histologic analysis. WT-RCR (n=3) and TNC-RCR (n=3) were sacrificed at 2 weeks postoperative and used for RNA-seq. Finally, WT-RCR (n=4) and TNC-RCR (n=8) underwent activity testing at 8 weeks postoperative.

Results: Tenascin C null mice have severe bone and tendon defects following rotator cuff repair. Tnc--RCR animals have a high degree of uncalcified fibrocartilage, severe disorganization of the organizing fibers, and increased bone remodeling compared to unoperated contralateral WT and TNC shoulders. Tenascin C null mice have reduced activity after rotator cuff repair including reduced wheel rotations, wheel duration and wheel episode average velocity compared to WT-RCR. Loss of Tenascin C following rotator cuff repair alters gene expression in the shoulder in comparison to WT-RCR with upregulation of the Hedgehog pathway and downregulation of the p53 pathway.

Conclusions: Deletion of Tenascin C results in a disorganized enthesis after rotator cuff repair, reduces activity and alters gene expression when compared to repairs in control animals. The data supports that variant genes identified in clinical studies of TNC that impair healing likely have a direct causative effect on rotator cuff repair failure. Further research is required to evaluate tissue specific alterations of the gene as well as possible adjuvants to improve enthesis healing in the setting of mutations.

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FOUR-DIMENSIONAL COMPUTED TOMOGRAPHY ANALYSIS OF THE STERNOCLAVICULAR AND ACROMIOCLAVICULAR JOINT MOTIONS

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Background: In the analysis of the shoulder complex, the sequential changes occurring in the sternoclavicular and acromioclavicular joints during active shoulder motion is challenging to track. This study aimed to clarify the in vivo sternoclavicular and acromioclavicular joint motions during active elevation using an upright four-dimensional computed tomography (4DCT).

Methods: Twelve healthy volunteers were enrolled in this study. Upright 4DCT of the bilateral shoulders during active elevation similar to a "hands up" motion was obtained. The three-dimensional (3D) bone surface models of the thorax, clavicle, scapula, and humerus were reconstructed from all frames of 4DCT data using a 3D-3D registration technique. The sternoclavicular and acromioclavicular rotation angles, joint distances, and closest points on the clavicle relative to the thorax and scapula were evaluated during 10° to 140° of humerothoracic elevation.

Results: The clavicle elevated, retracted, and posteriorly rotated relative to the thorax during active elevation, while the scapula rotated upwardly, internally, and posteriorly relative to the clavicle. All sternoclavicular and acromioclavicular joint rotation angles were significantly different from 30° to 50° of humerothoracic elevation compared with the values at 10° of humerothoracic elevation. The mean sternoclavicular and acromioclavicular joint distances were 1.9 to 2.7 mm and 1.3 to 2.4 mm, respectively. The closest points were located on the anteroinferior part of the medial and lateral clavicle in the sternoclavicular and acromioclavicular joints during humerothoracic elevation, respectively. Significant differences were observed in acromioclavicular joint distance and anterior/posterior movements of the sternoclavicular and acromioclavicular closest point compared with 10° of humerothoracic elevation.

Conclusions: This study clarified the 3D sternoclavicular and acromioclavicular joint motions during active elevation, including the sequential changes in these joint spaces. The clavicle and scapula were significantly rotated in the early phase of elevation compared to the past studies. We believe that the difference in the method of elevation result in earlier rotation timing. Our sternoclavicular and acromioclavicular closest point results indicated that the impingement tends to occur at the anteroinferior part of the medial and lateral aspects of the clavicle. Adequate resection of the anteroinferior part might be important for osteoarthritis or arthritis that resists conservative treatment.

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NO CHANGE IN PAIN INTENSITY DURING PROVOCATIVE TESTING IN EXPERIMENTALLY INDUCED SHOULDER PAIN FOLLOWING HYPERTONIC SALINE INJECTIONS

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Background: An immediate, transient increase in pain intensity in response to mechanical loading of injured tissue is assumed to play a driving role in motor adaptations to pain. To study the influence of shoulder pain on motor control, experimentally induced pain is often used, for example by injecting hypertonic saline into the supraspinatus muscle belly (SSMb) or the subacromial-subdeltoid bursa (SASD). For the clinical interpretability of such studies, it is relevant to know whether pain intensity is increased by physical loading of these injected structures.

Methods: 1-2mL hypertonic saline (5% NaCL) was injected in random order into the SSMb (n=10) or SASD (n=8) of healthy participants (age 22.9±2.9years, 5-male) under ultrasound guidance. Participants were then exposed to 8 different provocative tests (active and passive), in random order, at 20-second intervals. Pain intensity (VNRS-11) was reported during each provocative test. Areas (-diagram) and qualitative descriptors (Short-Form McGill Pain Questionnaire) of perceived pain were reported after completion of all tests. The impact of active/passive provocative tests on pain intensity was assessed using a linear mixed model with participants as random intercepts and full factorial Injection location (SSMb, SASD), rest-test, and Provocative tests as fixed factors. Areas of perceived pain were visually compared between the two injection sites. Pain descriptors with the highest summed scores were selected to describe the quality of the induced pain per injection site.

Results: Pain intensity was not significantly ($p>0.21$) altered by active nor passive provocative testing of the injected structures. SSMb-related pain was consistently perceived in the supraspinatus muscle and trapezius region and rarely in the deltoid region and was predominantly described as "cramping" and "gnawing". SASD-related pain was perceived only in the deltoid region and was predominantly described as "heavy" and "throbbing".

Conclusions: These findings demonstrate that injecting hypertonic saline into the SSMb or SASD appears not be suitable to mimic the mechanical pain response characteristic of pain related to tissue damage in common shoulder conditions. This must be considered when interpreting the clinical significance of outcomes from previous studies on motor adaptations to experimentally induced shoulder pain using hypertonic saline, and when developing new research questions.

EP.01.060

IMPACT OF AGE ON SHOULDER RANGE OF MOTION AND STRENGTH

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Background: Total shoulder arthroplasty (TSA) is a surgical technique commonly used to treat patients with arthritis and rotator cuff deficiency. Its purpose is to reduce pain and improve shoulder function, namely range of motion (ROM) and strength. While shoulder ROM and strength have been studied extensively in patients with various shoulder pathologies, there is a dearth of knowledge with regards to the asymptomatic population.

Methods: A cross-sectional study was conducted in the outpatient orthopaedic clinic following Institutional Review Board approval. Patients 18 years of age and older with at least one asymptomatic and healthy shoulder with no prior history of shoulder surgery, injury, or pain were enrolled in the study. Demographic information, ROM, and strength measurements were collected for 256 shoulders, evenly stratified into groups by age and sex. Statistical evaluation was conducted using Pearson correlations, ANOVA, and Bonferroni and Mann Whitney post hoc tests, with $p < 0.01$ indicating a significant difference.

Results: Abduction strength ($p < 0.001$), external rotation strength ($p < 0.001$), and internal rotation strength ($p < 0.001$) were negatively correlated with age when viewing the data as a whole and after stratification of males and females. Age and shoulder ROM, namely abduction ($p < 0.001$) and forward elevation ($p < 0.001$), were also significantly negatively correlated, although internal rotation decreased with age as well. When comparing across age groups, abduction ($p = 0.001$) and forward elevation ($p = 0.001$) were significantly higher in group 1 (18-35) when compared to group 4 (66+), but external rotation wasn't significantly different between these groups. External rotation ($p = 0.001$) was only significantly different between groups 2 (36-50) and 4. Group 4 was found to have significantly less external rotation strength than all 3 of the other groups.

Conclusions: Shoulder strength significantly decreased with age, with abduction strength and external rotation strength displaying the strongest negative correlations. Decreases in strength were most prominent in patients 66 years of age and above. Shoulder ROM was not as tightly correlated with age, although abduction, forward elevation, and internal rotation were found to generally decrease over time. Differences in external rotation were not clinically significant. These correlations provide useful controls for patients of various ages regarding their clinical outcomes when presenting with shoulder pathology.

EP.01.061

EFFECT OF TORQUE-COMPRESSION AND RSA BASEPLATE DESIGN ON IMPLANT STABILITY: A MICROMOTION STUDY

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Background: Initial stability of a reverse shoulder arthroplasty (RSA) glenoid baseplate, is essential for bone ingrowth to occur on implant surface, where micromotion must stay below 150-microns. This biomechanical study evaluates the effects of compression on baseplate micromotion in three different baseplate designs (1-piece design [1P], a 2-piece locking design [2PL] and a 2-piece non-locking design [2PNL]). Three levels of compression (810 N, 640 N and 530 N) were tested.

Methods: A total of 54 foam cylinders (healthy bone density, 30 PCF) were utilized for this investigation. The baseplates were inserted into each foam cylinder utilizing a digital torque gauge. A hybrid configuration of 1-locking (Superior position) and 3-non locking peripheral screw was selected. Testing methodology was based on ASTM F2028 at 0.5 Hz for 10,000 cycles. Micromotion was collected throughout cycles. A 1-way analysis of variance (ANOVA) was performed within each grouping, correcting for multiple comparisons with Tukey-Kramer HSD as the post hoc test. All data are presented as mean \pm standard deviation. Statistical significance was set at $P = .05$.

Results: Micromotion for each baseplate design increased as the amount of compression decreased. The 1P design remained below 150 μm threshold across all three compression scenarios. At 10k cycles, no statistical differences were detected between baseplate designs at 810 N compression. At 640 N compression, 2PL design had significantly more micromotion than 1P ($P=.0056$) and 2PNL ($P=.0127$). No differences between 1P and 2PNL were detected. Both modular designs maintained below the 150-micron threshold until the lowest level of compression tested, 530N. At 530 N compression, 2PL design had significantly more micromotion than 1P ($P=.041$), however no significant differences between 2PL and 2PNL, or between 1P and 2PNL were detected.

Conclusions: Glenoid baseplates with central screw fixation generate higher compression by increased torque input, improving baseplate stability in a healthy bone surrogate. However, results suggest the amount of torque required may differ across implant designs as compression may be generated at a different rate. Outcomes also suggest an optimal compression is required to maintain implant stability, specifically in modular designs.

EP.01.062

BIOMECHANICAL EVALUATION OF TRANSOSSEOUS ROTATOR CUFF REPAIR WITH VARYING TENDON THICKNESS AND SUTURE BITE AND METHODS.

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Background: Recently, some studies reported that fragility of rotator cuff tendon stump leads to retear after the repair. Although tendon thickness relates to biomechanical strength of rotator cuff repair, the mechanical properties varying tendon thickness is unknown. This study was to evaluate the biomechanical strength of rotator cuff repairs using transosseous techniques using different tendon thicknesses with varying suture sites and adding the horizontal cinch stitch techniques.

Methods: We used thirty-two porcine shoulders that created rotator cuff repair models with native (group N) or trimmed half (group H) thickness of infraspinatus tendons. The specimens were randomly divided into three repair techniques configurations: four transosseous simple stitches with 4-mm intervals at 15 mm (group 15) or 10mm (group 10) from the stump, with a horizontal cinch stitch (group 10C) was added in the lateral row at 5 mm from the stump. All specimens were set an angle at 30 degrees from the footprint and underwent cyclic loading for 200 cycles from 5 to 30 N to record elongation. Load-to-failure test at crosshead speed 20 mm/min. We calculated yield and maximum strength, liner stiffness from the displacement load curve. Data were analyzed by one-way analysis of variance with Student t test. Statistical significance was set at $p < 0.05$.

Results: In elongation, group H-10C showed a significantly smaller than other groups ($p < 0.05$). There were no significant differences between simple stitch repair groups. In maximum and yield load, group N-10 showed a significantly stronger than other groups ($p < 0.01$), and group H-10C showed a significantly stronger than group H-10 and H-15 ($p < 0.05$). Furthermore, failure load of group H-15 showed a significantly stronger than group H-10 ($p < 0.05$). In stiffness, group H-10C showed a significantly higher than other groups ($p < 0.01$), but there were no significant differences between simple stitch repair groups.

Conclusions: The thickness of tendon and the width of tissue bite affected the tensile strength, but there were no effect on elongation and stiffness. On other hand, adding horizontal cinch stitch technique in the lateral row showed superior biomechanical strength than transosseous simple stitch technique alone in the half thickness of tendon due to self-cinching mechanism.

EP.01.063

INFERIOR GLENOID COMPONENT INCLINATION CAN REDUCE SHEAR FORCES IN TOTAL SHOULDER ARTHROPLASTY

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Background: Total Shoulder Arthroplasty (TSA) is commonly used to alleviate pain and restore function in osteoarthritic (OA) shoulders. Despite the wide use of TSA, there are still concerns about glenoid loosening and wear that may be a result of excessive glenohumeral shear forces. Surgical guidelines recommend that glenoid component placement should restore neutral version, but little is known how the inclination can affect muscle and joint forces. This study uses an established shoulder biomechanical model to investigate how glenoid component inclination affects the biomechanics of TSA.

Methods: The Newcastle Shoulder Model (NSM) was used to calculate glenohumeral joint forces after virtual TSA. The NSM consists of all the joints and muscles of the upper extremity, and it can simulate functional shoulder motions including clavicle and scapula kinematics. Five CTs from pre-op OA patients were utilized to customize the NSM. A surgeon performed virtual TSA to the models using a commercial TSA system and applied three glenoid inclinations: 0°, 10° and 20° downward tilt. To investigate how the integrity of the rotator cuff (RC) muscles may affect the results, two different RC setups were also tested; i) healthy RC and ii) attenuated superior cuff. Glenoid joint contact forces (analyzed in compressive and shear) were computed for abduction in frontal and scapula planes.

Results: Glenoid inclination had a significant effect on glenohumeral joint contact forces. Shear forces were decreased with 10° and 20° inferior inclination, compared to 0°, in the models with the healthy RC ($p < 0.001$). The reduction of shear forces was larger for the models with the attenuated superior RC muscles, where the 20° glenoid inclination showed the largest reduction of shear forces (44.2% compared to 0°, $p < 0.001$).

Conclusions: Overall, inferior glenoid component inclination in TSA can reduce glenoid shear forces but the 20° of inclination showed to benefit mostly the models with the attenuated supraspinatus muscle. Overall, the data suggest that inferior glenoid component inclination may be beneficial for TSA, and more aggressive inclination should be considered for patients with attenuated superior cuff muscles. However, this investigation did not consider how glenoid bone quality may be affected by the inferior reaming.

EP.01.064

THE LATISSIMUS DORSI CREATES A POUCH FOR THE INFERIOR ANGLE OF THE SCAPULA DURING ARM ABDUCTION IN HUMANS

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Background: The importance of several scapulothoracic muscles including trapezius and serratus anterior in maintaining physiological scapula kinematics has been highlighted in the past, the relationship between the scapula and the latissimus dorsi muscle remains unclear. While anatomy books describe the inferior angle of the scapula as one of the origins of the latissimus dorsi, our clinical surgical observation is that the latissimus dorsi does not directly attach to the inferior angle of the scapula and creates a pouch into which the scapula slides during elevation of the arm. Based on this observation we hypothesize that the relative amount of latissimus and scapula overlap (LSO) will change with different arm positions.

Methods: All consecutive patients who had a whole- computed tomography scan in case of a polytrauma evaluation between 2018 and 2021 with complete depiction of the scapula and latissimus dorsi muscle were analyzed. 150 shoulders in 90 patients with arms up were matched according to their age (within 5 years), gender and affected side with 150 shoulders in 88 patients with arms down. Patients with pathologies of the upper extremities or thorax that potentially could alter LSO measurements were excluded. LSO was calculated as a ratio of the measured area of the latissimus dorsi projection on the scapula and the total scapula area.

Results: The mean age of the 178 patients (f=48; m=13) was 60 years. The arms up group showed a significantly higher LSO than the arms down group ($19.9 \pm 6.3\%$ vs. $2.7 \pm 2.2\%$; $p < 0.0001$). In the arms up group, approximately one fifth of the scapula was overlapped inferiorly by the muscle belly of the latissimus dorsi contrary to the almost non-existing LSO in the arms down group.

Conclusions: With arms up, humans show a significantly higher LSO in comparison to arms down indicating that the latissimus dorsi indeed creates a pouch during abduction of the arm while the claim that the latissimus has a firm origin on the inferior angle of the scapula needs to be questioned. This arm position dependent change of LSO warrants further consideration of the role of the latissimus dorsi in the pathogenesis of scapular dyskinesia.

EP.01.065

DIFFERENCE IN ANTERIOR AND POSTERIOR GLENOID MORPHOLOGY AFFECTS BONE GRAFT DIMENSIONS FOR GLENOID RECONSTRUCTION

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Background: There is a morphological anatomic asymmetry between the native anterior and posterior glenoid regarding the depth and resultant area available for bone graft placement on the glenoid neck. The purpose of this study is to define the depth available for anterior and posterior bone graft placement. We hypothesize there will be a greater depth available for graft placement on the anterior glenoid neck as compared to the posterior glenoid.

Methods: An age- and gender-matched cohort was generated from a retrospective review of patients who had undergone previous anterior or posterior glenoid reconstruction at a single institution. Patients were excluded if they had existing glenoid bone loss (GBL), glenoid dysplasia, glenoid fractures, or previous glenoid hardware. The mid-height of the glenoid was selected by simultaneously viewing the axial and coronal images. The glenoid width was recorded and 20% was calculated to simulate anterior and posterior GBL. Reference lines corresponding to the calculated 20% bone loss were then created along the anterior and posterior glenoid. The available depth was calculated from these reference lines to the glenoid neck. All images were reviewed by two independent observers and inter- and intra-observer reliability was calculated with the intraclass correlation coefficient (ICC).

Results: Thirty-three patients were available for review and met inclusion criteria. Computed tomography was utilized for five measurements, magnetic resonance imaging (MRI) for ten, and MRI arthrogram for 18. The mean glenoid width was 29.1 mm (range: 21.8-34.9 mm, SD: 3.18), and the mean simulated 20% GBL measurement was 5.9 mm. There was a statistically significant difference in the amount of area available for graft placement anteriorly on the glenoid neck compared to posteriorly (17.8 mm vs. 10.2 mm, respectively; $p < 0.01$). Inter-observer reliability was very good, with an ICC of 0.95, 0.84, and 0.89 for glenoid width, depth of posterior loss, and depth of anterior loss, respectively.

Conclusions: The depth available for bone graft placement is significantly more for the anterior glenoid neck as compared to the posterior glenoid due to the asymmetric morphology of the glenoid.

EP.01.066

JOINT KINEMATICS IN THE ROTATOR CUFF DEFICIENT SHOULDER

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Background: The association between rotator cuff pathology and humeral head migration has been acknowledged for decades now but remains poorly understood. The aims of this study are to evaluate the effects of isolated and combined rotator cuff tears on glenohumeral joint translations and muscle forces during abduction.

Methods: Eight fresh-frozen cadaveric upper limbs were dissected; their deltoid and rotator cuff muscle-tendons were sutured to simulate loading using weight-specific muscle force values derived from a previous EMG-driven study. Specimens were mounted to an Upper Limb Testing Apparatus, and sutures of their muscle-tendons were attached to stepper motors via pulley lines. Simulations of scapular-plane abduction were performed in the native shoulder and then repeated with the following rotator cuff conditions: isolated supraspinatus tear, combined supraspinatus and infraspinatus tear, and combined supraspinatus and subscapularis tear. The resultant muscle forces and humeral head translations during static abduction were measured. A two-way, repeated-measures ANOVA was conducted to compare rotator cuff tear conditions and joint angles with muscle forces and humeral head translations during abduction.

Results: There were significant increases in superior translation of the humeral head between the intact and supraspinatus-infraspinatus tear condition at 30° (mean increase: 5.2%, 95% CI: [0.9,9], $p = 0.02$) and 60° (mean increase: 15%, 95% CI: [0.7,30], $p = 0.04$) of abduction. No significant effects of cuff deficiency were observed in the anterior-posterior joint translations. Overall, significantly greater muscle forces applied to the deltoid and rotator cuff were required to achieve abduction upon cuff deficiencies, in comparison to the intact shoulder ($p < 0.05$).

Conclusions: While loss of supraspinatus function may be compensated by the deltoid and other rotator cuff muscles to achieve humeral elevation, the infraspinatus plays a crucial role in stabilising the head of the humerus during scapular-plane abduction. Clinically, the findings of our study may contribute to improving physiotherapeutic programmes and suggest that the infraspinatus be prioritised for repair over subscapularis.

EP.01.067

THE EFFECTS OF HYALURONIC ACID ON THE PROLIFERATION OF HUMAN DERMAL FIBROBLASTS AND THEIR EFFECTS ON TENDON-TO-BONE HEALING IN A RABBIT MODEL OF A CHRONIC ROTATOR CUFF TEAR

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Background: The purpose of this study was to determine the effects of HA on the proliferation of human dermal fibroblasts (HDFs) and to evaluate the HA as a carrier and HDFs on tendon-to-bone healing in a rabbit model of a chronic rotator cuff tear. The hypothesis of this study was that there would be an effect of hyaluronic acid on the proliferation of the human fibroblasts and there would be a synergistic effect of the human fibroblasts with hyaluronic acid on healing of repaired rotator cuff tendons of rabbits.

Methods: For in vitro study, HDFs were mixed with or without HA solution. The cells were then incubated and cultivated for proliferation. The absorbance ratio of 96h/24h was compared to evaluate the effect on cell proliferation. A total of 24 rabbits were randomly allocated into 3 groups (n=8 each). Supraspinatus tendons were detached and left for 6 weeks to establish a chronic rotator cuff tear model. Torn tendons were repaired with the injection of 10×10⁶ HDFs with HA in group A, HA only in group B, and saline only in group C. At 12 weeks after repair, the mechanical and histological evaluation were performed.

Results: In vitro study showed that the proliferation of HDFs was significantly increased when mixed with HA (HDFs with HA vs. HDFs without HA, p<0.01). In terms of in vivo study, group A showed significantly higher load-to-failure values than the other groups (p<0.001). In the histological evaluation, group A showed greater collagen fiber continuity, collagen density, the maturation of the tendon-to-bone interface structure, and the maturation of nuclear shape than the other groups (all p<0.05).

Conclusions: This controlled laboratory study verified the potential for the use HA for HDFs proliferation. The HDFs mixed with HA showed better healing in a rabbit model of a chronic rotator cuff tear.

EP.01.069

EVALUATION OF THE ROLE OF COMPUTATIONALLY PREDICTED MIRNA COMBINATION ON TENDON REGENERATION AND REMODELING

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Background: The age-related degenerative disease of the musculoskeletal condition, such as tendinopathy, causes an impaired life due to chronic pain, muscular stiffens and motion restriction. The healing process of such diseases very slow due to structural complexity of the tendon. The healing of tendon involves three main major steps; 1) inflammatory response, 2) cell proliferation and differentiation, and 3) remodeling of the Extra-Cellular Matrix (ECM). Therefore, a series of molecular events happens in a manner of orchestra to create the symphony of healing. Proliferation and differentiation of the tenocyte is essential and initial process of healing, therefore reprogramming of resident cells required to mitigate the above phenomena. This cellular reprogramming can achieve by epigenetic regulators such non-coding RNAs, and MicroRNAs (miRNAs) could be one of better choice.

Methods: In this study a computationally predicted miRNA involved in cell proliferation and differentiation of tenocyte were used to re-routing of the cellular function. This study was focused on the combinatorial effect bioinformatically predicted of miR-135 and miR-140 on tendon healing in rat model. In vivo study on healing of tendinopathy was evaluated by gene expression profiling using western blots and qRT-PCR, and IHC and HE.

Results: Many miRNAs are likely to regulate genes important for the tendinopathy healing process, and the result of this study allows an approach for miRNA-mediated regeneration of the tenocyte for tendon healing. The miR-135 and MiR-140 has potentially reprogram the tendon microenvironment to produce adequate number of tenocytes to properly remodel the ECM.

Conclusions: This shows the epigenetic regulation using more than one miRNA could be a better solution to tendon.

EP.01.070

INFLUENCE OF INCOMPLETE GLENOID ALL-POLYETHYLENE IMPLANT SEATING IN PRIMARY MECHANICAL FIXATION

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Background: In anatomical total shoulder arthroplasty, the presence of glenoid bone loss or the mismatch between the glenoid implant and the underlying subchondral bone might lead to an incomplete glenoid seating. Incomplete glenoid seating results in non-uniform stress on the glenoid implant and its fixation which might lead to implant failure. The purpose of this study was to compare cyclic stability between keeled glenoid implanted with different levels and types of seating, through a biomechanical evaluation.

Methods: Using bone substitute, an experimental protocol was designed to compare the loosening of a keeled glenoid prosthesis in 3 types of seating: (group A) peripheral support without central contact, (Group B), central contact without peripheral support, and (Group C) Eccentric peripheral defect (posterior glenoid bone loss). For each type of seating, 90%, 80%, and 70% of seating have been investigated. The implants were cyclically off-centered-load, to recreate the rocking-horse effect (1.000.000 cycles), with a constant load of 125daN. The displacement of the glenoid implants was assessed with an LVDT (Linear Variable Differential Transformer) gauge.

Results: During the cyclic loading, stability was not affected in the case of full peripheral support (group A) and for 90% of glenoid seating for groups B and C. With 80% of seating, group B failed after 605'848 cycles and group C after 604'539 cycles. With 70% of seating, group B failed after 409'646 cycles and group C after 475'034 cycles.

Conclusions: Cemented-keeled glenoid resistance to rocking-horse cyclic testing need a full peripheral support or at least 90% of seating. An improper technique of glenoid implantation diminishes the implant's biomechanical stability.

EP.01.071

DEVELOPMENT OF ANIMAL MODEL FOR SHOULDER INSTABILITY WITH GLENOID BONE DEFECT--A CADAVERIC STUDY IN CANINE

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Background: A reliable animal model is crucial for the basic research of the pathology and therapy for shoulder instability, however there is no widely used animal model in current studies. This study aims to investigate the anatomy of the canine shoulder, the surgical approach and method of a canine model for shoulder instability with glenoid bone defect on cadaveric specimen.

Methods: Three fresh-frozen cadaveric specimens of canine were included in this study. The specimens were subjected to unilateral procedure (model group) and the contralateral shoulder was designed as the sham group. For the model group, incision of the subscapularis, medial glenohumeral capsule and ligament, and medial glenoid bone defect were made. For the sham group, surgical exposure of subscapularis was made and then closed the wound. Pre-operative and post-operative medial drawer test, shoulder abduction angle measurement and computed tomography (CT) scan of the shoulder were performed.

Results: The anteromedial surgical approach to the canine shoulder is safe and feasible without important neurovascular structures, which may allow for better exposure of the operative area and reduces intraoperative complications. The medial drawer test was negative preoperatively and positive postoperatively in model group, and was negative in sham group. The abduction angle of shoulder was significantly greater postoperatively than preoperatively in model group ($P < .001$), but not in sham group. No significant difference was found in preoperative abduction angle between the 2 groups. The model group had greater postoperative abduction angle than the sham group ($P < .001$). Preoperative CT scan showed no dislocation and bone lesion of the shoulder in both groups. Postoperative CT scan showed that the mean bone defect was 25.3% (range 17%–33%), and the humeral head dislocated medially to the glenoid in the model group.

Conclusions: The subscapularis, medial glenohumeral capsule and ligament, and the medial glenoid are important medial stabilizers of the canine shoulder. Incising the medial stabilizers of the shoulder and making the medial glenoid bone defect can effectively and safely cause medial shoulder instability in the canine cadaveric specimen. The canine shoulder may be an optional animal model for shoulder instability with glenoid bone defect.

EP.01.072

ARTHROSCOPIC KNOTS: SUTURE AND KNOT CHARACTERISATION OF MODERN POLYBLEND SUTURE MATERIALS

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Background: The primary aim of this study was to explore the relationship between the biophysical structure and function of modern suture materials. Particularly the suture's ability to withstand the stressors of surgery and how the material properties affect knot stability. The secondary aim was to investigate the effect that different knots have on the suture material itself. This study builds on previous research assessing suture and knot characteristics but in modern Ultra High Molecular Weight Polyethylene (UHMWPE) materials currently in widespread clinical use in arthroscopic surgery.

Methods: Three common UHMWPE sutures and one polyester suture were tested in both a dry and wet state using the Geelong, Nicky's, Surgeons and Tautline knots. Tensile strength of knots were tested vertically at a 60mm/min strain rate and 45mm gauge length. Sutures were tied through a cannula around two 8mm diameter circular bollards. Testing was conducted in a controlled environment temperature and humidity environment ($20\pm 2^\circ\text{C}$, $65\pm 2\%$).

Results: No one knot type was optimal over all suture types. Mean tensile strength in both a dry and wet state and a low coefficient of variation (CV) in tensile strength in a wet state were considered as an indication of suitability. With Ethibond sutures this was the Geelong knot (CV:4.2%). With Orthocord sutures both the Geelong and Tautline knots (CV:4.2% and CV:11.9% respectively). With FiberWire sutures the Nickys and Tautline knots (CV:22.6% and CV:22.5% respectively). With ForceFiber sutures all four knots exhibited similar wet tensile strength with high variability showing that all should perform in a similar way in vivo.

Conclusions: This study demonstrates a statistically significant three-way interaction between polyblend suture materials, the knot and the environment. This has implications for knot security using the tested sutures in different environments, as one knot may not behave the same under all conditions.

EP.01.073

WHAT IS THE BEST POSITION FOR CORACOID FIXATION IN THE LATARJET PROCEDURE?

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Background: Purpose: Multiple problems and complications associated with Latarjet fixation have been described; thus, this is the first study in the literature to identify the maximum allowed screw clamping force and best fixation screw position for Latarjet surgery.

Methods: Methods: A variation of distal and proximal coracoid screw positions with and without a flat washer were evaluated through Finite Element Analysis (FEA), at a minimum distance of 3mm from edge. A loading progression test was performed until the maximum stress reached a limit imposed by the bone yield. We identified the maximum allowed screw clamping force based on a Von Mises and max principal stresses failure theory.

Results: Results: when using the flat washer the cortical bone generally has only space for one piece. For this reason, as a primary study, it was observed that when the distal screw was greater than 7 mm from the edge, the clamping force supported will be higher than when the proximal fixation regardless of the proximal location screw. We have found that the best position is 7mm from the distal edge, with the highest compression of 445 N (7mm proximal distance - 5mm distal distance) in due respect to the Von Mises failure theory. To get around this lack of space situation, in this study, we have proposed a fixation plate to replace the flat washer. This plate has shown very interesting values when compared to the previously flat washer study, but now, for both screw holes. With those results, we can assure that using a fixation plate like this will ensure more surgery safety and higher allowed compression force when clamping the bolts.

Conclusions: Conclusion: The distal screw provided higher tensile strength values when located more than 7 mm from the coracoid edge. The geometry of the coracoid in its distal position supports higher stress loads than in the proximal position. When the flat washer was in the proximal position, the coracoid was submitted with a more distributed and uniform load, preventing localized bone damage as a crush.

EP.01.074

LESS PAIN, BUT ONLY SMALL CHANGES IN SHOULDER KINEMATICS FOLLOWING TOPICAL ANESTHETIC IN PATIENTS WITH ONGOING SHOULDER PAIN

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Background: Persistent shoulder pain involves a complex interaction between physiological and psychological factors. Still unknown is to what extent associated movement behavior is part of an ongoing nociception-based adaptive mechanism. Aim of this multicenter observational trial was to observe the influence of immediate relief of nociception-based pain on shoulder and trunk kinematics during a semi-constrained painful overhead reach task in patients with ongoing shoulder pain.

Methods: Symptomatic shoulders of 29 patients (age 59.0 ± 12.8 years; 16-male) were injected with corticosteroids and lidocaine by their attending orthopedic surgeon. Immediately before and 5 minutes after, patients reached 10 consecutive times as high as possible to a target on the ceiling directly above. Pain intensity (VNRS-11) at each highest arm elevation, and shoulder and trunk kinematics (Xsens-DOT, wireless inertial measurement units) were recorded. Pre- and post-injection pain-scores and helical angles for thoracohumeral, scapulothoracic, humeroscapular and trunk contributions to the movement trajectory were compared.

Results: Generalized Estimating Equations analysis showed statistically significant pain reduction during the reach task after the injection ($n=27$). Statistical Non-Parametrical Mapping showed no differences in maximal shoulder and trunk helical angle contributions between conditions. Significant lower angles for the post-injection condition were found for part of the descending phase (thoracohumeral [75.3%, 92.9%]; $p=0.0005$; scapulothoracic [73.7%, 93.1%]; $p=0.0031$; humeroscapular [71.4%, 92.3%]; $p=0.0008$).

Conclusions: Acute pain relief following topical anesthetics does not result in immediate alterations in the maximal contribution of shoulder and trunk range of motion during a semi-constrained painful overhead reach task in patients with ongoing shoulder pain. However, there are signs of small alterations in kinematics during the descending phase.

EP.01.075

COMPARISON OF EFFICIENCY AND EFFECTIVENESS BETWEEN A SLAP HAMMER AND RIGID C-FRAME DEVICE FOR EXTRACTION OF AN INTRAMEDULLARY NAIL

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Background: Removal of orthopaedic intramedullary implants can be difficult and time-consuming. Instrumentation for implant removal is frequently deficient for effective removal. The purpose of this study is to compare the efficiency of a C-type jig with a standard slap hammer attachment. We hypothesize that a C-type jig will be a more energy efficient method of implant removal.

Methods: An IM nail removal was simulated in a series of 10 tests using 40 PCF Sawbones bone blocks with drilled holes and custom-made IM nails. Each attachment was secured to a Shukla Medical threaded connector from their IM nail revision product. A camera recorded each hammer swing, and a caliper recorded the distance the nail traveled out of the bone block. The data was then analyzed to determine extraction rate, and efficiency.

Results: The c-frame hammer exerted a greater force, had a greater extraction efficiency and required 37.4% less energy expenditure than the slap hammer to extract the nail the same distance. The C-frame hammer also removed the nail 38.1% faster with the same energy expenditure and possessed greater usable kinetic energy, whereas the slap hammer had more "lost" energy.

Conclusions: The c-frame hammer attachment was found to have a considerably higher extraction rate and efficiency than the slap hammer. It will be a more useful method of implant extraction, especially for cases involving larger bones or larger implants. However, the slap hammer may be more suitable for smaller tools or bones for which larger impact loading would be detrimental.

EP.01.076

LATISSIMUS DORSI TENDON TRANSFER IN REVERSE SHOULDER ARTHROPLASTY: RESTORING MECHANICAL ADVANTAGE BY TRANSFER POSTERIOR TO THE LONG HEAD OF THE TRICEPS

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Background: Latissimus Dorsi (LD) tendon transfers for massive rotator cuff tears was first introduced by Gerber and the technique consisted of releasing and transferring the LD tendon posterior to the long head of the triceps. Recently, LD transfer is used as an addition to Reverse Shoulder Arthroplasty (RSA) but is done from an anterior deltopectoral approach where the tendon is tunneled anterior to the long head of the triceps. This direction wraps the LD tendon in front of the long head of the triceps reducing its mechanical advantage to externally rotate the humerus. The purpose of this study was to assess the efficiency of the LD transfer as an external rotator when it is transferred anterior or posterior to the long head of the triceps in RSA.

Methods: Eight fresh frozen cadaveric shoulders were implanted with an RSA while the cuff tendons were cut. The specimens were tested with an established shoulder simulator and with the humerus at i)20° and ii)60° glenohumeral abduction. The LD tendon was transferred to the greater tuberosity first with an 'anterior approach' (tendon routed anterior to the triceps) and then with a 'posterior approach' (tendon routed posterior to the triceps). A pulling force was applied to the LD and the resulted external rotation motion was recorded.

Results: The data showed that the 'posterior approach' required less force to achieve external rotation of the arm throughout the motion ($p < 0.01$). The level of the abduction did not have any effect on the LD tendon approach ($p = .528$). There was no significant interaction between the rotation angle and the transfer approach ($p = .928$)

Conclusions: The study show that LD tendon transferred posteriorly to the long head of the biceps is more efficient in achieving external rotation in RSA. While the clinical results of the LD transfer for RSA have been debatable in clinical practice, the lack of efficacy of the transfer may be due to the technique of the transfer (anterior vs posterior). The posterior LD transfer is technically more challenging than the anterior transfer in an RSA setting, however its improved mechanical advantage may make this technique modification important to its success.

EP.01.077

REGENERATIVE THERAPEUTICS ADVANCEMENTS FOR DEGENERATIVE MUSCULOSKELETAL CONDITIONS (OSTEOARTHRITIS AND TENDINOPATHY)

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Background: The past two decades are witness of the tremendous discoveries in regenerative medicines. The ability to regenerate the tissue or organ during the therapy gained a huge attention by the clinicians and researchers. Advances in knowledge of mechanism to reprogram the resident cell in desirable cell lineage and subsequently remodeling of ECM allow the researchers to develop a better precision therapy for various degenerative diseases. Application of various autograftable/allograftable biologics, cell-lines and scaffolds empowers the clinicians to manage various chronic diseases in more effective way. 's own cells (Orthobiologics), Mesenchymal stem cells (MSCs), Extracellular vesicles (exosomes), Growth factor & secretomes, Scaffolds etc., have been identified as a safer and appropriate alternative as regenerative therapeutics.

Methods: This study is a scientometric analysis on the pre/clinical trials related to regenerative medicines, focusing on Osteoarthritis (OA) and tendinopathy. Osteoarthritis (OA) is a degenerative disease that worsens over time, often resulting in chronic pain. Degenerative tendinopathy (DT) is a continuum of tendon pathology, and tendon repair during the therapy take a longer period with several follow-up. Both the DTs and OAs are more critical in aged patients, a long-term administration of NSAID to such patients is one of the major concerns. Therefore, the regenerative medicines are considered a new hope along minimum invasive surgery, to the old-aged patients.

Results: More than 80 clinical trials are registered under regenerative categories for OA and DTs, globally. This study will provide an insight and comprehensive account on various clinical trials for the mentioned degenerative. In the studies the potentials, feasibility, and competitiveness with existing non-regenerative therapy. Therefore, this study will also discuss on recent preclinical works, including keywords the Regenerative medicines, Orthobiologics, orthopedics, OA, DTs, and molecular medicine. Which have potential to be considered as future regenerative medicine. Therefore, this article will address the development of therapies over the time by providing a detailed account on recent advancements made.

Conclusions: This study will provide insights on various factors affecting the healing process, and their involvement in remodeling of microenvironment of matrix. Information provided in this study will help to design more effective therapies for degenerative tendinopathy as well as osteoarthritis

EP.01.078

SCAPULAR MORPHOLOGY DIFFERENTIATES GLENOHUMERAL OSTEOARTHRITIS BUT NOT ROTATOR CUFF PATHOLOGY

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Background: Anatomic factors associated with rotator cuff pathology and shoulder osteoarthritis development are still a topic of debate. Most studies use two-dimensional methodology, but recent three-dimensional (3D) methods allow for a better understanding and analysis of the scapula's complex shape. The purpose of this study is to investigate whether scapular anatomy is associated with rotator cuff pathology or glenohumeral osteoarthritis using 3D statistical shape modelling (SSM).

Methods: A total of 125 computed tomography (CT)-scans of complete scapula were allocated to three groups. Rotator cuff group (RCG) included patients with posterosuperior rotator cuff tears. Osteoarthritic group (OAG) included patients with centric glenohumeral osteoarthritis. Each group included 55 patients matched by age and gender. Control group (CG) included 16 patients without shoulder pathology. A 3D segmentation of each scapula was manually created and surfaces were reconstructed for input to a SSM analysis. SSM-based correspondence particles were analyzed using principal component analysis (PCA) and linear discriminant analysis (LDA). Different landmarks were manually identified on the scapula. From these landmarks, 3D measurements of glenoid version and inclination, critical shoulder angle (CSA), acromial angle, among others, were obtained. Measurements were compared between the CG, RCG and OAG using an ANOVA or Student's T-test, as appropriate.

Results: There were no differences in mean age (RCG:57±9, OAG:58±8 and CG:61±7) and gender proportion (males:RCG:51%, OAG:51% and CG:75%) between groups. 13 PCA modes captured significant shape variation (83.5% of overall variation) among the three groups. The LDA was significantly different between OAG and both RCG and CG (RCG:1.0±1.4, OAG:-1.0±1.9 and CG:1.4±1.2). Glenoid version and inclination had no differences between groups. Compared to CG, OAG had smaller CSA (25.0°±6vs32.4°±4;p<0.01), smaller acromion-spine angle (71.9°±8vs76.6°±8;p:0.03), larger acromion angle (65.7°±9vs57.4°±9;p<0.01), a more superior and anterior postero-lateral corner of the acromion (p<0.01 for both) and more anterior coracoid tip (p<0.01). There were no significant differences in any measurements between RCG and CG.

Conclusions: Scapular morphology of OAG indicated a more superior and more horizontal acromion and with a lower CSA compared to control group. Conversely, this study was not able to identify association between the scapular morphology and the presence of rotator cuff pathology.

EP.01.080

IMAGING DIAGNOSIS USING ULTRASOUND SHEAR WAVE ELASTOGRAPHY FOR TENDINOPATHY OF THE LONG HEAD OF THE BICEPS TENDON

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Background: Tendinopathy of the long head of the biceps (LHB) tendon is common in sports enthusiasts and middle-aged and causes degeneration and changes its stiffness. However, a reliable imaging diagnosis has not been established. Shear wave elastography (SWE) provides quantitative tissue elasticity measurements. In this study, the relationship of preoperative SWE values with biomechanically measured stiffness and the degree of histological tissue degeneration of the LHB tendon was investigated.

Methods: LHB tendons were obtained from 18 patients (11 males and 7 females, mean age: 62.1 years) who underwent tenodesis with arthroscopic shoulder surgery. SWE values were measured preoperatively at two sites, proximal to and within the bicipital groove of the LHB tendon. The LHB tendons were detached immediately proximal to the fixed sites and at their superior labrum insertion. The distal 5 mm of the resected LHB tendon was used for histology and the remaining tendon was used for the biomechanical test. Tissue degeneration was histologically quantified using the modified Bonar score. The biomechanical test was performed using a tensile testing machine. Spearman's rank correlation coefficients were calculated for correlations between the SWE value, stiffness, and modified Bonar score of the LHB tendons.

Results: The SWE values of the LHB tendon were 502.1 ± 113.6 kPa proximal to the groove and 439.4 ± 123.3 kPa within the groove. The stiffness of the LHB tendon was 39.3 ± 19.2 N/mm. The all LHB tendon tissues showed signs of degeneration. The SWE values displayed a moderate positive correlation with the stiffness proximal to the groove ($r = 0.80$, $p < 0.01$) and within it ($r = 0.72$, $p < 0.01$). The SWE value of the LHB tendon within the groove showed a moderate negative correlation with the modified Bonar score ($r = -0.77$, $p < 0.01$).

Conclusions: These findings suggest that preoperative SWE values of the LHB tendon correlate moderately positively with stiffness and moderately negatively with tissue degeneration. Therefore, SWE may predict LHB tendon tissue degeneration and changes in stiffness caused by tendinopathy.

EP.01.081

THE EFFECTS OF SHORT HUMERAL STEM ALIGNMENT IN REVERSE TOTAL SHOULDER ARTHROPLASTY: A CADAVERIC BIOMECHANICAL STUDY

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Background: Interest in short humeral stems has increased in recent years, but with their use comes the risk of malalignment during implant insertion. In this study, we aim to evaluate the biomechanical effects of short humeral stem alignment in reverse total shoulder arthroplasty (RTSA).

Methods: Eight fresh-frozen human cadaveric shoulders were tested with the varus, valgus, and neutral alignments of a bespoke short stem in RTSA. The implants were designed to re-adjust alignment by changing humeral tray with a single stem. The degrees of inferior and lateral shift compared to the neutral position were measured in the varus and valgus alignments. Maximum abduction and adduction angle were measured. Impingement-free internal rotation (IR), external rotation (ER), and deltoid length were measured at 0° and 30° abduction. Anterior dislocation forces were measured at 0° and 30° abduction with 30° IR and 0° ER positions. Abduction capability (force for abduction) was measured at the maximal abduction angle at each consecutive load on the middle deltoid.

Results: Compared with the neutral alignment, the valgus alignment translated the humeral component more distally (10.46 ± 2.39 mm) and medially (8.30 ± 2.18 mm) while the varus alignment shifted the humerus more in the superior (11.29 ± 1.28 mm) and lateral (8.98 ± 0.88 mm) directions at 0° abduction. The abduction angle showed the highest value in valgus alignment ($86.2 \pm 3.84^\circ$, $P < 0.05$) while the varus alignment showed highest adduction ($18.41 \pm 7.40^\circ$) and IR ($68.91 \pm 15.01^\circ$) and ER ($45.16 \pm 10.49^\circ$) at the 0° abduction status than compared to the other alignments ($P < 0.05$). The anterior dislocation forces were significantly lower in the varus group compared to other groups at 0° ER ($P < 0.05$). Abduction capability was significantly higher in varus alignment at low deltoid load (5, 7.5 N; $P < 0.05$).

Conclusions: Varus alignment showed significantly higher degrees for adduction, internal rotation, external rotation, and lower anterior dislocation forces and lower initiating force for abduction than the neutral and valgus alignments. Valgus alignment should be avoided for better outcomes.

EP.01.082

DEVELOPMENT OF ANIMAL MODEL FOR CORACOID TRANSFER PROCEDURE—A CADAVERIC STUDY IN CANINE

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Background: The clinical study has been a research hotspot for coracoid transfer procedure, but the amount of basic research is limited because of the ethical complexities and the lack of reliable animal model. This study aims to investigate the surgical method of a canine model for coracoid transfer procedure on cadaveric specimen.

Methods: Three fresh-frozen cadaveric specimens of canine were included in this study. One shoulder of each specimen was subjected to coracoid transfer procedure (model group) and the contralateral shoulder was designed as the shoulder instability group (control group). For the control group, incision of the subscapularis, medial glenohumeral capsule and ligament, and medial glenoid bone defect were made. For the model group, transferring the coracoid and supraglenoid tubercle graft with the biceps tendon onto the medial glenoid using suture-button fixation after performing the destabilization procedure. Preoperative and postoperative medial drawer test, shoulder abduction angle measurement and computed tomography (CT) scan of the shoulder were performed.

Results: There were no important neurovascular injuries or fractures during the operation. The medial drawer test was both negative preoperatively and postoperatively in model group and was negative preoperatively but positive postoperatively in control group. There was no significant difference between preoperative and postoperative shoulder abduction angle in model group, and postoperative abduction angle was significantly greater than preoperative one in control group ($P < .001$). No significant difference was found in preoperative abduction angle between the 2 groups, but the model group had lesser postoperative abduction angle than the control group ($P < .001$). Preoperative CT scan showed no dislocation and bone lesion of the shoulder in both groups. Postoperative CT scan showed a satisfactory position and fixation of the graft, and no dislocation of glenohumeral joint in model group. The mean glenoid surface area increased to 110.3% (range 108%–113%) compared with the area preoperatively. In control group, the mean bone defect was 25.3% (range 17%–33%) and the humeral head dislocated medially to the glenoid.

Conclusions: In canine cadaveric specimen, the coracoid transfer procedure is feasible and effective to restore medial glenohumeral stability with glenoid bone defect. The canine shoulder may be an optional animal model for coracoid transfer procedure.

EP.01.083

BETAMETHASONE INJECTION AT DIFFERENT STAGES SHOWING DIFFERENT EFFECT ON EARLY TENDON-TO-BONE HEALING IN A RAT ROTATOR CUFF TEAR MODEL

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Background: Corticosteroid injection (CSI) has been used to relieve shoulder pain postoperatively, though its adverse effect on tendon-to-bone healing has been proven. However, whether there is any difference in the negative effect caused by CSI at different stages on rotator cuff healing is still unknown. The aim of the study was to evaluate the effect of subacromial betamethasone injection at different time points on the early tendon-to-bone healing in a rat rotator cuff tear model.

Methods: 21 rats were divided into three groups equally. In experimental groups, betamethasone was injected into the subacromial space intraoperatively and 7 days after surgical repair. In control groups, the torn tendon was repaired similarly with saline injection. All animals were sacrificed for biomechanical testing and histological evaluation 2 weeks after the operation.

Results: The postoperative injection group showed significantly inferior maximum load and stiffness compared with that of the control group (10.97 vs 15.36 N and 8.10 vs 12.27 N/mm, respectively; $P < 0.05$), and values in the intraoperative group were slightly lower than that of the control group (13.42 vs 15.36 N and 11.27 and 12.27 N/mm, respectively; $P > 0.05$). Worse histological formation of the bone-tendon interface was observed in experimental groups compared with the control group, especially in the postoperative injection group.

Conclusions: This study found that the postoperative corticosteroid administration at the recovery stage could harm the rotator cuff healing biomechanically and histologically in a rat tear model. However, the intraoperative corticosteroid injection did not show significant adverse effects, suggesting that intraoperative injection's application might be better in clinical practice.

EP.01.084

AUTOMATED EVALUATION OF CELL INFILTRATION AND REMOVAL IN DECELLULARIZED TENDON SCAFFOLDS – EXPERIMENTAL STUDY IN RABBITS

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Background: Massive rotator cuff lesion is one of the most common lesions in shoulder surgery, in these injuries the use of decellularized tendon scaffolds (DTSs) is a reality in some countries of the world. In this way, our aim is to develop a semiquantitative and automated measurement of nuclear material removal and cell infiltration in decellularized tendon scaffolds (DTSs).

Methods: Sixteen pure New Zealand rabbits were used, and the gastrocnemius muscle tendon was collected bilaterally from half of these animals (16 tendons collected); 4 were kept as control and 12 were submitted to the decellularization protocol (DTS). Eight of the DTSs were used as an in vivo implant in the experimental rotator cuff injury (RCI) model, and the others, as well as the controls, were used in the semiquantitative and automated evaluation of nuclear material removal. The eight additional rabbits were used to make the experimental model of RCI and subsequent evaluation of cellular infiltration after 2 or 8 weeks, within the DTS.

Results: The semiquantitative and automated analysis used demonstrated a removal of 79% of nuclear material ($p < 0.001$ and power $> 99\%$) and a decrease of 88% ($p < 0.001$ and power $> 99\%$) in the area occupied by nuclear material after the decellularization protocol. On cell infiltration in DTS, an increase of 256% ($p < 0.001$ and power $> 99\%$) in the number of cells within the DTS was observed in the comparison between 2 and 8 weeks postoperatively.

Conclusions: The proposed semiquantitative and automated measurement method was able to objectively measure the removal of nuclear material and cell infiltration in DTS.

EP.01.085

EARLY EDEMA FORMATION AFTER RELEASE OF THE INFRASPINATUS MUSCLE AS AN EXPERIMENTAL MODEL OF ROTATOR CUFF LESIONS IN SHEEP - A HISTOLOGICAL ANALYSIS

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Background: The aim of these experiments was to prove muscle edema formation histologically during the first 4 weeks after the release of the infraspinatus tendon without or with additional trauma while the muscle was stretched. The study was based on the hypothesis that edema formation contributes to an inflammatory reaction and already early muscle fiber degeneration before fatty infiltration takes place. Muscle edema was expected in both groups, but trauma to the tendon was considered closer to the acute clinical trauma and was hypothesized to increase edema.

Methods: An animal model in sheep with acute release of the infraspinatus tendon as a model for rotator cuff lesions in humans was used for these experiments.

Results: Early edema formation after tendon release of the infraspinatus muscle was documented histologically without or with additional trauma to the muscle. Both groups showed a peak and significant increase of edema formation between 3-4 weeks in MRI being confirmed with histological sections ($p=0.0001$) and lyophilization samples. Histology showed normal muscle tissue with fibers closely attached to each other at t_0 , whereas at the later time points (t_{21} & t_{28}), widening of the interstitial spaces between fibers, fiber degeneration with an increase of fibrosis ($p=0.008$) but no fat tissue between the epimysium was recorded in both groups. Muscle fiber diameter was significantly increased over time ($p=0.0001$). Inflammatory mediators, NF κ B, inflammatory cytokines and macrophages were also increased over time mainly between t_0 and t_{21} resp. t_{28} . Positive correlations were found for muscle edema formation and distance between fibers ($p<0.05$). Differences between NTG and TG were not significant.

Conclusions: The results of this study proved our hypothesis that after release of the infraspinatus muscle edema formation occurs with a peak at 3-4 weeks causing an inflammatory reaction that induced already muscle fiber degeneration before fatty infiltration takes place. Additional trauma to the stretched muscle as would be expected in a trauma case of rotator cuff lesions aggravated symptoms slightly and showed slight protraction of healing mechanism, but without statistical significance.

EP.01.087

PARSONAGE-TURNER SYNDROME AND SARS-COV-2 INFECTION: A CASE REPORT

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Background: Parsonage-Turner syndrome (PTS), is an uncommon condition. The diagnosis is clinical but imaging assessments (MRI) and electromyography (EMG) can support the diagnosis. It's a pathology still unknown. Certain situations are at risk : postoperative, post-infectious and post-vaccination

Methods: This Case Report is about one case of Parsonage-Turner Syndrome post SARS-Covid 19 viral infection.

Results: A 22 year old man with no previous history presented with sudden neck and right upper extremity pain three weeks after a SARS COVID-19 viral infection. During electromyographic evaluation, denervation was found in the trapezius muscle and the serratus anterior muscle.

Conclusions: PTS is a rare condition that can occur after COVID 19 infection. The combination of long thoracic nerve damage and accessory spinal nerve damage is almost exclusively seen in PTS. This is a diagnosis that should not be overlooked in order to treat the affected patient more effectively.

EP.02.001

NEUROPLASTICITY CAUSED BY PERIPHERAL PROPRIOCEPTIVE DEFICITS IN PATIENTS WITH RECURRENT ANTERIOR SHOULDER INSTABILITY: FUNCTIONAL MRI STUDY

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Background: Proprioceptive feedback is crucial for motor control and stabilization of the shoulder joint in everyday life and sports. Shoulder dislocation causes anatomical and proprioceptive feedback damage that contributes to subsequent dislocations. Previous recurrent anterior shoulder instability (RSI) studies did not investigate functional neuroplasticity related to proprioception of the injured shoulder. Thus, we aimed to study the differences in neuroplasticity related to motor control between patients with RSI and healthy individuals, using functional magnetic resonance imaging, and assess the effects of peripheral proprioceptive deficits due to RSI on CNS activity.

Methods: Using passive shoulder motion and voluntary shoulder muscles contraction tasks, we compared the CNS correlates of proprioceptive activity between patients having RSI (n = 13) and healthy controls (n = 12) to clarify RSI pathophysiology and the effects of RSI-related peripheral proprioceptive deficits on CNS activity. Moreover, to assess changes in the CNS due to peripheral proprioceptive deficits, we applied the glenoid bone defect calculated using 3D-CT for the parameter of the damage in the proprioceptive generator.

Results: Decreased proprioception-related brain activity indicated deficient passive proprioception in patients with RSI ($P < 0.05$ family-wise error, cluster level). Proprioceptive afferent-related right cerebellar activity significantly negatively correlated with the extent of shoulder damage ($P = 0.001$, $r = -0.79$). Functional magnetic resonance imaging demonstrated abnormal motor control in the CNS during voluntary shoulder muscles contraction.

Conclusions: We compared differences in CNS correlates of proprioceptive activity between patients with RSI and healthy controls to gain insights into the pathophysiology of RSI and assess the effects of peripheral proprioceptive deficits due to RSI on CNS activity. We found that decreases in proprioception-related brain activity supported deficits of passive proprioception in patients with RSI.

Our integrated analysis of peripheral anatomical information and brain activity during motion tasks can be used to investigate other orthopedic diseases.

EP.02.003

RECURRENT ANTERIOR INSTABILITY IN YOUNG ATHLETES WITH SHOULDER HYPERLAXITY: OUTCOMES OF THE ARTHROSCOPIC TRILLAT PROCEDURE

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Background: The treatment of recurrent anterior shoulder instability in patients with shoulder hyperlaxity (defined as external rotation $>90^\circ$) remains challenging with a high risk of failure after capsular shift alone and a low rate of return to sports. The purpose of this study was to assess the outcomes of the arthroscopic Trillat procedure for the treatment of recurrent anterior instability in young athletes with shoulder hyperlaxity (ER $> 90^\circ$).

Methods: We performed a retrospective evaluation of patients with recurrent anterior instability and shoulder hyperlaxity who underwent an arthroscopic Trillat between 2009 and 2019. Patients with concomitant rotator cuff lesions, voluntary or multidirectional instability were excluded. The osteotomized coracoid was fixed above the subscapularis with a cannulated screw or a suture button; a capsular plication was systematically associated. We followed patients with X-rays, CT-scans, Subjective Shoulder Value, VAS, Walch, Constant, and Rowe scores. Mean follow-up was 56 months (24-145).

Results: Twenty-eight consecutive patients, 30 shoulders (mean age 25 years) were identified, and all met criteria. The main finding under arthroscopy was a "loose shoulder" with anteroinferior capsular redundancy and no or few (10%) labrum tears, glenoid erosion (13%) or Hill-Sachs lesions (10%). At last follow-up, 90% of the shoulders (27/30) were stable, and 79% (19/24) of the patients practicing sports returned to their preinjury activity level. The Walch-Duplay and Rowe scores improved from 54 (38-68) to 81 (4-100) and 55 (30-71) to 84 (45-100) respectively, $p < 0.001$. The 3 patients with instability recurrence had substantial humeral and/or glenoid bone loss; two were revised with a Latarjet procedure.

Conclusions: The arthroscopic Trillat is an effective procedure for the treatment of recurrent anterior instability in young athletes with shoulder hyperlaxity, allowing return to overhead/contact sports. In patients with humeral or glenoid bone loss, the Latarjet procedure should be preferred.

EP.02.004

COMPARISON OF ARTHROSCOPIC PRIMARY AND REVISION BANKART REPAIR FOR CAPSULOLABRAL RESTORATION: A MATCHED-PAIR ANALYSIS

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Background: There have been no previous studies comparing serial radiologic results between primary and revision Bankart repair despite the significance of capsulolabral height and slope restoration. The purpose of this study was to compare serially the height and slope of the repaired labrum in the early postoperative period among primary and revision Bankart repair groups, and to compare clinical outcomes between the two groups.

Methods: This study included each 24 patients who underwent arthroscopic primary Bankart repair (Group A) and revision Bankart repair (Group B) matched by age, sex, and glenoid defect ratio. Postoperative serial radiologic assessment of the repaired labral height and slope was proceeded using magnetic resonance imaging (MRI) or computed tomographic arthrography (CTA) at 3 weeks and 6 months.

Results: There were no significant differences in labral height and slope at 3 weeks and 6 months postoperatively in Group A. However, significant reductions in labral height and slope were evident between 3 weeks and 6 months postoperatively in Group B ($P < 0.05$). Group A yielded superior results to Group B with respect to labral height and slope at each time point ($P < 0.05$) in between-group analyses. The clinical outcomes were not significantly different between the two groups except for the patients' return to their pre-morbid sports activity level ($P = 0.024$) 6 months.

Conclusions: The height and slope of the repaired capsulolabral structures in the early postoperative period after arthroscopic revision Bankart repair group were significantly lower than those of the primary Bankart repair group. Also the reduction of labral height and slope was significant in the revision Bankart repair group over time. Nonetheless, clinical outcomes did not differ significantly except return to pre-morbid sports activity level at final follow-up

EP.02.005

ASSOCIATION BETWEEN EXCESSIVE JOINT LAXITY AND A WIDER HILL-SACHS LESION IN ANTERIOR SHOULDER INSTABILITY

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Background: Excessive general joint laxity, a negative prognostic factor in joint instability, has not been studied to determine its relationship with bipolar bone loss in anterior shoulder instability. This study aimed to investigate the characteristics of bipolar bone defects in the presence of excessive joint laxity and the surgical outcomes based on the on-track/off-track theory. We hypothesized that (1) patients with excessive joint laxity might have less significant bipolar bone defects compared with those without excessive joint laxity and (2) no significant difference would be found in the clinical outcomes, including recurrence rate.

Methods: This study included 81 patients who had undergone arthroscopic Bankart repair, with (group L; n = 33) or without (group N; n = 48) excessive joint laxity. The presence of excessive joint laxity was defined as a score of 4 or more of Beighton and Horan criteria. Bipolar bone lesions were assessed using preoperative 3D CT. The functional outcomes at the 2-year follow-up were assessed using the recurrence rate, SSV, Rowe score, UCLA shoulder score, active range of motion, and the sports/recreation activity level.

Results: No significant difference was found in the glenoid bone defect, shoulder functional scores and recurrence rates between groups. Off-track lesions were identified in 13/33 of group L and 7/48 of group N. The mean Hill-Sachs interval to glenoid track ratio was 83.1% in group L and 75.2% in group N. Additional remplissage procedures were more frequently performed in group L (16/33) than in group N (8/48).

Conclusions: Patients with anterior shoulder instability and excessive joint laxity had a significantly wider Hill-Sachs lesion and more off-track lesions than those with normal joint laxity despite the lack of a significant difference in the glenoid bone defect. However, these differences in the Hill-Sachs lesions were not related to differences in surgical outcomes using track theory, including recurrence instability between the groups.

EP.02.007

RISK FACTORS ASSOCIATED WITH THE LEVEL OF RETURN TO SPORTS FOLLOWING CORACOID TRANSFER PROCEDURE FOR ANTERIOR SHOULDER INSTABILITY.

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Background: This study aimed to determine the rate of different levels of RTS in athletes undergoing the modified arthroscopic Bristow procedure and variables associated with the level of RTS.

Methods: The study was performed retrospectively on patients with traumatic anterior shoulder instability who underwent the modified arthroscopic Bristow procedure in our hospital with a minimum follow-up of two years. The RTS rate, the level of return, and the timing of return were assessed. Additionally, factors such as preoperative basic information, clinical outcomes, graft position, graft healing, and graft absorption were analyzed to investigate their correlation with the level of RTS. Multivariate regression models were used to evaluate the factors affecting the level of RTS.

Results: In total, this study included 182 shoulders of 177 athletes undergoing the modified arthroscopic Bristow procedure. Of these patients, 142 (78.0%) shoulders of 137 athletes were enrolled, with a mean of 3.3-years follow-up. At the final follow-up, 134 (94.4%) shoulders were able to RTS, 123 (86.6%) shoulders were able to RTS to the preinjury level, 52 (36.6%) shoulders could be completely "forgotten" without any psychological barrier during exercise. The multivariate logistic regression analysis identified the variable associated with RTS at the preinjury level as previously failed arthroscopic Bankart repair ($P < 0.001$). As for the "forgetting" operated shoulder, the duration from first dislocation to surgery was a significant independent predictor ($P = 0.034$).

Conclusions: Although a large majority of athletes were able to RTS at the preinjury level after the modified arthroscopic Bristow procedure, about two-thirds of the athletes felt difference in shoulders on both sides and could not completely "forget" the operated shoulder during exercise. Previously failed Bankart repair and the duration from first dislocation to surgery were the risk factors associated with the level of RTS after the modified arthroscopic Bristow procedure.

EP.02.008

PREDICTORS OF BONE DEFICIT IN SHOULDER INSTABILITY: THE LUXE COHORT STUDY, A LARGE INCLUSIVE PROSPECTIVE STUDY

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Background: Recurrent anterior traumatic shoulder instability is related to progressive bone loss on both the humeral and glenoid side. The severity of bone loss is known to be one of the principal prognostic factors for treatment success. Identification of risk factors of larger bone deficit may help to identify patients at risk. The purpose of this study is to identify modifiable risk factors that will help us counsel patients on habit modification.

Methods: Since 2010, all patients undergoing surgical treatment for recurrent shoulder instability are included in a vast inclusive prospective study cohort: the LUXE study. All patients with complete demographic data and good quality computed tomography (CT) scans were included. Bone loss was measured using the Glenoid Track method. Statistical correlations were used to correlate the Glenoid Track bone loss measurement method with multiple variables such as patient age, gender, BMI, the mean number of shoulder dislocations reported prior to surgery, alcohol and tobacco consumption and epilepsy.

Results: A total of 204 patients met inclusion criteria (161 male) with a mean age of 29 years. The mean number of dislocations prior to surgery was 14. Patient BMI was of 25 on average. A quarter of patients were smokers and a total of 47% reported alcohol consumption over the recommendations issued by Health Canada. Epilepsy was the cause of instability in 6% of patients. Off-track shoulder lesions were identified in 43% of shoulders and significant glenoid bone deficit, meaning 25% or more of the glenoid diameter, was seen in 19% of cases. Male gender, smoking, drinking alcohol, epilepsy, the number of dislocations and older age were all risk factors for greater bone loss at presentation.

Conclusions: This study has shown multiple modifiable risk factors of increased bone loss in recurrent shoulder instability patients. Canadian shoulder surgeons should work closely with primary care physicians who are seeing patients with traumatic shoulder dislocations. Patients should be educated on how smoking and drinking are related to worse outcomes on shoulder anatomy. They should also be oriented younger and earlier than a mean of 14 shoulder dislocations for surgical stabilization to prevent progression of damage to their shoulder.

EP.02.009

EVALUATION OF LATARJET PROCEDURE IN FEMALE ATHLETES: A 3-YEAR FOLLOW-UP PROSPECTIVE COHORT STUDY

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Background: Although there is a low incidence of shoulder instability in women, this population is still representative and is often associated with lower rates of return to sports. Few studies have evaluated the results of the Latarjet procedure in this population.

Methods: Prospective cohort study of female athletes who underwent the Latarjet procedure between 2013 and 2018. The participants were followed up for 3 years. Primary outcomes included the visual analog scale for pain; range of motion: active elevation, passive elevation, active external rotation, and passive external rotation. The functional scores were as follows: American Shoulder and Elbow Surgeons score, the Western Ontario Shoulder Instability Index, and the Athletic Shoulder Outcome Rating Scale. Additional data were collected regarding return to sport, complication rates, and patient satisfaction.

Results: Thirteen female athletes were evaluated. There was a significant reduction in the mean range of motion for all movements at 4 weeks after surgery. Patients recovered a range of motion similar to the preoperative values after 6 months. The mean visual analog scale reached 6.39 at the first week after surgery and decreased to values below preop at 8 weeks. The mean preoperative Western Ontario Shoulder Instability Index was 126.77, and at the end of follow-up, the WOSI index was 45.08 (min 37; max 65; $P < .05$). The mean preoperative American Shoulder and Elbow Surgeons score was 41.61 (min 35; max 46), and at the end of follow-up, the mean ASES score was 84.46 (min 80; max 90; $P < .05$). The mean Athletic Shoulder Outcome Rating Scale in the preoperative period was 39.38 (min 37; max 42), and at the end of follow-up, the mean ASORS score was 83.15 (min 77; max 85; $P < .05$). The rate of return to sports was 92.3%, and 84.6% of patients were satisfied with the surgery. The aesthetic satisfaction rate was 76.9%. The complication rate was 15.4% (1 screw failure and 1 dislocation recurrence).

Conclusions: Latarjet surgery in female athletes showed high rates of return to sports and improved functional scores without impairing range of motion after the procedure. Recurrence and complication rates were low.

EP.02.010

ARTHROSCOPIC POSTERIOR CAPSULE AUGMENTATION WITH GRACILIS ALLOGRAFT FOR REFRACTORY POSTERIOR INSTABILITY DUE TO SOFT TISSUE INSUFFICIENCY

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Background: Posterior instability is increasingly recognized as a cause of shoulder pain which may be under diagnosed and difficult to treat because of a multifactorial etiology and subtle clinical presentation. Posterior labral repair and plication have performed well in primary cases, but in revision scenarios there are few options to arthroscopically address soft tissue insufficiency or capsular laxity posteriorly. To address this challenging clinical problem, a novel technique for salvage of failed posterior instability with arthroscopic capsular augmentation utilizing gracilis allograft was developed. The technique augments the size of the labrum, statically re-centers the humeral head, and increases the strength of the thin or lax posterior capsule while also reducing its volume. This paper reports the clinical outcomes of the first case series.

Methods: Using the SOS database, 5 patients were identified who had been treated with posterior capsule augmentation for recurrence of instability and posterior shoulder pain by the attending surgeon. All patients had previously had temporary clinical success from the previous primary surgery for arthroscopic posterior labral repair which had recurred. The results were analyzed with ASES scores at latest follow-up.

Results: 5 patients in the series had submitted surveys at follow up of 6 months, 6 months, 1 year, 1 year, and five 5 years. The mean ASES improved from 41 preoperatively to 77 postoperatively. There were no complications intraoperatively. One patient was revised successfully for a traumatic failure of the graft due to a fall. The patient with the lowest ASES score (47) had a complex etiology of instability involving long thoracic nerve palsy.

Conclusions: Surgeons currently have very limited options to offer patients with recurrent posterior instability. Moreover, the pathophysiology is incompletely understood. Bone block procedures have been described which may increase risk of arthritis or fail to treat soft tissue elements. Arthroscopic Capsular augmentation with gracilis allograft simultaneously addresses many of the common soft tissue deficits of the posterior labrum and capsule with minimal risk of serious complications. Moreover, it is easy to revise in the event of future surgery. Further work is need to define indications for soft tissue augmentation of the posterior shoulder.

EP.02.012

CLINICAL AND RADIOGRAPHIC OUTCOMES AFTER ARTHROSCOPIC LATARJET PROCEDURE VERSUS ARTHROSCOPIC BRISTOW PROCEDURE: A COMPARATIVE STUDY WITH 3.4-YEAR FOLLOW-UP.

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Background: No comprehensive comparative study including both clinical and radiological outcomes has been published regarding the arthroscopic Latarjet and Bristow procedures. The purpose of this study was to compare the clinical and radiological outcomes of these two procedures.

Methods: Patients who underwent an arthroscopic Latarjet or an arthroscopic Bristow procedure were retrospectively reviewed with at least 2 years of follow-up. Thirty-eight shoulders in the Latarjet group and thirty-four in the Bristow group were included. Recurrence of dislocation, clinical scores, the rate of return to sports-RTS and CT assessment (the position of the transferred coracoid, graft healing, graft absorption and glenohumeral degenerative osteoarthritis-OA) were obtained at the final follow-up.

Results: No recurrent dislocation occurred in either group and no significant differences were found in clinical scores between the 2 procedures with a mean follow-up of 3.4 years. The surgery time for the Bristow group was significantly shorter than that for the Latarjet group ($p < 0.001$). The transferred coracoid had healed in 94.7% of the patients in the Latarjet group and 85.3% in the Bristow group at the final follow-up ($p = 0.01$). No significant difference was detected between the 2 groups regarding graft absorption or the degree of glenohumeral OA. However, moderate and severe OA only occurred in the Latarjet group at the final follow-up (4/38, 10.5%). The postoperative external rotation angle and level of RTS favored Latarjet procedure ($p = 0.030$ and $p = 0.034$, respectively)

Conclusions: Both the arthroscopic Latarjet and Bristow procedures led to good clinical scores with no new dislocation episodes. The Bristow group showed significantly less graft healing than the Latarjet group. However, the arthroscopic Bristow procedure was superior to the arthroscopic Latarjet procedure in the duration of surgery, the superior-inferior position of the graft, loss of external rotation and level of RTS.

EP.02.013

IS ENDOBUTTON A GOOD OPTION FOR BONE BLOCK FIXATION IN GLENOHUMERAL INSTABILITY?

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Background: Recurrent anterior shoulder instability is associated with bone loss in 90% cases. Significant bone loss repair carries a high risk of failure more than 70%. Latarjet or bone block procedures are the treatment for this cases using screws as usual option for fixation. However complications as screw pullout, loosening, breakage, bone block fracture, non-union and graft migration have induced the search of new systems for fixation as endobutton in order to decrease complication rate.

Methods: Fifty patients underwent an arthroscopic Latarjet or bone block procedure from may 2017 to december 2021 with at least 12 months follow up. Screw fixation was used in the first group with 25 patients and endobutton fixation was performed in the second one (another 25) Epidemiologic (sex, age), clinical (ROM), radiological variables (Hill- Sachs, Bony Bankart) and complications (hardware, graft malposition, resorption) have been studied.

Results: 43 patients (86%) were men with a mean age of 32 years old and 16 (32%) were women with a mean age of 30 yo. Pre- op variables: Injury characteristics: Hill- Sachs (mild 8%, moderate 40%, severe 52%), Bony Bankart (no existence 8%, type 1 (20%), type 2 (26%) and type 3 (46%))

Post- op variables:

First group: No apprehension. Mean RE 30°. 40% of complications (28% related to material: 8% long screws; 16% screw pullout; 4% screw bad position) 8% graft/coracoid malposition and 4% graft resorption (3 patients needed surgery to solve material complications)

Second group: No apprehension. Mean RE 35°. 12% complications 12% (graft resorption/ malposition)

Conclusions: Arthroscopic Latarjet/ bone block procedures are technically difficult but they have shown good results in glenohumeral instability treatment. Although screw fixation have good clinical and radiological results, endobutton system decrease hardware complications becoming a good option in this type of surgery.

EP.02.014

UNDERSTANDING RISK FOR EARLY DISLOCATION WITHIN 90 DAYS OF REVERSE TOTAL SHOULDER ARTHROPLASTY: EXTREME RARE EVENT DETECTION THROUGH COST SENSITIVE MACHINE LEARNING

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Background: Reliable prediction of postoperative dislocation after reverse shoulder arthroplasty (RSA) would help with patient counseling as well as surgical technique modifications. Since this is a relatively rare event, understanding interactions between multiple risk factors is important to identify those patients most at risk. A novel game-theory-based approach was taken to develop machine learning models capable of predicting dislocation leading to hospital admission within 90 days of RSA.

Methods: A retrospective review of the Nationwide Readmissions Database (NRD) was performed to identify patients who underwent RSA between 2016 and 2018 and subsequently required readmission for prosthetic dislocation. Of the 74,697 index procedures included in the dataset, 740 (0.99%) were complication by dislocation resulting in hospital readmission within 90-days. Five machine learning algorithms were evaluated. Shapley additive explanation (SHAP) values were calculated for the top performing models to quantify the importance of features and understand variable interaction effects, with hierarchical clustering used to identify cohorts of patients with similar risk factor combinations.

Results: Of the five models evaluated, the XGBoost algorithm was most reliably able to predict dislocation after RSA (c-statistic 0.71, F-2 score: 0.07, recall: 0.84, Brier score: 0.21). SHAP value analysis revealed multifactorial explanations for dislocation risk, with presence of a preoperative humerus fracture, disposition involving discharge/transfer to a SNF, ICF, or other nonroutine facility, and Medicaid as the expected primary payer resulting in strong, positive, and unidirectional effects. In contrast, factors such as comorbidity burden, index procedure complexity/duration as measured by total charges, age, sex, and presence or absence of preoperative glenohumeral osteoarthritis displayed bidirectional influences on risk, indicating potential protective effects for these variables and opportunities to reduce risk where optimization is possible.

Conclusions: Machine learning can reliably predict patients at risk for postoperative dislocation resulting in hospital readmission within 90-days of RSA. While individual risk for dislocation varies significantly, SHAP analysis revealed a particularly at-risk cohort consisting of young, male patients with high comorbidity burdens who are indicated for RSA after a humerus fracture.

EP.02.015

MODIFIED DELPHI STUDY TO IDENTIFY PATIENT-REPORTED OUTCOME DOMAINS THAT CAN BE USED TO DEVELOP A CORE OUTCOME SET FOR SHOULDER INSTABILITY RESEARCH

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Background: There is no international consensus on which outcomes should be used in shoulder instability research. This leads to variations in outcomes for clinical trials and prospective cohort studies, hampering comparison of results and performing meta-analyses. The aim of this study was to take the first step towards developing a Core Outcome Set (COS) for shoulder instability research and include healthcare providers and patients in a modified Delphi design to identify patient-reported outcome (PRO) domains for said COS.

Methods: Healthcare providers in emergency care medicine, physiotherapy and orthopaedic/trauma surgery and patients were included in a panel for a modified Delphi study. A literature review was performed to identify patient-reported outcome measures currently used in shoulder instability research to be transformed in PRO domains. The modified Delphi study consisted of three rounds, comprising (1) evaluating PRO domains identified through the literature review with the panel, (2) rating the importance of the PRO domains and (3) rating the importance of the PRO domains again after seeing a summary of the results of round two. Importance was rated on a 9-point Likert scale. Consensus was defined as > 80% of the panel giving a score of 7 or higher. A consensus of > 90% was defined as strong consensus.

Results: In total, 44 healthcare providers and 30 patients completed all three rounds. Round one identified 54 PRO domains. After round three, the panel reached consensus on 11 PRO domains that should be included in the COS, comprising re-dislocation (99%), instable feeling of the shoulder (96%), limitations during sport (93%), patient satisfaction with the shoulder (93%), fear/anxiety for re-dislocation (91%), range of motion (88%), return to old level of functioning (85%), performing daily activities (85%), return to sport (82%), return to work (82%), and trusting the shoulder (81%).

Conclusions: Healthcare providers and patients reached a consensus on 11 PRO domains that should be included in a COS for shoulder instability research. These PRO domains can facilitate design and development of future clinical trials and outcomes. Future studies on an international scale should include all stakeholders to define which PRO domains should be measured and how to measure them.

EP.02.016

KINEMATIC ANALYSIS OF DAMAGED CAPSULOLABRAL STRUCTURE IN PATIENTS WITH ANTERIOR SHOULDER INSTABILITY USING CINE-MRI

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Background: The main cause of recurrent shoulder dislocation is incomplete healing of the anteroinferior capsulolabral structure after detachment from the glenoid rim. Dynamic assessment of the damaged anterior capsulolabrum could elucidate this controversial problem. This investigation aimed to assess damaged anterior capsulolabral motion during axial shoulder rotation in patients with anterior shoulder instability. We hypothesized that damaged labrum could be reduced successfully by immobilization in an internal rotational position in some cases, although the external rotational position could capture the damaged labrum on the glenoid.

Methods: This was a descriptive epidemiology study conducted between January 2012 and March 2015. Twenty-nine shoulders of 28 patients with anterior shoulder instability or primary shoulder dislocation (19 men and nine women) who underwent cine-MRI during axial rotation of the adducted arm were included. During imaging, the shoulder was rotated passively from maximum internal rotation to maximum external rotation in the first 10 s and then back to maximum internal rotation in the subsequent 10 s. We assessed the rotational angles of the damaged labrum when it coapted on and departed from the glenoid rim. Evaluation of the rotational angles was performed on a series of axial images through the humeral head center.

Results: The mean coordination and departure angles were $12.0 \pm 19.1^\circ$ and $2.8 \pm 21.2^\circ$, respectively. Additionally, seven of 29 shoulders showed that the damaged labrum coapted on the glenoid rim before the rotational angle exceeded 0° during external rotation. In 13 shoulders, the damaged labrum could remain repositioned on the glenoid rim over the neutral position during internal rotation. In two shoulders, the damaged labrum did not cover the glenoid at the maximum external rotation. The injected saline moved from the dorsal to the volar side of the glenohumeral joint during internal rotation in each shoulder.

Conclusions: Our findings suggest that in some cases, healing of the damaged labrum after an initial shoulder dislocation could be successful using a traditional internal immobilization. Moreover, the position of the joint fluid may also explain that hematoma in the glenohumeral joint after shoulder dislocation supports the healing of the damaged labrum.

EP.02.017

SIGNIFICANT DIFFERENCES IN OSSEOUS SHOULDER MORPHOLOGY SCAPULOTHORACIC ORIENTATION AND MUSCLE VOLUME IN PATIENTS WITH CONSTITUTIONAL STATIC POSTERIOR HUMERAL DECENTERING COMPARED TO HEALTHY CONTROLS

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Background: Constitutional static posterior humeral decentring (C1) has been recognized as a pre-osteoarthritic deformity, which leads to early-onset posterior decentring osteoarthritis. However, little is known about the true etiology of this pathologic shoulder condition. The aim of this study was to perform a comprehensive analysis of all parameters currently under investigation that might be associated with a C1 shoulder.

Methods: A retrospective, comparative study was conducted, analyzing 17 C1 shoulders in 10 patients, who underwent a magnetic resonance imaging (MRI) with complete depiction of the trunk from the base of the skull to the iliac crest including both humeri. The mean age of the patients was 33.9 (range, 16-62 years) and all patients were men.

To measure and compare the osseous shoulder morphology (glenoid version, glenoid offset, humeral torsion, anterior acromial coverage (AAC), posterior acromial coverage (PAC), posterior acromial height (PAH) and posterior acromial tilt (PAT)) and scapulothoracic orientation (scapular protraction (PRO), scapular internal rotation (IR), scapular upward rotation (UR), scapular translation (ST), scapular tilt (T) and thoracic kyphosis (K)) these patients were matched 1:4 according their age, sex and affected side with shoulder-healthy patients, who had received positron emission tomography (PET)-computed tomography (CT). To measure and compare the muscle volume of the shoulder girdle (subscapularis, infraspinatus/teres minor, supraspinatus, trapezius, deltoid, latissimus dorsi/teres major, pectoralis major and pectoralis minor) patients of the study cohort were matched 1:2 with patients, who had received PET-MRI. Patients with visual pathologies of the upper extremities were excluded.

Results: The C1 group had a significantly higher glenoid retroversion, increased anterior glenoid offset, reduced humeral retrotorsion, reduced AAC, reduced PAC, increased PAH and increased PAT compared to controls ($p < 0.05$). Decreased humeral retrotorsion showed significant correlations with higher glenoid retroversion ($r = -0.711, p < 0.01$) and higher anterior glenoid offset ($r = -0.71, p < 0.01$). Significant differences were found in terms of less UR, less T and less K in the C1 group ($p < 0.05$). The muscle volume of trapezius and deltoideus were significantly higher in C1 group ($p < 0.05$).

Conclusions: These found differences may play a crucial role in understanding the delicate balance of both static and dynamic stabilizers in glenohumeral centering.

EP.02.018

WHAT IS THE MOST RELIABLE METHOD OF MEASURING GLENOID BONE LOSS IN ANTERIOR GLENOHUMERAL INSTABILITY? A CADAVERIC STUDY COMPARING DIFFERENT MEASUREMENT TECHNIQUES FOR GLENOID BONE LOSS

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Background: Preoperative quantification of bone loss has a significant effect on surgical decision making and patient outcomes. Various measurement techniques for calculating glenoid bone loss have been proposed in the literature. To date, no studies have directly compared measurement techniques to determine which technique, if any, is the most reliable.

Methods: Six cadaveric shoulders with 3 incremental bone defects were sequentially created resulting in 18 glenoid samples. Two- and three-dimensional representative CT scan en face images were used for analysis. Six observers (three experienced and three with less experience) measured the bone defect of all the samples with HOROS software using 5 commonly employed methods. These included 2 linear (Shaha, Griffith), 2 surface (Barchilon, Glenoid arc angle) and one statistical shape model (Giles). Intraclass correlation (ICC) using a consistency model was used to determine consistency between surgeons. Paired t-tests were used to calculate the accuracy of each measurement technique relative to physical measurement.

Results: For more experienced observers, all methods indicated good consistency ($ICC > 0.75$, ranging 0.75 to 0.88), except the Shaha method which indicated moderate ($0.65 < ICC < 0.75$, ranging 0.65 to 0.74). Consistency among the experienced observers was better for 2D than 3D images though the differences were not significant. For less experienced observers the Giles method in 2D had the highest consistency ($ICC: 0.88, 95\%CI: 0.76, 0.95$), though Giles, Barchilon, Griffith and Glenoid arc angle were not significantly different. Among less experienced observers 2D images using Barchilon and Giles methods had significantly higher consistency than 3D images. Regarding accuracy, most of the methods significantly overestimated the actual physical measurements by a small (mean within 5%) amount. The smallest bias was observed for 2D Barchilon measurements and the largest differences were observed for Giles and Griffith methods.

Conclusions: Glenoid bone loss calculation presents variability depending on the measurement technique, with different consistencies and accuracies. We recommend the use of the Barchilon method by surgeons who frequently measure glenoid bone loss because it presents the best combined consistency and accuracy. However, if glenoid bone loss is measured occasionally, the most consistent method is Giles method, although an adjustment for the overestimation bias may be required.

EP.02.019

LONG TERM OUTCOMES OF ARTHROSCOPIC MODIFIED NEER INFERIOR CAPSULAR SHIFT FOR TRAUMATIC ANTERIOR SHOULDER INSTABILITY, OVER 20 YEARS OF FOLLOW UP

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Background: This study aimed to assess the long-term outcomes of the arthroscopic modified Neer inferior capsular shift procedure across more than 20 years in patients with traumatic anterior shoulder instability.

Methods: We reviewed 95 cases out of 108 surgeries. Participants in this study comprised 83 patients (83 shoulders, 60 men, 23 women) out of 95 cases after excluding 12 with Labrum avulsion tear. Mean follow-up 23.8 years between 21 and 27. We compared the recurrent instability rate after surgery, apprehension, revision rate, satisfaction, return to preinjury sporting activity, and patient background characteristics between recurrent and nonrecurrent groups. Thirty-two patients who were examined directly were evaluated for differences in range of motion and muscle strength between affected and nonaffected sides. Clinical outcome scores used for this study were the UCLA score

Results: One shoulder showed posttraumatic instability after 5 years that needed surgery and one patient had a dislocation while playing soccer 15 years after surgery, but no revisions were required. Both cases were males. No significant differences in any patient characteristic were identified between the recurrent and nonrecurrent groups. No significant differences between affected and nonaffected sides were seen in the mean active range of motion or muscle strength for external rotation in the anatomic position or in 90° of abduction. Patients reported that 81 shoulders (97.5%) were much better. Most athletes (88.4%) had returned to sports activity at a level more than 89%.

Conclusions: We investigated long-term outcomes of the arthroscopic modified inferior capsular shift procedure for traumatic anterior shoulder instability. Our data suggest that recurrent instability might result from new trauma even if a long time has passed since the open modified inferior capsular shift procedure, so follow-up should be continued as long as possible after surgery. The satisfaction was high and clinical scores were good. We thus believe this surgical method offers good results even after more than 20 years.

EP.02.020

OPEN VERSUS ARTHROSCOPIC SUTURE BUTTON FIXATION LATARJET PROCEDURE FOR ANTERIOR SHOULDER INSTABILITY: A COHORT STUDY

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Background: To date, we have no studies comparing the arthroscopic technique with suture-button with the conventional open surgery.

Our study aims to compare the clinical and radiological results and complications between open surgical techniques with screw fixation and arthroscopic surgery using suture-button, regarding functional scales, rehabilitation time, rate of resorption, graft consolidation and complications.

Methods: Multicenter retrospective cohort study, with prospectively collected data, comparing the clinical and radiological results between 2 types of Latarjet surgery: open approach with graft fixed by screws (Open Group) versus arthroscopic approach with graft fixed by Suture-Button (Arthroscopic Group). Patients with recurrent anterior traumatic glenohumeral dislocation, who had an ISIS score equal or greater than 4, glenoid bone loss > 20%, off-track lesion or recurrence after Bankart repair were included. All patients had pre- and 2-year postoperative clinical and imaging results.

Results: 38 patients were evaluated in the Open Group and 44 in the Arthroscopic Group. There was 1 recurrence in each group, 1 case of dislocation in the open group and 1 case of subluxation in the arthroscopic group ($p=0.463$ and $p>0.999$, respectively). Apprehension was more frequent in the open group (13.2% vs 4.5%), but with no statistical difference ($p=0.241$). The Rowe scale did not differ between groups at any of the assessment times. The groups did not differ in the postoperative radiographic appearance with regard to resorption, consolidation and positioning of the graft. Infection, neurological injury, migration and graft breakage were more frequent in the arthroscopic group, without, however, presenting a statistically significant difference. The total number of complications was 15.8% in the open group and 20.5% in the arthroscopic group ($p=0.586$). Multiple regression analysis did not observe the influence of any of the possible confounding factors on the final result.

Conclusions: The open Latarjet procedure and the arthroscopic suture-button technique lead to similar results at 2 years of follow-up. The Rowe scale score, complications and graft consolidation, positioning and reabsorption rate also did not differ between two groups.

EP.02.021

THE INFLUENCE OF GLENOID BONE LOSS AND GLENOID BONE GRAFTING USING THE LATARJET PROCEDURE ON GLENOHUMERAL JOINT CONTACT LOADING

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Background: Glenohumeral joint mechanics before and after glenoid bone grafting for recurrent anterior instability remains poorly understood. We aimed to develop a computational model before and after the Latarjet procedure, and use this to evaluate the influence of glenoid bone loss and graft (positioning) on graft and cartilage contact pressure.

Methods: A multi- musculoskeletal model of a healthy male shoulder was developed comprising the scapula, humerus, articular cartilage, glenoid labrum and 26 muscle-tendon units. A Bankart lesion was performed, as well as 10% and 25% glenoid bone loss conditions with and without the Latarjet procedure. Simulations of abduction and external rotation (ABER) were undertaken, and bone, cartilage and graft contact loading quantified with the humeral head centred on the glenoid, at the glenoid half width, and placed on the glenoid rim.

Results: Compared to the intact condition, creating a Bankart lesion and subsequently 10% and 25% of glenoid bone loss resulted in a significant increase in maximum glenoid (up to 402% increase) and humeral (up to 444% increase) cartilage contact pressure ($p < 0.05$). The Latarjet procedure with a graft flush with glenoid bone significantly reduced the maximum glenoid cartilage contact pressure compared to the 10% ($p < 0.001$) and the 25% glenoid bone loss condition ($p = 0.031$). Graft lateralization of 1mm simulated with 10% bone loss increased the maximum humeral cartilage contact pressure by 130% with the humerus at half-width. When the graft was lateralized by 1mm in the 25% bone loss condition, maximum humeral cartilage contact pressure was increased by 46% at the half-width position, while the graft was almost maximally and the glenoid cartilage only minimally loaded.

Conclusions: Labral damage and increasing glenoid bone loss significantly increases glenoid and humeral cartilage contact pressure in the shoulder. The Latarjet procedure can mitigate these increased contact pressures to an extent, though glenoid contact loading was shown to be sensitive to graft placement.

Increased glenoid and humeral cartilage contact pressure depend on integrity of the labrum and degree of glenoid bone loss. The Latarjet procedure reduces high glenoid contact pressure associated with bone loss in the unstable shoulder.

EP.02.022

ARTHROSCOPIC LATARJET: PROSPECTIVE EVALUATION OF CLINICAL OUTCOMES, GRAFT AND SCREW POSITIONING, AND CORACOID GRAFT UNION ON COMPUTED TOMOGRAPHY AT 6 MONTHS POSTOPERATIVELY

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Background: The arthroscopic Latarjet procedure is a technically demanding procedure that has advantages of reduced scarring and postoperative stiffness, faster recovery, better articular reduction visualization and ability to treat concomitant glenohumeral injuries. This study prospectively assessed clinical outcomes following the arthroscopic Latarjet and assessed graft union on computed tomography (CT) at 6-months postoperatively.

Methods: This is a prospective, consecutive evaluation of all patients that underwent arthroscopic Latarjet procedure treated by a single surgeon from June 2017 to December 2021. Preoperative CT was utilized to assess Glenoid Track (GT), Hill-Sachs interval (HSI) and the difference between HSI and GT (HSI-GT). Immediate and 6 month postoperative CT scans were obtained to assess (GT) measurement, initial screw position, changes in graft or screw position, and assess bony union. Range of motion and outcomes [Rowe score, Western Ontario Shoulder Instability Index (WOSI) score, and Simple Shoulder Test (SST)] were assessed. Univariate analysis was utilized ($p < 0.05$ statistically significant).

Results: There were 46 patients, mean age 26.39 +/- 9.83 years, with follow-up of 25.95 months (range, 7-52 months) included. Average glenoid bone loss was 14.4% +/- 0.062%. Excellent clinical outcomes were obtained with significant improvements in Rowe (50.87 to 95.76, $p < 0.001$), WOSI (1064.67 to 199.89, $p < 0.001$), and SST (7.00 to 11.61, $p < 0.001$) with 97.6% satisfaction. Complications included 2 intra-op graft fractures (4.3%), one postoperative radial nerve neurapraxia that resolved at 3 months (2.1%), and one case of recurrent instability 4 months postoperatively after a seizure (2.1%). 95.6% of grafts were optimally placed in the sagittal plane and 93.5% were in the axial plane. The average screw angulation was 17.05° (range, 7° to 40.3°) with 93.5% graft union.

Conclusions: This study was unique in prospectively evaluating consecutive arthroscopic Latarjet cases with postoperative CT, demonstrating an excellent union rate (93.5%) at 6 months. These results should be interpreted with caution; this procedure does have a steep learning curve. However, proper surgical indications, procedural training and practice can achieve superb clinical outcomes, a low complication profile that emulates open Latarjet, high frequency of optimal graft placement, and a high union rate.

EP.02.023

BULK OSTEOCHONDRAL ALLOGRAFT FOR MASSIVE HILL-SACHS DEFECT COMBINED WITH LATARJET PROCEDURE FOR BIPOLAR BONE LOSS IN ANTERIOR INSTABILITY

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Background: Recurrent subluxation and dislocation can result in fracture or erosion of the anteroinferior glenoid with indentation or impaction fracture of the posterior humeral head, the Hill-Sachs lesion. These shoulders with large bipolar bone loss pose particularly difficult problem for surgical stabilisation. We performed bulk osteochondral allograft reconstruction of the Hill Sachs defect in conjunction with simultaneous Latarjet procedure for large bipolar lesions. We describe our surgical technique and report the outcomes of a series of 10 patients who underwent this procedure.

Methods: Between 2013-2019, 10 patients had combined osteochondral bulk humeral allograft reconstruction for large Hill-Sachs lesion combined with Latarjet anterior stabilisation. All patients underwent arthroscopic evaluation prior to definitive surgery. The indication for the procedure were "engaging" Hill-Sachs lesion or "off-track" bipolar bone loss. Patients with humeral head defects that presented to the central articular area of the glenoid in functional ranges of movements were also indicated. For outcomes, we enquired of dislocations or subluxations and return to occupation/sports. Functional scores were obtained, including instability-specific tools (Oxford Shoulder Instability Score & Western Ontario Shoulder Instability Index, WOSI), upper limb functional score (QuickDash) and general health function questionnaire (EuroQol, EQ-5DL).

Results: No patient reported further dislocations. 2 patients subjectively describe symptoms of instability: 1 interpreted crepitus as subluxations but declined further intervention; Patient 3, an epileptic, subluxes posteriorly and self-relocates after fits. 7 patients reported intermittent pain in the shoulder: 3 moderate and 4 mild.

Eight of 10 patients are in employment: 1 unemployed and the other, a student. Two military personnel in the cohort continue to enjoy successful careers in the army. Eight are still participating in sports. Range of movements were: external rotation 30-70 degrees, flexion 160-180 degrees and abduction 160-170 degrees. Radiographs at follow-up revealed partial resorption of the allograft in 3 patients. There were no cases of infection in this cohort. Three patients had transient axillary nerve palsy, but all recovered within 4-6 weeks.

Conclusions: To date, we are not aware of any reports of combined humeral head allograft with Latarjet for severe bipolar bone loss in anterior shoulder instability. Our result support the use of this procedure.

EP.02.024

2-YEAR OUTCOMES AFTER ARTHROSCOPIC BICEPS TRANSFER TO THE GLENOID WITH BANKART REPAIR FOR RECURRENT ANTEROINFERIOR GLENOHUMERAL INSTABILITY IN SUBCRITICAL BONE LOSS

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Background: To evaluate the short-term outcomes of the arthroscopic dynamic anterior stabilization (DAS), which is a transfer of the intra-articular portion of the long head biceps through the subscapularis split and fixation on the anterior glenoid, combined with a Bankart repair.

Methods: A retrospective evaluation was performed of DAS and a minimum of 2-year follow-up. Inclusion criteria were the presence of anteroinferior instability, a positive apprehension test at 90° of abduction and external rotation, and subcritical glenoid bone loss (less than 20%). Exclusion criteria were severe glenoid bone loss (more than 20%), presence of biceps lesions or rupture (spontaneous or biceps tenotomy), pre-existing glenohumeral osteoarthritis, multidirectional or voluntary instability, previous arthroscopic stabilization procedure, and epilepsy. Outcomes included the Rowe score, range of motion (ROM), and recurrence.

Results: 68 patients were treated with DAS and arthroscopic Bankart repair during the study period. One person was lost to follow-up, leaving 67 patients available at last follow-up. Those 67 patients had an average age of 31.9 ± 12.3 years (range, 18-68) and were evaluated at an average follow-up of 3.2 ± 0.7 years (range, 1.2-4.2). The Rowe score increased from 36.1 ± 16.2 (range, 10-70) preoperatively to 89.8 ± 20.1 (range, 30-100) postoperatively ($P < .001$) with almost all patients (90.9%) improving their score beyond the minimal clinically important difference of 9.7 points. Postoperatively, ROM was maintained. Three patients (2%) analyzed at final follow-up demonstrated recurrence, one was successfully treated conservatively, but two revised with a Latarjet. No postoperative Popeye deformity, biceps cramping, or other complication were reported.

Conclusions: The DAS procedure may be an option for augmentation of a Bankart repair in patients with anterior shoulder instability and subcritical bone loss. ROM is maintained without evidence of postoperative Popeye deformity or biceps cramping.

EP.02.025

ARTHROSCOPIC LATARJET WITH SUTURE-BUTTON FIXATION

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Background: the arthroscopic Latarjet procedure is a technically challenging technique that provides well known results. The first series reported fixation with screws. An alternative fixation had been proposed, with a button, to improve the reproducibility and to decrease the complications due to the screws. The first reports with this fixation yield comparable rate of fusion. The objective of this study was to assess the fusion rate, and the bone modifications with this kind of fixation.

Methods: Two hundred sixteen cases were included in this prospective study. An arthroscopic Latarjet, fixed by one button, according to the Smith&Nephew technique, has been performed by a single surgeon, for anterior instability. The protocol consisted post operatively on a CT-scan at 3-12-24 weeks. We measured the coronal and the sagittal position of the bone block, the distance between the bone block and the glenoid, the diameter of the glenoid tunnel, the fusion rate, and the time to fusion.

Results: the position was « flush » in 92,6% of cases in the coronal plane, and under the equator in 87,5%. At last FU, we had 9 cases of non-union (4%), and 18 cases of delayed fusion. The fusion rate was 92% at 3 months, and 96% at 6 months. For the bone blocks healed at the end, the diameter of the glenoid tunnel was inferior to 2 mm in 62% of cases at 3 weeks, and inferior to 1 mm in 90% of cases at 3 months. Inversely, the diameter of this tunnel significantly increased, and was superior to 3 mm, in all the cases of delayed or non-union.

Conclusions: this technique achieved a reliable position of the bone block, and a very good fusion rate with this new type of fixation. The fusion can be long to obtain, between the third and the sixth months. The diameter of the glenoid tunnel was the best predictive factor for the fusion. The widening of the diameter of the glenoid tunnel during the first 3 weeks, above 3 mm, was the most predictive factor for a delayed or non-union of the bone block.

EP.02.026

SHOULD WE CHANGE THE MINIMUM FOLLOW-UP TO EVALUATE RECURRENCES AFTER ARTHROSCOPIC BANKART REPAIR?

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Background: There is a great discrepancy between the rates of recurrence reported after arthroscopic Bankart repair in relation to the follow up time.

Purpose: The purpose of our study was to analyze the rate of recurrences after arthroscopic Bankart repair in the long-term emphasizing whether the minimum follow-up of two years is adequate to assess this outcome.

Methods: Between January 2008 and April 2013, 356 athletes underwent arthroscopic Bankart repair for anterior glenohumeral instability in our institution. Return to sports, the Rowe score, Subjective Shoulder Value (SSV) and the Athletic Shoulder Outcome Scoring System (ASOSS) were used to assess functional outcomes. We analyzed the proportion of recurrence, before and after 4 years of follow-up. Additionally, we perform a Kaplan Meier curve to evaluate recurrence-free time in patients with recurrence.

Results: The mean follow-up was 10.5 years mean (SD 1.59) and the mean age was 20.8 (SD 3.9). In total, 90% of patients were able to return to sports; of these, 91% returned at their preinjury level of play. The Rowe, SSV, and ASOSS scores showed statistical improvement after operation ($P < 0.01$). The proportion of patients with recurrence during the complete follow-up was 25% (IC95% 20%-31%) ($n=70$), the mean time until the recurrence was 3.8 years (SD 2.6). In patients with recurrence only 39% (IC95% 30%-48%) occur 2 years after the surgery and 61% (IC95% 50%-73%) occur 4 years after the surgery.

Conclusions: In our study, the effectiveness of the Bankart surgery to stabilize the shoulder decreased significantly over time. Indeed, less than half of the recurrences occurred after 2 years of follow up. Therefore, we propose that the minimum recommended follow-up should be 4 years, otherwise, it is very likely that the actual rate of recurrences will be significantly underestimated

EP.02.027

KNOTTED VERSUS KNOTLESS FIXATION FOR ANTERIOR LABRUM TEARS; RETROSPECTIVE SINGLE-CENTER COMPARATIVE STUDY

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Background: Over 90% of shoulder dislocations are in the anterior direction. Surgical treatment with arthroscopic anterior labral repair has been successful in restoring stability and function in the absence of glenoid bone loss. Studies have suggested there are no significant differences in the clinical outcomes or return to play (RTP) of knotted versus knotless anchoring for any location of labrum repair. The purpose of this study is to further compare the surgical failure rates, rates and timeline for RTP, abduction and external range of motion (ROM) and patient-reported outcomes (PRO) between knotted and knotless anterior labral repair.

Methods: Patients were excluded if they did not undergo either a knotted or knotless anterior labral repair. Demographic and surgical data were collected including age, sex, race, laterality, characterization of the labral tear, number of anchors and anchor location. Patient participation in sport, if any, ability to RTP, operative times, abduction and external ROM, and PROs at 3-, 6-, and 12-months were also collected.

Results: The average ages of patients with knotted (n=12) and knotless (n=13) fixation of the anterior labrum repair was 27.8 (\pm 13.5) and 20.0 (\pm 4.8), respectively. No patients in either group required revisions and there was no significant difference in those that were able to return to play (RTP) between the groups ($p=0.412$). There were no significant differences in patient reported outcomes (PROs) preoperatively or 6- and 12-months postoperatively. Abduction range of motion (ROM) was significantly decreased preoperatively for patients with knotted fixation when compared to knotless fixation (148 ± 41 vs 177 ± 11 , $p=0.025$). No other significant difference was recorded.

Conclusions: Patients who underwent knotted or knotless fixation for anterior labrum tears reported similar PROs at 6- and 12-months postoperatively. There was no difference in ROM between the knotted and knotless cohorts at any time postoperatively. There was a significant difference in pre-operative abduction ROM for knotted fixation. The significantly decreased range of motion in preoperative abduction may suggest a predisposition for selecting knotted fixation in severe cases of anterior shoulder instability. These findings add to the current literature suggesting there is no preferred method when assessing post operative outcomes.

EP.02.029

POSTOPERATIVE SEIZURE IS A MAJOR RISK FACTOR FOR RECURRENCE OF ANTERIOR INSTABILITY AFTER SHOULDER STABILIZATION IN EPILEPTIC PATIENTS

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Background: The higher failure rates reported with stabilization of recurrent anterior shoulder instability in epileptic patients remain a concern. Non-compliance with neurological treatment and post-surgical seizures are a well-known factor for recurrence of anterior instability. The purpose of this study was to evaluate the outcomes of shoulder stabilization and to identify risk factors related to postoperative recurrence of anterior shoulder instability in a selected compliant patient population.

Methods: We performed a monocentric retrospective study including epileptic patients with associated anterior shoulder instability. Between 2003 and 2018, 32 epileptic patients (37 shoulders) were seen in our clinic for recurrent anterior shoulder instability; 9 (28%) were not operated because of non-observance of neurologic treatment and/or seizure in the last 6 months. Twenty-three compliant patients (26 shoulders), underwent arthroscopic shoulder stabilization. A soft tissue procedure was performed in 14 cases and a Latarjet procedure in 12 cases. Recurrence of instability and seizure were assessed at 2 years minimum postoperatively.

Results: At a mean follow-up of 7 years (2-15), 11 patients out of 23 (48%) had a new seizure episode. Five of them (5 shoulders) experienced an associated recurrence of instability (19%), all were caused by a new epileptic seizure. There was a higher risk of recurrent instability in case of new seizure ($p=0.007$). Drug-resistance ($p=0.01$), younger age ($p=0.04$) and hyperlaxity ($p=0.01$) were other risk factors for postoperative recurrence of instability. Conversely, the type of surgical technique was not related to increased risk of instability recurrence.

Conclusions: Despite preoperative patient selection for observance of neurologic treatment, about half of epileptic patients suffered new seizures after surgical shoulder stabilization and about half of them had a recurrence of anterior instability. Postoperative epileptic seizure, drug-resistance, younger age and hyperlaxity and are risks for recurrent instability after surgery, regardless of the chosen stabilization procedure.

EP.02.030

ARTHROSCOPIC LATARJET VERSUS ARTHROSCOPIC ANTERIOR BONE BLOCK PROCEDURES FOR ANTERIOR SHOULDER INSTABILITY: A PROPORTIONAL META-ANALYSIS COMPARING RECURRENCE, COMPLICATION AND REOPERATION RATES

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Background: The purpose of this study is comparing the recurrence, complication and reoperation rates of arthroscopic Latarjet (AL) and anterior arthroscopic bone block procedures (ABB) for anterior shoulder instability.

Methods: A systematic search was conducted to identify clinical studies reporting outcomes of both AL and ABB procedures. Exclusion criteria were: less than 24 months of minimum follow-up; less than 10 cases included; revision procedures from previous glenoid bone grafting; epilepsy. Data regarding the study design, demographics, the surgical technique and the clinical outcome were extracted and qualitatively analyzed. A proportional meta-analysis was conducted to compare the complication, recurrence and reoperation rate between the two groups. Multiple subgroup analyses were led to analyze the incidence of each complication and to assess the weight of different types of graft in the ABB group and different fixation methods in the AL. The modified Coleman Methodology Score (mCMS) was used to assess the risk of bias of the included studies.

Results: Out of 5010 potentially relevant studies, 19 studies regarding AL (968 cases) and 16 regarding ABB (517 cases) were finally included. The two groups were comparable by age ($p=0.12$), sex ($p=0.32$), glenoid bone loss ($p=0.14$), ratio between primary and revision cases ($p=0.98$), length follow-up ($p=0.33$), mCMS ($p=0.13$) and level of evidence ($p=0.53$). We did not observe any difference about the recurrence ($p=0.65$) and reoperation rate ($p=0.85$) between the two groups. A tendency towards a higher rate of complications was found in the ABB group ($p=0.10$) as compared to AL. The subgroup analysis showed a higher graft-related complication rate in the ABB group ($p=0.05$). No difference was observed for persistent positive apprehension ($p=0.59$), metalwork-related complications ($p=0.21$), progression of osteoarthritis ($p=0.4$), infection ($p=0.58$), nerve palsy ($p=0.24$) and graft malposition ($p=0.2$).

Conclusions: Both AL and ABB are safe and effective in the treatment of anterior shoulder instability. While we found a similar rate of recurrence and reoperation after AL and ABB, a trend towards increased complications after ABB as compared to AL was showed, although non-significant. This could be potentially explained by a higher rate of graft-related complications in the ABB group.

EP.02.031

OUTCOMES OF BANKART REPAIR VERSUS INFERIOR CAPSULAR SHIFT IN ARTHROSCOPIC TREATMENT OF RECCURENT ANTERIOR SHOULDER DISLOCATION

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Background: The most common complication after repair of recurrent anterior shoulder dislocation is the recurrence which may differs according to the technique

AIM- This study is done to prove or not our experience that recurrence of anterior shoulder instability is higher after arthroscopic Bankart than after L-CUT Arthroscopic Inferior Capsular Shift (AICS).

Methods: : A double retrospective study done in one center. Between 2012 and 2015 42 patients operated by L-type AICS were matched with 42 patients operated with arthroscopic Bankart. The same rehabilitation program was applied for both groups. All patients completed a questionnaire and were examined.

Results: All patients had more than 3 episodes of anterior recurrent dislocation, near equal age average, and same type of tissue lesion without bony lesion. All patients were evaluated for function, range of motion, sports and occupational activity. The average follow up was 6 years. The recurrence rate of anterior instability was 8/42 (19%) in the Arthroscopic Bankart repair (ABR) group and 1/42 (2%) in the AICS group. The range of motion of the AICS group was near normal while there was 13% average loss of range of motion in the ABR group. The strength was near normal in both groups.

Conclusions: This study has confirmed our experience that the rate of recurrent instability after arthroscopic Bankart is significantly higher than AICS. This study also showed a significant normal range of motion and function of the shoulder in cases with AICS than that treated with ABR.

EP.02.032

TWO OR FOUR CORTICAL-BUTTONS FOR ARTHROSCOPIC LATARJET: DOES IT MATTER ? A CASE-CONTROL, COMPARATIVE STUDY

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Background: While 2 screws are traditionally used for coracoid bone block fixation, no gold standard technique has yet been established when using cortical buttons. The purpose of this study was to compare anatomic and clinical outcomes of the arthroscopic Latarjet procedure using either 2 or 4 buttons for coracoid bone block fixation.

Methods: A total of 23 patients with 4-button fixation (group 4B) were matched for age at surgery, sex, and follow-up to 46 patients who had 2-button fixation (group 2B). All patients underwent guided arthroscopic Latarjet (using coracoid and glenoid guides), and a tensioning device was used to rigidify the suture button construct and get intraoperative bone block compression. The primary outcome was assessment of bone block positioning and healing using computed tomography scans performed at 2 weeks and at least 6 months after surgery. The mean follow-up was 49 ± 7 months (range, 24-64 months).

Results: The bone block healing rate was similar in both groups: 91% in group 4B versus 95.5% in group 2B. The transferred coracoid was flush to the glenoid surface in 21 patients (91%) in group 4B and 44 patients (96%) in group 2B ($P=0.6$); it was under the equator in 22 patients (96%) in group 4B and 44 patients (96%) in group 2B ($P=0.99$). There was no secondary bone block displacement; the rate of bone block resorption was similar between the groups: 28% in group 4B and 23% in group 2B ($P = 0.71$). Patient-reported outcomes, return to sports, and satisfaction were also similar between the groups. The operating time was significantly longer in group 4B (95 vs 75 minutes; $P = 0.009$).

Conclusions: A 4-button fixation technique did not demonstrate any anatomic or clinical advantages when compared with a 2-button fixation technique, while making the procedure more complex and lengthening the operating time by 20 minutes. A 2-button fixation is simple, safe, and sufficient to solidly fix the transferred coracoid bone block. The use of drill guides allows accurate graft placement, while the use of a tensioning device to rigidify the suture button construct provides high rates of bone block healing with both techniques (>90%).

EP.02.033

HIGH FAILURE RATE AFTER CONSERVATIVE TREATMENT FOR RECURRENT SHOULDER DISLOCATION WITHOUT SUBJECTIVE APPREHENSION ON PHYSICAL EXAMINATION

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Background: The purpose of this study was to investigate the outcomes of conservative treatment for recurrent shoulder dislocation without subjective apprehension, despite the presence of a Bankart lesion or glenoid defect.

Methods: A retrospective analysis was performed for 92 patients with recurrent shoulder dislocation treated with conservative treatment due to negative apprehension between 2009 and 2018. The failure of the conservative treatment was defined as a dislocation or subluxation episode or subjective feeling of instability based on a positive apprehension. The Kaplan-Meier method was used to estimate failure rates over time, and a receiver operating characteristic (ROC) curve was constructed to determine a cut-off value for a glenoid defect. The clinical outcomes were compared between patients who completed conservative treatment without recurrence of instability (Group A) and those who failed and subsequently underwent surgical treatment (Group B) using shoulder functional scores and sports/recreation activity level.

Results: This retrospective study included 61 of 92 eligible patients with recurrent shoulder dislocation. Among the 61 patients, conservative treatment failed in 46 (75.4%) over the 2-year study period. The cut-off value for a glenoid defect was 14.4%. The association between glenoid defect size ($\geq 14.4\%$ or as a continuous variable) and survival was statistically significant ($p = 0.039$ and $p < 0.001$, respectively). The mean glenoid defect size in Group B increased from $14.6 \pm 3.0\%$ to $17.3 \pm 3.1\%$ ($p < 0.001$), and clinical outcomes for Group A were inferior to those for Group B at the 24-month follow-up.

Conclusions: Conservative treatment for recurrent shoulder dislocation in patients without subjective apprehension showed a high failure rate during the study period, especially if the glenoid defect was $\geq 14.4\%$ in size. Despite clinical improvement in patients who completed conservative treatment without recurrence, functional outcome scores and sport/recreation activity levels were better in the patients who underwent arthroscopic Bankart repair. Therefore, for recurrent anterior shoulder instability, even without subjective apprehension, surgical treatment is warranted over conservative treatment.

EP.02.034

REVISION ARTHROSCOPIC LABRAL REPAIR USING ALL SUTURE ANCHORS PROVIDED SHOULDER STABILITY IN PATIENTS WITH SUBCRITICAL GLENOID BONE LOSS AFTER FAILED BANKART REPAIR

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Background: All suture anchors have been clinically used for primary arthroscopic Bankart repair due to their ability to minimize initial bone loss and use of curved guide in surgery. However, the clinical efficacy of revision arthroscopic labral repair using all suture anchors is unproven. The purpose of this study was to prove the clinical adequacy of using all suture anchors in revision arthroscopic labral repair after a failed Bankart repair.

Methods: A total of 28 patients who underwent arthroscopic revision labral repair using all-suture anchors after failed primary arthroscopic Bankart repair were enrolled. Revision surgery was determined for patients who had frank redislocation history with subcritical glenoid bone loss of glenoid (<15%), non-engaged Hill Sachs lesion or off-track lesion. Clinical outcomes were evaluated using shoulder range of motion (ROM), the Rowe score, American Shoulder and Elbow Surgeons (ASES) score, apprehension and redislocation rate. Postoperative shoulder anteroposterior radiograph was assessed to evaluate the arthritic change of glenohumeral joint.

Results: Average age of the patients was 28.1 ± 6.5 years old and the mean duration of revision operation from the primary arthroscopic Bankart repair was 5.4 ± 4.1 years. Compared to the number of suture anchor used in the primary operation of 3.1 ± 0.5 , statistically larger number of all suture anchors (5.8 ± 1.3 , $P < 0.001$) were inserted in the revision surgery. During the mean follow-up period of 31.8 ± 10.1 months, a total of 3 patients (10.7%) required reoperation due to traumatic redislocation and symptomatic instability. Of patients who complained of symptoms that did not require reoperation, 2 patients (7.1%) had subjective instability with apprehension depending on the arm position. There was no significant change between preoperative and postoperative ROM. However, ASES (preoperative: 61.2 ± 13.3 to postoperative: 81.4 ± 10.4 , $P < 0.01$) and Rowe scores (preoperative: 48.7 ± 9.3 to postoperative: 81.7 ± 13.2 , $P < 0.01$) were significantly improved after revision surgery. Eight patients (28.6%) showed arthritic change of the glenohumeral joint in the last plane anteroposterior radiograph.

Conclusions: Revision arthroscopic labral repair using all suture anchors demonstrated satisfactory clinical outcomes in terms of functional improvement. Postoperative stability was obtained in 82% of patients without recurrent shoulder instability after failed arthroscopic Bankart repair.

EP.02.035

THE SIRSI SCORE PREDICTS PSYCHOLOGICAL READINESS TO RETURN TO SPORTS AFTER SURGICAL STABILIZATION OF GLENOHUMERAL INSTABILITY

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Background: PURPOSE: To evaluate the predictive ability of the SIRSI scale in measuring the effect of psychological readiness on return to sports and to compare it between athletes who returned to sports with athletes who did not return to sports.

Methods: A prospective analysis was performed of patients who underwent an arthroscopic Bankart repair or a Latarjet procedure between January 2019 and September 2020. Psychological readiness to return to play was evaluated using the SIRSI score. Preoperative and postoperative functional outcomes were measured by the ROWE, ASOSS, and WOSI scores. The predictive validity of the SIRSI scale was assessed by the use of receiver operating characteristic (ROC) curve statistics. A logistic regression analysis was performed to evaluate the effect of psychological readiness on return to sports and return to pre-injury sports level.

Results: A total of 104 patients were included in this study. Overall, 79% returned to sports. The SIRSI scale had excellent predictive ability for return-to-sport outcomes (return to sports: area under ROC curve, 0.87 [95% CI, 0.80-0.93] return to pre-injury sports level: area under ROC curve, 0.96; [95% CI, 0.8- 0.9]). A cut-off level of > 55 was used to determine if an athlete was psychologically ready to return to sports and to return to pre-injury sports level. Of those who returned to sports, 99% were psychologically ready to return to play with a SIRSI median of 65 (IQR 35-41). In comparison, in the group that did not return to sports only 1% achieved psychological readiness with a SIRSI median of 38.5 (IQR 35-41) ($p < 0.001$). For every 10-point increase in the SIRSI scale, the odds to return to sports is increased by 2.9 times. Moreover, those who did not achieve their pre-injury sports level have shown poorer psychological readiness to return to play and SIRSI score results.

Conclusions: The SIRSI score is a useful tool for predicting if patients are psychologically ready to return to sport after glenohumeral stabilization surgery. Patients who returned to sports and those who returned to their pre-injury sports level were significantly more psychologically ready than those who did not return.

EP.02.036

ARTHROSCOPIC RECONSTRUCTION OF THE GLENOID LABRUM WITH A COLLAGEN MEMBRANE SCAFFOLD

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Background: In the setting of subcritical bone loss, an arthroscopic Bankart repair is sometimes inadequate to prevent recurrent instability after surgery. This study aims to assess efficacy of labral augmentation by biologic scaffolding in the treatment of traumatic recurrent anterior shoulder instability.

Methods: A retrospective study was conducted. All patients with a history of recurrent anterior shoulder instability were considered eligible. They underwent x-rays, computed tomography (CT) scan to rule out critical bone defects and magnetic resonance imaging (MRI) to check out soft tissue lesions. Inclusion criteria: history of recurrent unilateral anterior shoulder instability, intraoperative finding of hypoplastic/insufficient glenoid labrum. All patients underwent an arthroscopic labral augmentation by using a porcine dermal collagen matrix rolled-up to obtain a cylindrical scaffold about 5-mm thick, perfectly fitting the length of the labral lesion. Bilateral MRI were performed at 6 months follow-up. Clinical follow-up was performed at minimum 2 years after surgery. Primary outcome was the recurrence of instability. Secondary outcomes were functional assessment by Rowe score, and subjective assessment by short version of Disabilities of the Arm, Shoulder and Hand (Quick-DASH), and Western Ontario Shoulder Instability (WOSI) questionnaires. Scaffold integrity and integration was assessed on postoperative MRI. Pre- and postoperative outcomes were compared with a two-way paired t-test for normally distributed data, otherwise the Wilcoxon signed-rank test was used. Significance was set at $p < 0.05$.

Results: Twenty consecutive patients were enrolled. The mean age was 27.4 ± 5.9 years (range: 19-38 years). Mean follow up was 38.7 ± 3 months (range: 36-46 months). Only one patient (5%) reported recurrent anterior instability. Pre- and postoperative clinical outcomes showed significant improvements ($p < 0.0001$). Mean Rowe score changed from 15 ± 6.5 to 90.7 ± 6.3 ; mean DASH score changed from 56.8 ± 10.8 to 13.7 ± 5.7 ; mean WOSI changed from 1609 ± 217 to 271 ± 97 . MRIs showed no differences between morphological labral augmentation characteristics and the contralateral unaffected labrum ($p < 0.26$).

Conclusions: Labral augmentation by using a biologic scaffold is a viable option to address labral reconstruction when labral deficiency is encountered as a main problem in the setting of traumatic recurrent anterior glenohumeral instability

EP.02.037

3D KINEMATIC EVALUATION OF SHOULDER INSTABILITY: A SYSTEMATIC REVIEW

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Background: The motion analysis motion capture is a useful tool that allows a better and deeper understanding of the motion of our . The investigation focused on upper limb kinematics analyses has increased and subsequently their studies too, including shoulder instability area. This systematic review aims to review motion analysis studies in the setting of shoulder instability including Anterior Shoulder Instability (ASI) and Multidirectional Instability (MDI).

Methods: We performed a Systematic Review of articles using PubMed, Scopus, and Cochrane Library databases. Cross-sectional or longitudinal studies with 3D motion analysis systems in patients with ASI, MDI and asymptomatic shoulders were included. No publication date, no publication status, and no language restrictions were imposed. We excluded studies with the presence of rotator cuff tear, osteoarthritis, and stiffness, presence of any mental incompetency, psychiatric or emotional difficulties related to voluntary instability, and any musculoskeletal, neurologic, or genetic abnormality.

Results: Fourteen studies were included in the review, totalizing 132 patients with ASI, 101 patients with MDI, and 135 asymptomatic shoulders. The average quality of studies, based on the MINORS instrument for risk of bias assessment was 9.75 (maximum is 16) for the non-comparative studies and 14.8 (maximum is 24) for comparative studies. The study population included patients with MDI treated non-surgically and surgically, patients with ASI treated non-surgically, treated surgically with arthroscopic Bankart repair, open Bankart repair, open capsular shift, and Latarjet. This review comprised different types of motion capture systems: reflective markers with cameras, electromagnetic tracking systems, computerized tomography, and dynamic fluoroscopy. The variables analyzed included movement time, movement amplitude, acceleration, glenohumeral translation, glenohumeral, humerothoracic and scapulothoracic peak angles, scapular translations, scapulothoracic rhythm, humeral head contact center at glenoid and movement smoothness parameterization surrogates.

Conclusions: Although the kinematic analysis studies can provide significant data on shoulder motion, we realized a massive heterogeneity regarding study methods, sample sizes, populations, outcomes, and motion capture systems. Further standardized and homogenous studies may improve the quality assessment of the studies. The current protocols are inefficient to reflect in vivo the biomechanical findings already already demonstrated in vitro/ ex vivo. Furthermore, higher-demand functional protocols/tasks are needed for more sensitive and accurate analysis

EP.02.040

RADIAL-SLICE MAGNETIC RESONANCE ARTHROGRAM FOR THE EVALUATION OF POSTERIOR INFERIOR LABRAL LESION

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Background: Radial-slice magnetic resonance imaging (MRI) has been applied for the evaluation of the glenoid labrum which is needed to investigate the entire circumference of the margin with a vertical section. The purpose of this study was to determine whether radial-slice magnetic resonance arthrogram (MRA) could provide more precise information of posterior inferior labral lesions in comparison with conventional MRA in patients with anterior shoulder instability.

Methods: 33 patients who underwent 3.0-T MRA with conventional images (oblique coronal and axial images) and radial-slice images and underwent arthroscopic shoulder surgery between July 2019 and September 2022 were enrolled. The presence of posterior inferior labral lesion was investigated in 1-hour intervals from 3:00 to 9:00 in clock face terms by two raters, respectively. The final diagnosis of posterior inferior labral lesion was confirmed by arthroscopic findings. The sensitivity, specificity, accuracy and inter-rater reliability examined at each site were compared between conventional and radial MRA. Also, the height of the glenoid labrum was evaluated to compare two sequences.

Results: The mean age (\pm SD) of subjects was 24.39 ± 7.56 years old and the mean duration of period between symptom occurrence and undergone MRA was 904.42 days (11 - 2938 days). The sensitivity, specificity, and accuracy of radial MRA in diagnosis of Bankart lesion were higher than conventional MRA (92.9%, 100%, and 92.9% vs. 75.5%, 100%, and 75.5%, respectively). Those of posterior inferior labral lesions were 70.4%, 93.1%, and 86.8% in radial MRA and 48.1%, 93.1%, and 80.8% in conventional MRA. The heights of the glenoid labrum at 4:00 to 5:00 and 7:00 to 9:00 were significantly increased in radial MRA than in conventional MRA. At 7:00 to 9:00 in clock face terms, the mean height of labrum (\pm SD) was 1.84 ± 1.19 mm in conventional MRA and 3.60 ± 1.46 mm in radial MRA. ($p < 0.001$)

Conclusions: Radial-slice magnetic resonance arthrogram could evaluate posterior inferior labral lesions as well as Bankart lesions more accurately than conventional MRA. The posterior inferior labrum of the glenoid which has a higher height measured in the vertical section of radial MRA could have more precise information about the lesion.

EP.02.042

EFFECT OF ANTERIOR GLENOID CHONDROLABRAL DEFECTS ON ANTERIOR GLENOHUMERAL STABILITY: A BIOMECHANICAL STUDY

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Background: It is well known that glenoid osseous defects >13.5% of the glenoid width critically destabilize the shoulder, as do labral tears. Chondrolabral defects often occur with anterior dislocation of the shoulder. It is unclear whether glenoid chondrolabral defects contribute to shoulder stability and, if so, at what size they become critical. The purpose of this study was to determine the effect of incremental chondrolabral defect sizes on anterior shoulder stability in the setting of labral deficiency.

Methods: This controlled laboratory study tested 12 fresh-frozen shoulders. Specimens were attached to a custom testing device in abduction and neutral rotation with 50-N compression applied to the glenoid. The humeral head was translated 10 mm anterior, anteroinferior, and anterosuperior with the conditions of intact cartilage and labrum and anterior full-thickness chondrolabral defects of 3-, 6-, and 9-mm width. Translation force was measured continuously. Peak translation force divided by 50-N compressive force defined the stability ratio.

Results: The anterior stability ratio decreased between the intact state ($36\% \pm 7\%$) and all defects >3 mm ($<32\% \pm 8\%$; $P < .023$). The anteroinferior stability ratio decreased between the intact state ($52\% \pm 7\%$) and all defects >3 mm ($<47\% \pm 7\%$; $P < .006$). The anterosuperior stability ratio decreased between the intact state ($36\% \pm 4\%$) and all defects >6 mm ($<33\% \pm 4\%$; $P < .006$). A 3-mm defect equated to 10% of the glenoid width. There were moderate to strong negative correlations between chondrolabral defect size and stability ratio in the anterior, anteroinferior, and anterosuperior directions ($r = -0.79, -0.63,$ and $-0.58,$ respectively; $P < .001$). There were moderate to strong negative correlations between the percentage of glenoid chondrolabral defect size to the glenoid width and the stability percentage in all directions ($r = -0.81, -0.63,$ and $-0.61;$ $P < .001$).

Conclusions: An anterior glenoid chondrolabral defect >3 mm (>10% of the glenoid width) significantly decreased anterior and anteroinferior stability. Chondrolabral defect size negatively correlated with stability. Clinical Relevance: To fully restore glenohumeral stability, in addition to labral repair, it may be necessary to reconstruct chondrolabral defects as small as 3 mm (10% of the glenoid width).

EP.02.043

ROTATOR CUFF MUSCLE IMBALANCE IN PATIENTS WITH CHRONIC ANTERIOR SHOULDER INSTABILITY

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Background: No study analyzes the rotator cuff changes according to the chronicity of shoulder anterior instability. This study aimed to evaluate the rotator cuff muscle cross-sectional areas in acute and chronic shoulder anterior instability and to determine the associations between rotator cuff imbalance and chronicity.

Methods: Between December 2014 and September 2021, patients who confirmed anterior shoulder dislocation were included. We divided the patients into two groups according to the time between the first dislocation episode and the MRI image (Acute group = between 1 and 30 days, Chronic group = over two years). The rotator cuff (supraspinatus, subscapularis, and infraspinatus + teres minor) muscle areas were measured in the scapular Y view and glenoid face view using MRI. And then, the percentage of each muscle area was calculated to the total rotator cuff muscle.

Results: A total of 56 patients (28 patients in the acute group and 28 in the chronic group) were enrolled. In the Y view, the supraspinatus muscle area was larger in the chronic group than in the acute group. ($17.2 \pm 2.3\%$ vs $15.6 \pm 2.2\%$, $p=0.006$) But the subscapularis muscle area was smaller in the chronic group. ($47.1 \pm 3.5\%$ vs $49.6 \pm 5.3\%$, $p=0.044$). In the glenoid face view, The supraspinatus muscle area was larger in the chronic group than in the acute group. ($18.5 \pm 2.5\%$ vs $15.8 \pm 2.2\%$, $p=0.000$) But the subscapularis muscle area was smaller in the chronic group. ($41.6 \pm 3.2\%$ vs $45.6 \pm 4.4\%$, $p=0.000$).

Conclusions: Patients with chronic shoulder anterior instability had larger supraspinatus muscle areas as compared with acute instability. In contrast, the subscapularis muscle area was larger in the acute group than in the chronic group.

EP.02.044

PREDISPOSING FACTORS ASSOCIATED WITH RECURRENT INSTABILITY IN BIPOLAR LESION WITH SUBCRITICAL GLENOID BONE DEFECT AFTER ARTHROSCOPIC BANKART REPAIR.

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Background: This study aimed to (1) measure quantitatively bony defect (Hill-sachs lesion and glenoid) and glenohumeral joint volumes and (2) to determine risk factors of predisposing anterior instability of glenohumeral joint regarding both bony & soft stabilizer of shoulder.

Methods: After obtaining approval from the institutional review board, we retrospectively reviewed patients who underwent arthroscopic Bankart surgery for recurrent anterior shoulder dislocation between January 2015 and January 2020. Eligible patients were those who: (1) had traumatic dislocation 2) had bipolar lesion (Subclinical glenoid bone defect (<15%) and Hill-Sachs lesion) 3) > 2 times of anterior shoulder dislocation 4) undergone pre-operative shoulder magnetic resonance image and shoulder computed tomography 4) undergone post-operative shoulder computed tomography arthrography after at least 6 months post-operatively 5) follow up at least 2 years. The patient group was divided into groups with and without recurrent instability (Or apprehension test positive or not). An image reconstruction program (3-dimensional slicer) was used to calculate joint volume (4 quadrant), Characteristics of Hill-sachs lesion (Length, depth, width) and distance from most medial margin of hill sachs lesion to the medial edge of the glenoid track. we also measured glenoid bony defect using shoulder CT reconstruction images.

Results: In total, 72 patients with an average follow up 4.4 ± 2.68 years (59 in on-track group and 13 in off track group) were enrolled. In on-track group, 13 patients (25%) experience instability after operation, while in off-track group, 7 patients (53%) experience instability after operation. In on-track group, anteroinferior quadrant joint volume and length of Hill-Sachs lesion were associated with instability. ($P < .001$ and 0.017 , respectively). ROC curve demonstrated predictive power of each factors for instability (AUC=0.862, Cut off value= 5904.39 mm³ for AIQ volume and AUC=0.74, Cut off value= 12.51 mm for length of Hill-Sachs lesion). In off track group, there are no statistically significant factor associated with instability.

Conclusions: Off track hill sachs lesion is an independent risk factor regardless of other variables. However in on-track hill sachs lesion, length of hill-sachs lesion and anteroinferior joint volume can be factors that can predict instability of shoulder.

EP.02.046

SHOULDER INSTABILITY SURGERY IN COMPETITIVE WRESTLERS: OUTCOMES, REOPERATIONS, AND RETURN TO PLAY AT 5 YEARS MEAN FOLLOW UP

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Background: Wrestling is a physically demanding sport with young athletes prone to traumatic shoulder instability (SI). However, there is a paucity of data evaluating the results of shoulder instability surgery (SIS) in this cohort. The purpose of this study was to assess reoperation rates, patient-reported outcomes (PRO), and return to wrestling (RTW) following SIS in a cohort of competitive wrestlers.

Methods: All competitive wrestlers with a history of shoulder instability and subsequent surgery at a single institution between 1996 and 2020 were identified. All directions of shoulder instability (anterior SI [ASI], posterior SI [PSI], and traumatic multidirectional SI [MDI]) were included. Exclusion criteria included revision SIS and less than 2 years of clinical follow-up. Patients were contacted for determination of reinjury rates; current sport status; and Western Ontario Shoulder Instability index (WOSI) scores.

Results: Ultimately, 104 wrestlers were included at a mean follow-up of 5.2 years (range, 2.0 - 22.0). At presentation, 58 (55.8%) wrestlers presented after a single SI event while 46 (44.2%) sustained multiple events. ASI was the most common direction (n = 79; 76.0%) followed by PSI (n = 14; 13.4%), and MDI (n = 11; 10.6%). Surgical treatment was most commonly an arthroscopic soft tissue stabilization (n = 88; 84.6%), followed by an open soft tissue repair (n = 13; 12.5%) and open bony augmentation (n = 3; 2.9%). RTW occurred in 50.7% of wrestlers at a mean of 9.8 ± 9.6 months. Recurrent instability was the most common complication in 18 (17.3%) wrestlers. Revision SIS was performed in 15 (14.6%) wrestlers. Across the entire cohort, Kaplan-Meier survivorship free from recurrent instability and revision surgery was 91.4% and 98.1% at 1 year, 90.4% and 92.5% at 2 years, 71.9% and 70.7% at 5 years, and 71.9% and 66.5% at 10 years, respectively.

Conclusions: Anterior shoulder instability was the most common direction among competitive wrestlers presenting for SIS. Though surgery led to favorable outcomes within the first 2 years, rates of recurrent instability and revision surgery remain a concern for this cohort over time.

EP.02.048

WHY DO PATIENTS WITH ANTERIOR SHOULDER INSTABILITY NOT RETURN TO SPORT AFTER SURGERY? A SYSTEMATIC REVIEW OF 63 STUDIES COMPRISING 3545 PATIENTS

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Background: To review athletes' reasons not to return to sport (RTS) after surgical treatment of anterior shoulder instability, comparing capsulolabral repair and bony reconstruction procedures.

Methods: A systematic review was performed using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis) guidelines. PubMed, Embase/Ovid, Cochrane Database of Systematic Reviews/Wiley, Cochrane Central Register of Controlled Trials/Wiley, SPORTDiscus/Ebsco and Web of Science/Clarivate Analytics were searched in collaboration with an information specialist up to August 11th 2022. Observational and interventional studies reporting reasons for no RTS following surgical treatment of anterior shoulder instability were included. Quality assessment of studies was conducted using the Methodological Index for Non-Randomized Studies (MINORS) criteria and Risk of Bias (RoB) assessment. Forest plots were generated to show an overview of the proportion shoulder function independent reasons for each study.

Results: Sixty-three studies were included reporting on 3545 athletes, of which 2588 (73.0%) underwent capsulolabral repair versus 957 (27.0%) who underwent surgical treatment with bony reconstruction procedures. A total of 650 athletes (18.3%) was unable to RTS. The reason not to RTS was most frequently shoulder function independent (70.0%) compared to shoulder function dependant (30.0%) following both capsulolabral repair and bony reconstruction procedures. Most cited reasons for no RTS after capsulolabral repair were fear of re-injury (16.8%), personal reasons or change of priorities (11.2%) and retirement/discharge of military service or sports team (10.2%). Of these reasons, 106 (22.0%) were not specified other than being shoulder function dependant or shoulder function independent. Most cited reasons for no RTS after bony reconstruction procedures were fear of re-injury (12.5%), shoulder pain (10.1%) and retirement/discharge of military service or sports team (9.5%). Of these reasons, 74 (44.0%) were not specified other than being shoulder function dependant or shoulder function independent. Forest plots showed a variation from 0-100% shoulder independent reasons for both procedures.

Conclusions: The majority of athletes who did not RTS following surgical treatment for anterior shoulder instability did so due to shoulder function independent reasons, such as fear of re-injury. However, there was a high variety between studies and many reasons were unspecified, warranting unified definitions for reasons of patients that do not RTS.

EP.02.051

THE EFFECT OF GLENOID DEFECT SIZE ON THE MORPHOLOGICAL CHANGE OF THE GRAFTED CORACOID AFTER LATARJET PROCEDURE

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Background: There are some reports describing that bone graft osteolysis occurs after Latarjet procedure. Assuming that osteolysis is due to stress shielding, it should be more prominent in cases with smaller glenoid bone loss. However, there have been no reports investigating how the defect size would affect the morphological changes. To clarify the effect of glenoid defect size on morphological changes of the grafted coracoid after Latarjet procedure.

Methods: Thirty-seven consecutive patients with recurrent anterior dislocation of the shoulder underwent Latarjet procedure in our institute. Of these, 29 patients (26 male and 3 female) who met the following inclusion criteria were retrospectively reviewed: 1) unilateral dislocation, 2) CT scans of bilateral shoulders were obtained 3 months, 1 year, and 2 years after surgery, 3) a minimum follow-up of 2 year. The mean age was 32 years, and the mean follow-up was 27 months. The patients were divided into 2 groups: the large defect group with a glenoid bone loss > 20% (13 patients) and the small defect group < 20% (16 patients). Bone graft union or osteolysis was evaluated in the CT images. The size (length, width, and thickness) of the bone graft and the articular surface area of the glenoid were measured by ImageJ (NIH, Bethesda).

Results: One patient showed an incomplete union. Relative to the uninvolved side, the surface area in the large defect group decreased from $105 \pm 7\%$ (3 months postop), to $102 \pm 11\%$ (1 year postop) and $98 \pm 9\%$ (2 years postop), whereas in the small defect group, it decreased from $125 \pm 21\%$ to $110 \pm 12\%$ and $105 \pm 12\%$, respectively. The %decrease in the small defect group was significantly greater than that in the large defect group. The length of the bone graft in both groups significantly decreased from mean 21.0 mm, 20.1 mm to mean 17.3 mm, 15.6 mm, respectively.

Conclusions: The smaller the glenoid defect, the greater the amount of bone resorption of the grafted coracoid. This makes the final glenoid surface area closer to the uninvolved side regardless of the glenoid defect size.

EP.02.052

DETERMINANTS OF SYMPTOM INTENSITY AND MAGNITUDE OF INCAPABILITY MORE THAN ONE YEAR AFTER SURGERY FOR ANTERIOR SHOULDER INSTABILITY

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Background: Active young people with anterior shoulder dislocations are often offered surgical treatment due to a high risk of recurrent dislocation(s). Measures of success after surgery include avoidance of subluxation, dislocation episodes, and confidence to return to activity. For other shoulder specific pathologies, magnitude of incapability and pain intensity are only partially explained by pathophysiology, with psychosocial factors also accounting for variations.. In this study we aim to 1) determine what factors are associated with variation in 1) magnitude of capability measured by the OSIS score and 2) pain intensity measured by the Brief Pain Inventory, more than 2 years after surgery.

Methods: In a single-centre, cross-sectional study, patients with traumatic anterior shoulder dislocations were included. These patients were treated with an arthroscopic Bankart repair without remplissage with a minimum of 2 years follow-up. Using an online questionnaire we collected measures of calm and capability (OSIS and BPI), mental health (GAD-2, PHQ-2, and the TAMPA scale for kinesiophobia), and physical health such as revision surgery and the presence of a Hill-Sachs lesion. A negative binominal regression analysis was used to seek factors associated with the OSIS score and NRS pain intensity score.

Results: A total of 80 patients completed the questionnaire and were used for analysis. Greater incapability measured by the OSIS score was associated with greater unhelpful thinking measured by the TAMPA scale for kinesiophobia (Regression Coefficient [RC] = -0.050; 95% Confidence Interval [CI] = -0.073 to -0.026; P = <0.01), and revision surgery (RC = -0.27; 95% CI = -0.41 to -0.13; P = <0.01). Greater pain intensity was also found to be associated with greater unhelpful thinking measured by the TAMPA scale for kinesiophobia (RC = 0.25; 95% CI = 0.038 to 0.46; P = 0.021).

Conclusions: The observation that mental health factors account for variation in both magnitude of capability and pain intensity in patients with traumatic anterior shoulder dislocations that were treated with an arthroscopic Bankart repair, suggests that musculoskeletal health also depends on mindsets, and might direct us to design comprehensive care strategies that also address mental health .

EP.02.053

SHIFT STICK BANKART REPAIR; AN ARTHROSCOPIC REPAIR BY DOING AN L-CUT INFERIOR CAPSULAR SHIFT AND LABRUM FIXATION ON A BLEEDING ANTERIOR GLENOID SURFACE IN RECURRENT SHOULDER DISLOCATION

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Background: The aim of this study is to evaluate functional and radiological results of a new technique of arthroscopic Bankart repair by doing a glenoid neck abrasion and inferior Capsular shift to reattach the labrum to a bleeding anterior glenoid surface followed by immobilizing the shoulder between 3 and 6 weeks in neutral rotation to allow healing.

Studies by Itio, Miller and others have reported that in first time shoulder dislocation, improving the coaptation of the labrum to the glenoid through increasing soft tissue tension by immobilization in external rotation increase healing and reattaching the labrum to the glenoid.

This knowledge led us to simulate the situation in cases of recurrent anterior shoulder dislocation

Methods: 41 patients with Bankart lesion and recurrent anterior shoulder dislocation, aged between 16 and 40 years, underwent arthroscopic L-cut inferior capsular shift and Glenoid neck abrasion followed by postoperative immobilization in 20 degrees abduction and neutral rotation. Pre and postoperative evaluations included detailed physical examination, assessment using the Neer and Constant scale for shoulder functions, anteroposterior and axillary radiographs as well as MRI were done. The mean follow up was 40.8 months (from 12 to 55 months).

Results: Forty patients were reexamined. According to Neer score, the results were excellent in 38 patients (95%) and satisfactory in 2 patients (5%). Preoperative mean Constant scale was 64.2 and 87.6 postoperatively. The mean preoperative active external rotation was 45° with positive apprehension, which increased postoperatively to 62° respectively. All the patients were satisfied with the operation. In 33 cases postoperative MRI after more than 6 months from surgery was done, and in 29 of these cases the Labrum was healed to the glenoid.

Conclusions: This study shows arthroscopic Bankart repair with glenoid neck abrasion and , L-cut inferior capsular shift followed by postoperative immobilization is an alternative option to the glenoid invasive anchor fixation. It avoids the anchor fixation complications, takes a shorter time of surgery and is much cheaper.

EP.02.054

POSTERIOR UNSTABLE AND PAINFUL SHOULDER: AN EARLY STAGE OF POSTERIOR STATIC SUBLUXATION?

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Background: Posterior Unstable Painful Shoulder (P-UPS) is part of the posterior shoulder instabilities spectrum. The aim of our study was to specify the clinical and radiological setting of patients with P-UPS, and to analyze the clinical results after arthroscopic posterior Bankart repair procedure. Our hypothesis was that P-UPS was a form of static posterior subluxation and that the symptoms can be improved by arthroscopic posterior Bankart repair.

Methods: A single-center retrospective study between January 2013 and January 2021. We included twenty-eight patients with shoulder pain, following often unnoticed trauma or repetitive strain injuries, without any clinical history of instability. Posterior instability tests were painful, and a lesion of the posteroinferior labrum was found on arthroCT. Our primary endpoint was the evaluation of pain (VAS) postoperatively after a minimum of two years. We measured posterior subluxation on CT-scan (subluxation threshold was set at 55%), taking the Friedman line as a reference on reformatted CT-scan.

Results: Arthroscopic posterior bankart decreased significantly the patients' pain from 7/10 to 2/10 postoperatively ($p < 0.001$) without decreasing active glenohumeral mobility. More than two-thirds of the patients returned to sport, 79% of them at the anterior level. 75% returned to work, 64% at the same job. Overall, 88% of the patients were satisfied with surgery and the mean pain was assessed at 2 ± 1 against 7 ± 1 preoperatively. Mean posterior subluxation was measured at $60 \pm 3\%$ with glenoid retroversion at $9 \pm 2^\circ$. Eighty percent of the patients had a posterior humeral static subluxation greater than normal.

Conclusions: Clinical results after arthroscopic posterior Bankart were satisfactory, with a significant reduction in pain and an improvement in the patients' quality of life. We found an almost systematic posterior humeral static subluxation that may suggest that P-UPS could represent an early stage of static posterior subluxation.

EP.02.055

BONE RESORPTION COMPARING ALLOGRAFT & AUTOGRAFT USING A METAL-FREE CERCLAGE FIXATION IN RECURRENT ANTERIOR SHOULDER INSTABILITY. MINIMUM 2-YEAR SEQUENTIAL CT SCAN AND CLINICAL OUTCOME FOLLOW-UP

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Background: Arthroscopic glenoid reconstruction using tricortical Iliac crest bone graft (ICBG) with capsulolabral repair can restore the glenoid surface area. We analyze the resorption rate of different ICBGs using CT scans and clinical outcomes of patients with anterior glenoid bone loss (GBL) at a minimum 2-year follow-up.

Methods: 23 patients with GBL > 15% were operated on using a metal-free suture-tape cerclage graft fixation. ICBG was used with 15 allografts and 8 autografts. The articular graft surface of the postoperative CT scan, at 6, 12, and 24 months was divided into 6 squares areas aligned in 2 columns to evaluate the graft resorption. WOSI, Rowe, SSV, and Constant-Murley-CM scores and the bilateral ROM at 2 yrs. were assessed.

Results: The mean age was 30.2 years \pm 8.0. The average GBL was 19.7% \pm 3.40.

All patients showed a graft union. One patient was lost to follow-up. The overall glenoid surface area increased from 80.3% \pm 3.47 to 117% \pm 8.2 ($P < 0.001$) post-surgery, before reducing to 98.7% \pm 6.23 and 95% \pm 5.7 at 12 and 24 months respectively ($P = 0.001$).

The overall resorption rate for all areas was 49.3 \pm 22.2% ($P = 0.005$). The full resorption graft rate for the allograft was (3/14) 21.4% and 0/8 for autograft giving a global rate of (3/22) 13.6%; the absolute difference of osteolysis % comparing types of grafts was 21.4% (95% CI: -9.89 to 52.74) $P < 0.485$.

Two allografts presented subluxations or dislocations revised with the same technique giving a 9% (2/22) overall failure rate. We found improvement for all the functional WOSI, Rowe, CM, and SSV from (35.1, 24.8, 83.1, and 30.9) to (84.7, 91.1, 96.5, and 90.9) ($P < 0.001$). The lost ER-1 and ER-2 were 11.5° ($P < 0.01$) and 4.8° ($P < 0.02$). No differences were found between grafts regarding ROM and clinical outcome scores at 1 and 2 yrs. No major complications were reported at the end of the follow-up.

Conclusions: The expected resorption rates mainly affected the non-loading zones. Autografts may develop more predictable behavior compared to allografts. The use of the metal-free cerclage fixation method is effective, and safe, reduces hardware complications, and presents excellent clinical outcomes.

EP.02.057

RISK FACTORS FOR BONE LOSS IN ANTERIOR SHOULDER INSTABILITY

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Background: Anterior shoulder dislocations can result in glenoid and humeral bone loss. Larger defects contribute to increase instability and are difficult to manage. The development of these bone defects remain ill-understood. We sought to determine risk factors for the development of bone defects in anterior shoulder instability.

Methods: 88 consecutive patients who had arthroscopic shoulder stabilisation (n= 37), Laterjet (n= 41) and Laterjet with Hill-Sach's osteochondral graft (n= 10) were included. The number of dislocations, ISIS, age at first dislocation were collated. Pre-operative MRI/CT scans were used to measure glenoid bone loss and Hill-Sachs lesions.

We assessed correlations between the degree of glenoid bone loss, size of Hill-Sach's lesion, on- vs off- track bipolar interaction, with clinical factors i.e. number of dislocations events, duration of instability and Instability Severity Score (ISIS)

Results: The prevalence of glenoid bone loss was 82% (72/88) and prevalence of Hill-Sach's lesion 91% (79/88). The prevalence of critical and subcritical size bipolar bone loss was 11% (10/88) and 55% (48/88) respectively. Off-track bipolar lesions were present in 12.5% (11/88). There was inverse relationship between the size of glenoid loss and Hill-Sach's. There was moderate correlation between number of dislocations with duration of instability ($r=0.44$, $p<0.001$), between linear glenoid loss with number of dislocations ($r=.047$, $p<0.001$) and linear glenoid loss with duration of instability ($r=0.33$, $p<0.001$).

Multivariate linear regression revealed significant relationship between linear glenoid loss with age at surgery ($\beta=0.03$, SE 0.01, $p<0.05$), number of dislocation ($\beta=0.06$, SE 0.01, $p<0.001$) and ISIS score ($\beta=0.02$, SE 0.005, $p<0.001$). With logistic regression, the number of dislocations and ISIS scores showed odds ratio of 1.4 and 2.3 respectively ($p<0.001$) for subcritical bone loss. There was a $pr=0.9$ for subcritical bone loss >9 dislocations and $pr=0.9$ of subcritical bone loss with ISIS >6 .

Conclusions: The number of dislocations and ISIS scores were best predictors for subcritical glenoid bone loss and can be expected with >9 dislocations and ISIS score of >6 . The clinical factors that we examined did not fully explain the bone defects. We postulate that other risk factors may also contribute to bone loss (e.g. violence of dislocation, pre-existing laxity, sublaxations).

EP.02.058

DEMOGRAPHICS AND OUTCOMES OF SHOULDER INSTABILITY IN INDIVIDUALS WITH ELEVATED MASS INDEX

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Background: Traumatic shoulder dislocations in the adolescent, active adult, and elderly have been well studied. No specific study has investigated the characteristics and outcomes of anterior shoulder dislocations in morbidly obese individuals. The objective of this study is to describe shoulder dislocations in patients with mass index (BMI) greater than 40.

Methods: A retrospective chart review was performed to identify patients aged 18 and older with a BMI > 40 who presented with a shoulder dislocation within a single institution from 2000-2020. Dislocation pattern, associated injuries, treatment modalities, and associated complications were recorded. Complications were defined as recurrent instability as demonstrated by a single recurrent dislocation event, infection, arthrofibrosis, and associated neurovascular injury.

Results: Seventy-seven patients were included in our study. Average age was 47.95 +/- 2.06 (range 18-81), with average BMI of 45.01 +/- 5.67 (range 40-78). Sixty-five dislocations (84%) were due to ground level fall, 8 (10%) were due to assault, and 4 (5%) were due to motor vehicle collision (MVC) ($p < 0.01$). There was a significant increase in the number of patients with BMI greater than 40 presenting per year ($r^2 = -0.831$, $p < 0.01$) over the past 20 years. There was a significant increase in the average BMI per year ($r^2 = 0.504$, $p = 0.028$). Fifteen patients (19.5%) experienced at least one recurrent dislocation, with average time to recurrent dislocation of 449 days (1.23 years). Hill-Sachs lesions were the most common associated injury ($p = 0.03$). Bankart lesions were the only associated injury found to be associated with an elevated BMI ($p = 0.04$). Fifty-six patients (72.7%) were managed non-operatively and 21 patients (27.3%) underwent surgical intervention.

Conclusions: Over time, there has been an increase in shoulder dislocations in morbidly obese individuals in the United States, alongside an overall increase in the average BMI of patients who present with shoulder dislocations. These injuries most commonly happen due to low energy mechanisms and can be associated with Bankart lesions. There was a recurrent dislocation rate of 19.5%. Appropriate education and outcome expectations for nonoperative and operative treatment should be provided given the high risk of recurrent dislocations in this patient population.

EP.02.059

ARTHROSCOPIC "BANKART PLUS" REPAIR AND HETEROLOGOUS GLENOID BONE GRAFTING, TREATING RECURRENT ANTERIOR INSTABILITY. A PRELIMINARY CLINICAL AND RADIOLOGICAL MULTICENTRIC STUDY.

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Background: A number of bone reconstruction procedures using autografts or allografts have been widely proposed to address anterior glenoid bone loss. The purpose of the present study was to investigate the clinical and radiographic outcomes of arthroscopic xenograft bone block procedure plus soft tissue augmentation with upper third of subscapularis tendon at 2 years follow-up.

Methods: Twenty patients with chronic anterior-inferior instability and glenoid bone loss > 10% underwent arthroscopic xenograft bone block procedure plus soft-tissue augmentation with upper third of subscapularis tendon. Clinical outcomes were evaluated according to Western Ontario Shoulder Instability Index and the Rowe scale. Computed tomographic investigations were performed to assess any signs of resorption or displacement of the xenograft.

Results: Twenty consecutive patients were prospectively included in the study. The average duration of follow-up was 24 months (range, 20.0 - 31.7 months). Rowe score raised ($p < .0001$) from 38.3 (range: 32.5 - 44), up to 95.5 points (range: 91.1 - 99.5). Eighteen patients (90%) were scored as excellent, one patient (5%) was scored as fair and another patient (5%) was scored as poor. Western Ontario Shoulder Instability Index score improved significantly ($p < .0001$) from 1242 (range: 1192 - 1292.) up to 120 points (range: 35-205). CT scans performed at 24-month follow-up, revealed a not significant volume reduction of the xenografts ($P > .05$) and absence of graft areas affected by signs of resorption, and breakage. In one patient (5%) angulation of the xenograft was noted.

Conclusions: The combination of bone block procedure with xenograft and soft tissue augmentation with upper third of subscapularis tendon allows an all-arthroscopic anatomic restoration of the glenoid, as well as, a capsule-labral repair without compromising shoulder external rotation. Absence of radiographic signs of resorption, major displacement of the xenografts and absence of secondary osteoarthritis resulted at 24-months follow-up.

EP.02.060

ARTHROSCOPIC BONE GRAFTING OF THE HUMERAL HEAD FOR TREATMENT OF A LARGE HILL-SACHS LESION, A NEW TECHNIQUE USING TRANSOSSEOUS SUTURE FIXATION

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Background: Recurrent anterior shoulder dislocation often leads to the presence of a Hill-Sachs lesion. A large Hill-Sachs lesion compromises shoulder stability. This study will report the technical challenge and the outcome of a new technique of arthroscopic bone grafting and transosseous suture fixation of a large Hill-Sachs Lesion.

Methods: The procedure include allograft placement via postrolateral portal and graft suspension fixation using transosseous suture for bone graft compression. We used this technique combined with arthroscopic anterior inferior capsular shift. Eight cases of recurrent shoulder dislocation were treated between 2017 and 2021 by one surgeon in two centers. There were 8 males with an average age of 24 years (between 16 and 30). The depth of the defect was more than 10 mm. Arthroscopic inferior capsular shift plus arthroscopic bone grafting was done in all cases. We were able to evaluate 7 of the 8 cases treated with an average follow up of 18 months (between one and four years).

Results: The postoperative rehabilitation took 4 months. The range of motion and function in all cases was normal. No symptoms of subluxation or dislocation had occurred in any of cases. The strength compared to the opposite normal side was similar. was complaining of instability. The x-rays done 3 months after surgery showed filling of the empty bone spaces. According to Neer score all cases were rated excellent.

Conclusions: The clinical and radiographic result strongly encourage using Arthroscopic Bone Grafting of the Humeral Head techniques for recurrent shoulder dislocation with Hill large Sachs defect.

EP.02.061

SCREW FIXATION VERSUS SUTURE-BUTTON FIXATION IN THE LATARJET PROCEDURE FOR RECURRENT ANTERIOR SHOULDER INSTABILITY—A MULTICENTER RETROSPECTIVE STUDY WITH A MINIMUM 5-YEAR FOLLOW-UP

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Background: The Latarjet procedure with screw fixation and suture-button fixation are two commonly used techniques to treat recurrent anterior shoulder instability. There is no consensus among shoulder physicians regarding the indications for choosing one over the other.

Methods: Data on all patients who were treated surgically for recurrent anterior shoulder instability between January 2016 and October 2017 were retrospectively collected at 2 medical centers. All patients had a minimum 5-year follow-up. Clinical outcomes measures included pain visual analog scale (VAS), American Shoulder and Elbow Surgeons (ASES) function score, Constant-Murley score, Rowe score and range of motion (ROM). Radiographic outcomes measures included graft position, graft resorption, glenohumeral joint osteoarthritis. A total of 80 patients were included. 40 patients received arthroscopic Latarjet procedure with screw fixation in one hospital and 40 received suture-button fixation in another one.

Results: After a mean follow-up of 5.8 years (range, 5-6 years), no recurrent dislocation occurred and the apprehension test was negative in both groups. No significant difference was found in surgery time between the 2 groups ($P=0.13$). At the final follow-up, no significant difference was detected between the 2 groups regarding any of the clinical outcome measurements and all clinical outcome scores were significantly improved in both groups. 37 grafts were flush to the glenoid in the screw group and 35 grafts were flush to the glenoid in the suture-button group. A vertical position between 3 and 5 o'clock was achieved in all grafts in both groups. Graft resorption occurred in all grafts and grafts in the screw group had significantly higher resorption rate compared with grafts in the suture-button group ($P<.05$), but it did not significantly influence the clinical outcome. All cases in both groups showed no progression of glenohumeral joint osteoarthritis. 1 case experienced stiffness of the shoulder in the screw group and 1 case experienced fibrous graft union in the suture-button group.

Conclusions: Both techniques are effective for the treatment of recurrent anterior shoulder instability with critical glenoid bone loss. The arthroscopic Latarjet procedure with screw fixation showed a higher rate of graft resorption than suture-button fixation, but it did not significantly influence the clinical outcome.

EP.02.063

VITAMIN D DEFICIENCY IS ASSOCIATED WITH WORST OUTCOME IN RECURRENT SHOULDER INSTABILITY SURGERY

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Background: Vitamin D deficiency may impact bone health and increases the risk of injury in athletes. Its role in shoulder instability is unknown. We hypothesize that the incidence of vitamin D deficiency in a cohort of recurrent traumatic shoulder instability (RTSI) will be high and that vitamin D deficiency may be correlated to outcome after shoulder stabilization.

Methods: This prospective cohort study included all patients scheduled for shoulder stabilization surgery (Bankart or Latarjet). Initial evaluation included physical exam, CT scan, MRI, vitamin D dosage and QoL questionnaires (WOSI, DASH). After surgery, all patients were followed every 3 months the first year and yearly thereafter. A normal vitamin D level was 75 IU, important deficiency was less than 50 IU and severe deficiency less than 30 IU. Bone density was measured on CT scan with the Hounsfield scale. All patients with vitamin D deficiency received a prescription for 1000 IU daily.

Results: Seventy-seven patients were included in this study, 49 males and 28 females. The mean age at surgery was 30 years (range 18-52) and the vitamin D level was below 75 IU for 74% of patients, under 50 IU for 45% and under 30 IU for 12%. The mean follow-up was 3 years (range 1-8). The mean number of dislocations prior to surgery was 14 (range 2-200). Patients with 30 IU or less, had a worst outcome at last follow-up (WOSI of 1351 vs 514, $p < 0.001$; DASH of 39.29 vs 12.85, $p = 0.002$). They also had more pain at last follow-up (DASH question 9) ($p = 0.014$). Finally, bone density on the glenoid vault (261 vs 360, $p = 0.189$) and humeral head (118 vs 158, $p = 0.106$) side was lower on the CT scan, but not statistically significant.

Conclusions: Most participants had Vitamin D deficiency. Vitamin D levels of 30 IU or less in patients with RSTI were associated to worse outcomes at last follow up as measured by WOSI and DASH. They also seemed to have lower bone density at presentation. Future studies should consider vitamin D dosage after a first dislocation and the impact of a more aggressive supplementation on outcome.

EP.02.064

DOES INNOVATION IN LATARJET FIXATION REALLY IMPROVE CLINICAL OUTCOME?

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Background: The Latarjet procedure is a technique used for the treatment of anterior glenohumeral instability associated with bone loss. Different methods of fixation for the coracoid have been described. The aim of this study is to compare the clinical results and complications between screws or a plate with screws.

Methods: Retrospective study including patients with anterior glenohumeral instability associated with bone loss who were treated using the Latarjet technique between October 2009 and February 2021. A total of 85 patients were included in the study, of whom 64 completed at least one year of follow-up. In 35 patients (group 1) the coracoid was fixed with a plate and in the remaining 29 patients (group 2) with screws. Exclusion criteria were: previous surgical history on the same shoulder, bone loss >30% of the glenoid, bone loss <10% of the glenoid or previous infection on the shoulder. During follow-up, complication rate was recorded and WOSI test used to assess PROMs. Patient's return to sport activity was also collected.

Results: A total of 53 men and 11 women with a mean age of 30 years completed follow-up. Both groups were homogeneous in terms of age, gender, shoulder laterality, Hill-Sachs lesion and % glenoid bone defect. No differences were observed in terms of function analysed by the WOSI test ($p=0.140$), with a mean score in group 1 of 20.37 points (SD 19.90) and 30.48 (SD 25.46) for group 2. The prevalence of complications was of 8.6% in group 1 and 13.8% in group 2 ($p=0.692$), without any redislocation in group 1 and 2 cases (6.9%) in group 2 ($p=0.201$). There was a higher prevalence of patients undergoing plate surgery who returned to sport activity (77.1% group 1 and 51.7% group 2) ($p=0.039$).

Conclusions: The use of a plate in the Latarjet technique may improve the predisposition to return to sport activity in patients with anterior glenohumeral instability associated with bone loss. In addition, these two techniques are similar in terms of functional outcomes and complication rates.

EP.02.066

CAUSES AND EFFECTS OF GRAFT NONUNION FOLLOWING CORACOID TRANSFER PROCEDURE FOR ANTERIOR SHOULDER INSTABILITY

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Background: Nonunion of bone graft is the main reason for the failure of coracoid transfer procedure. However, few studies have analyzed the effects and causes of bone nonunion.

Methods: Patients who underwent an arthroscopic Bristow procedure were retrospectively reviewed with at least 2 years of follow-up. Graft nonunion occurred in 4.8% (32/168) of shoulder. We conducted a 1:2 matching study between nonunion population and union population. Recurrence of dislocation, clinical scores, the rate of return to sports-RTS and CT assessment (the position of the transferred coracoid, graft healing, graft absorption and glenohumeral degenerative osteoarthritis-OA) were obtained at the final follow-up.

Results: Except for SSV score ($p=0.004$), other clinical scores showed no statistical significance between the two groups. Non-healing group had poor return to sports. There was no statistical difference in the time to return to sports. The complication rate and reoperation rate of non-union group were significantly higher than those of union group, especially screw related complications. Preoperative smoking history and sleep quality were risk factors for bone healing.

Conclusions: There was no statistical correlation between graft healing and functional score or postoperative stability following coracoid transfer procedure for anterior shoulder instability. However, the complication rate and reoperation rate of non-union group were significantly higher than those of union group. Preoperative smoking history and sleep quality were risk factors for bone healing.

EP.02.069

POSTERIOR TRAUMATIC INSTABILITY TREATED BY POSTERIOR OPENING WEDGE OSTEOTOMY AND GLENOID AUGMENTATION USING AN IMPLANT-FREE, J-SHAPED ILIAC CREST BONE GRAFT

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Background: Background: Traumatic posterior shoulder instability often occurs in patients with excessive retroversion in addition to posterior glenoid bone loss and soft tissue failure. For surgical correction we sought to address the bony deformity both in the axial plane by posterior opening wedge osteotomy together with augmenting posterior glenoid bone loss in the sagittal plane.

Methods: Methods: Six consecutive patients with a history of traumatic posterior instability and CT confirmed glenoid retroversion of greater than 10° combined with posterior glenoid bone loss were enrolled in a clinical trial of a new surgical technique that combines posterior opening wedge osteotomy and glenoid augmentation with an implant-free, J-shaped graft harvested from the ipsi-lateral iliac crest. Postoperatively, patients were rested in an abduction pillow sling for 6 weeks before a graduated rehabilitation program of range of motion and strengthening. Between 3 to 4 months, patients could return to full activities including collision sports.

Results: Results: We performed this operation in 6 individuals with no peri-operative complications. We followed them until CT confirmation of union and return to full activities including sports. Glenoid retroversion was corrected to 0° plus or minus 5° and glenoid surface area was augmented by a mean of 15%. Post-operative PROM's suggested excellent and significant relief of symptoms, no recurrent instability episodes and return to previous level of sport in all cases including 3 full or semi professional collision sport athletes (Australian Rules Football).

Conclusions: Conclusions: Posterior opening wedge osteotomy and glenoid augmentation with J-graft has been an effective method of dealing with traumatic posterior instability in patients with pre-existing significant glenoid retroversion combined with acquired posterior glenoid bone loss.

EP.02.070

RETURN TO PLAY FOLLOWING OPEN LATARJET IN UNDER 20 YEAR OLD COLLISION ATHLETES

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Background: The purpose of this study was to evaluate recurrence rates, return to play (RTP) and clinical outcomes in collision athletes under 20 who underwent open Latarjet for anterior shoulder instability.

Methods: A retrospective review of collision athletes under 18 years old, who underwent open Latarjet procedure a single surgeon between the years of 2010-2019 was carried out. Recurrent instability, rate of RTP and time to RTP were recorded. The Shoulder Instability Return to Sport after Injury score (SIRSI) score, Subjective Shoulder Value (SSV), and Visual Analogue Scale (VAS) scores were also evaluated.

Results: The study included 87 male collision athletes with a mean age of 18.6 ± 1.0 years (range: 17-20). The mean follow up for patients was 35 ± 26.5 months. A total of 76 (87.4%) returned to full sport at a mean time of 6.4 ± 2.2 months, with 57 (65.5%) returning to their pre-injury level of participation. The mean SSV score for patients at final follow up was 82.3 ± 17.9 , the mean SIRSI score was 68.4 ± 20.9 and the mean VAS score was 2.5 ± 2 . Nine patients (6.9%) re-dislocated their shoulder, with 5 of these requiring a further surgery for instability (2.3%).

Conclusions: There is a low redislocation rate among young athletes undergoing open Latarjet for anterior shoulder dislocation at mid-term follow-up. Additionally, there are good clinical outcomes with a high rate of return to play in this population.

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RESULTS OF ARTHROSCOPIC LATARJET WITH 2 SCREWS IN A SECOND GENERATION SURGEON

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Background: Bone stabilization of the shoulder using the arthroscopic Latarjet technique has been known since 2007. Results from the 2015 French Arthroscopic Society symposium showed identical results between the open and arthroscopic techniques.

In this study we want to show our results following arthroscopic surgery performed by a second generation surgeon. The main objective of this study is to show that our results are not inferior to those of the first generation surgeons who developed the arthroscopic technique.

Methods: We performed a retrospective single-center study from 2018 to 2022 including 58 arthroscopic Latarjet, performed by 1 senior surgeon, using 1 technique. We included 58 patients who underwent an arthroscopic procedure and were referred to our team of sports physicians and physical therapists for an in-depth study of their shoulder using the S-Start (Shoulder-SanTy Athletic Return To Sport) method and proprioception. On our side we have evaluated the usual scores, ROWE Walch-Duplay, Constant Elevation, external and internal rotations with abduction. From a radiographic point of view, a control CT scan was performed at 3 months to check the consolidation of the bone block and its position.

Results: We had 100% arthroscopic Latarjet with 23.68% of associated procedures, an average age of 28.9 years 75% male, 45.8% right side, 73% operated on the dominant side.

From the point of view of the usual scores, the scores were similar to those of first-generation surgeons, and we showed non-inferior results with 100% bone consolidation of our bone blocks, 91% good positioning in the mediolateral plane and 97% in the superolateral plane.

Concerning proprioception and S-start, the patients showed excellent results.

Finally, from 2018 to 2022, the average surgical time decreased by more than 20%.

Conclusions: Thus, a second generation surgeon presents satisfactory clinical and radiological results to which we have added innovative evaluation tools in our current practice.

We therefore recommend this arthroscopic Latarjet technique to future generations because it is reliable and reproducible and allows to perform associated procedures at the same time.

EP.02.072

INDICATIONS FOR GLENOID BONE GRAFT SURGERY ASSOCIATED WITH FAVORABLE FUNCTIONAL OUTCOMES: A SYSTEMATIC REVIEW

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Background: Anterior shoulder dislocation commonly presents as a complication of recurrent instability and occurs in up to 60% of patients. Determining the best surgical treatments for anterior shoulder instability is debatable, with several procedures developed over time. Specifically, in patients with bone lesions, the Latarjet technique had a recurrence rate of 4.7%, demonstrating an advantage over Bankart repair. However, the Latarjet technique is also associated with a high rate of postoperative complications, occurring in up to 30% of cases. The aim was to determine indications for bone grafting procedures associated with better functional results. This will help in choosing this type of surgery appropriately for shoulder instability

Methods: This systematic review was conducted in accordance with the International Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The studies were subdivided according to the main criteria used to indicate glenoid bone graft surgery, Radiological indications group (R), Radiological and clinical indications group (R + C) and Arthroscopic indications group (A). The extracted and evaluated outcomes were: functional scores (ROWE, WOSI, Constant, SSV, SANE, and VAS).

Results: In the electronic search conducted in April 2022, 1567 articles were identified. After applying the inclusion criteria, a total of 23 articles were selected for the systematic review. Regarding the functional scores, we observed that group A had a greater number of statistically better results than groups R and (R + C), whereas the (R + C) group had a greater number of statistically worse results. It is worth mentioning that all the groups obtained statistically better and worse results. This highlights the variability of the functional scores used to evaluate the results of bone grafting procedures.

Conclusions: In this systematic review, the subgroups presented similar results in the parameters evaluated; however, the radiographic indications group presented the best results in the specific scores for shoulder instability and our systematic review is the first to determine indications for glenoid bone graft surgery that would lead to better functional outcomes in prospective studies.

EP.02.073

MICROINSTABILITY CHARACTERISED BY SMALL AND EASILY OVERLOOKED ANTERIOR LABRAL OR HILL-SACHS LESIONS CAN BE MANAGED WITH ARTHROSCOPIC ANTERIOR LABRAL REPAIR

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Background: Some young individuals present with shoulder pain without a definite history or complaint of instability. However, careful history taking, physical examination, and high-quality magnetic resonance imaging may reveal evidence of instability of which the patient is unaware. This study aimed to report the characteristics and surgical outcomes of patients with microinstability compared to those of patients with classic recurrent anterior shoulder instability.

Methods: From 2005 to 2018, 35 patients with microinstability (group M) underwent arthroscopic anterior labral repair (AALR) and were compared to 35 sex- and age-matched patients with classic recurrent anterior shoulder instability (group C) who also underwent AALR. Baseline characteristics, preoperative apprehension test findings, preoperative imaging for the presence of anterior labral and Hill-Sachs lesions, preoperative and postoperative (over 2 years) range of motion (ROM) and functional scores, final complications, and patient satisfaction were analysed.

Results: The most common chief complaints in groups M and C were pain (29/35) and both pain and instability (27/35), respectively. Only pain during the apprehension test was predominant in group M (M vs. C, 27 vs. 1, $p < 0.001$). High incidence of chronic repetitive injuries (26/35) and acute trauma (28/35) were observed in groups M and C, respectively. Over half of the patients in group M showed anterior labral lesions on magnetic resonance arthrography (MRA, 18/35), and 21 patients had Hill-Sachs lesions on MRA/three-dimensional computed tomography. Finally, 29 patients showed either anterior labral or Hill-Sachs lesions on preoperative imaging. The lesion severity was higher in group C than that in group M. All patients underwent AALR with/without the remplissage procedure, with no significant differences in final clinical outcomes, complications, and patient satisfaction between the groups.

Conclusions: Microinstability is diagnostically challenging and can be diagnosed in young patients with ambiguous shoulder pain during motion, without instability. Pain on anterior apprehension test and subtle labral and/or Hill-Sachs lesion on imaging study could be diagnostic clues. This condition can be managed with arthroscopic anterior labral repair with or without the remplissage procedure. The possibility of microinstability in young patients with shoulder pain should always be considered, and small anterior labral or Hill-Sachs lesions should be closely monitored.

EP.02.075

EVALUATION OF KINESIOPHOBIA IN PATIENTS TREATED WITH ARTHROSCOPIC BANKART REPAIR FOR ANTERIOR GLENO-HUMERAL INSTABILITY

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Background: Kinesiophobia (fear of movement) has been claimed as a limiting factor in the return to pre-injury sport level after several procedures (such as: anterior cruciate ligament reconstruction, rotator cuff repair). No previous studies evaluated the effect of kinesiophobia after shoulder stabilization surgery. The study aims to analyze the prevalence of kinesiophobia in patients affected by anterior gleno-humeral instability and treated with arthroscopic labral stabilization procedure as well as the correlation between kinesiophobia and outcome predictors

Methods: A retrospective study was conducted. Patients who underwent arthroscopic labral stabilization procedure with a minimum of 6 months follow up after the surgery, were included. Preoperative computed tomography (CT) scan was performed in all patients. Exclusion criteria were: glenoid bone deficit > 20% of the area of the inferior part of glenoid, bipolar bone defects with "off-track" pattern, combined treatment with rotator cuff tears, and/or previous surgery. Primary outcome was the Tampa Scale of Kinesiophobia (TSK-13). Secondary outcomes were: the Western Ontario Shoulder Instability Index (WOSI), the American shoulder and elbow score (ASES), the Depression Anxiety Stress Scale 21 (DASS-21), the Tegner Activity Scale and the H-G Ratio. Univariate and Multivariate analysis were performed to determine which predictors were independently associated with the kinesiophobia. Significance was set at <0.05.

Results: The study included 132 patients: 109 males and 23 females. Mean age (+ SD) of patients was 19 ± 8 years. The mean follow-up was 84 months. The mean number of pre-operative shoulder dislocation was 15. One-hundred-seventeen (89%) patients performed sport activities before surgery. Postoperatively, 19 patients (14.4%) experienced a recurrence of dislocation. The analysis showed a significant correlation between kinesiophobia and the number of pre-operative dislocations as well as recurrence of post-operative dislocations. Postoperatively, all functional scores (ASES, WOSI, Tegner, DASS-21) showed a significant correlation with Kinesiophobia.

Conclusions: Kinesiophobia after arthroscopic labral repair is independently associated with number of pre-operative dislocations, recurrence of post-operative dislocations and functional scores for subjective evaluation at follow-up.

EP.02.076

RELIABILITY OF ANTERIOR GLENOID DEFICIENCY MEASUREMENT USING 2D MULTIPLANAR RECONSTRUCTION (MPR) OF MAGNETIC RESONANCE IMAGING (MRI) IN PATIENTS WITH SHOULDER INSTABILITY

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Background: Shoulder instability is a common condition that occurs especially in an sportive group of patients. Especially where recurrent it has been associated with humeral head and glenoid bone loss. Accurate measurement of the glenoid bone loss can be assessed by CT or MRI and is crucial to the pre-operative planning. The aim of our study is to show the reliability of anterior glenoid lesion measurement using 3D MPR MRI and how it's affected by observer's practice.

Methods: Six inexperienced observers (medical students) measured width, height, area of the glenoid, erosion edge length, area of bone loss, Pico index on MRI images of 80 patients with history of shoulder dislocation using Osirix software. Measurement of each patient was taken twice, with at least one week interval between measurements. Afterwards, intra-class correlation coefficient (ICC) and minimal detectable change with 95% confidence (MDC95%) were calculated. The results were also compared between the first 30 and last 30 reviewed patients.

Results: ICC and MDC95% differed between parameters with excellent results for width and height and poor for area of bone loss. Between first and last 30 patients intra-observer ICC and MDC95% values improved in all of the parameters, on the other hand inter-observer ICC and MDC95% values remained practically unchanged or worsened in most of the parameters. There were significant differences between observers.

Conclusions: 2D MPR MRI measurement of anterior glenoid lesion is a very good tool for simple parameters, like glenoid width or height. The more complex the measurement, the less reliable MPR MRI is. As the method is practiced the intra-observer reliability improves. The pace of learning between the observers is very individual. With practice the differences in measurements between each observer became worse or remained mostly unchanged which suggest that experienced specialists is needed to get accurate results.

EP.02.077

CONCOMITANT GLENOHUMERAL PATHOLOGIES IN PATIENTS WITH ACROMIOCLAVICULAR JOINT DISLOCATIONS: HOW DO ACUTE AND CHRONIC INSTABILITIES DIFFER?

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Background: ACJ dislocations may be associated with persistent pain. Concomitant glenohumeral pathologies (CGP) are common in patients suffering ACJ dislocations, but evidence of their treatment is limited.

This study aims to record the prevalence and treatment of CGP in cases with acute and chronic ACJ dislocations (Rockwood types II-V) and to investigate the influence of prior surgical treatment in chronic cases.

Methods: This retrospective cross-sectional binational, bicentric study included patients that underwent arthroscopically-assisted stabilization for acute and chronic (>21 days after injury) ACJ dislocations (Rockwood types II-V). Preoperative data, intraoperative CGP and treatment (debridement, reconstructive measures) were recorded.

Results: 540 patients (471 men, 69 women; mean age 39.4 years) were included, with 410 (75.9%) patients treated in the acute setting (group A), and 130 (24.1%) treated in the chronic setting (group C).

CGP prevalence was 30.7%; most commonly being supraspinatus tendon (SSP) (14.8%) and labral lesions (14.4%). There was no difference between group A and C (A: 29.3% vs. C: 35.4%; $p=0.19$).

Within group C, CGP were more prevalent in surgery-naïve patients (45.7% vs 18.4%, $p=0.002$). In patients with previous surgical treatment, CGP were more common in patients with prior open surgery than arthroscopic surgery (17.9% vs 6.3%). This difference was not statistically significant ($p=0.392$), presumably due to the small number of chronic, previously operated cases ($n=49$).

Besides older patients ($r=0.97$; $p=0.004$), Rockwood type IIIB cases had higher rates of CGP (37.4% vs. type V: 27.8%; $p=0.028$) but also displayed a higher rate of chronic cases ($p<0.001$) and a longer accident-to-surgery-interval ($p<0.001$). The most common CGP were treated by debridement rather than constructive measures (SSP: 71.4% vs. 28.6%; Labrum: 65.6% vs. 34.4%; $p<0.001$, respectively).

Conclusions: This study with the - to our knowledge - largest sample size to date, confirms the high rate of CGP in acute and chronic ACJ instabilities, especially in older patients. CGP are more common in chronic cases after prior conservative treatment than after surgical treatment, suggesting that CGP may have been overseen in patients with initially acute and non-operatively treated ACJ dislocations. The most common CGP were mostly treated with debridement.

EP.02.078

THE CIRCLES MEASUREMENT DETECTS WORSE CLINICAL OUTCOMES AFTER ARTHROSCOPICALLY-ASSISTED ACROMIOCLAVICULAR JOINT RECONSTRUCTION

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Background: The severity of acromioclavicular joint (ACJ) dislocations is primarily graded according to vertical instability, although horizontal instability may potentially be more relevant clinically.

The circles measurement is a validated new method that considers both instability components. Its clinical relevance has not been assessed, yet.

The aim of our study was to examine the association between the postoperative circle measurement and clinical outcomes in patients treated with arthroscopically-assisted ACJ stabilization.

Methods: 26 male patients (mean age 39.4 years) with an acute Rockwood type V injury with bilateral anteroposterior stress views and bilateral Alexander views before and after surgical treatment (1-2 years Follow-Up, FU) with a low-profile TightRope combined with a percutaneous AC cerclage were included.

Radiologically, the bilateral coracoclavicular distance (CCD), the degree of dynamic posterior translation (DPT) and the newly described circles measurement were assessed at both time points. Clinically, the Constant Score, ACJ Instability Score (ACJI), Taft Score (TF) and Subjective Shoulder Value (SSV) were recorded.

Results: At a mean FU of 21.0 months, the CCD was reduced from 21.4 (19.7-23.0) mm to 11.4 (95% CI 10.0-12.7) mm preoperatively. Similarly, the circles measurement distance was reduced [25.7 (22.8-28.6) mm to 4.0 (1.4-6.7) mm; $p < 0.001$]. Reduction by both methods showed a correlation ($r = 0.462$, $p = 0.017$).

The postoperative circles measurement was associated with the postoperative DPT ($r = 0.870$, $p < 0.001$), differentiating between cases with no [-0.6 (-2.2-0.9) mm] and partial DPT [6.9 (4.5-9.4) mm; $p = 0 < 0.001$] as well as partial and complete DPT [17.0 (11.8-22.2) mm; $p = 0.009$].

It also showed a correlation with the ACJI ($r = -0.557$; $p = 0.003$), the TF ($r = -0.356$; $p = 0.044$) and the SSV ($r = -0.483$; $p = 0.031$). Specifically, cut-off values for worse clinical outcomes were 5.7 mm for the ACJI [81.1 (73.8-88.5) points vs. 89.7 (84.7-94.6) points; $p = 0.026$], 2.5 mm for the TF [10.5 (10.0-11.1) points vs. 11.3 (10.5-12.0) points; $p = 0.02$] and -1.2 mm for the SSV [95.1 (91.4-98.9) points vs. 91.3 (88.6-94.0) points; $p = 0.031$].

Conclusions: The postoperative circles measurement appears to be a valuable tool to detect worse clinical outcomes after arthroscopically-assisted ACJ stabilization. Surgical techniques should aim to restore the circle measurement distance of the healthy opposite side.

EP.02.080

THE CLINICAL IMPACT OF LOW GRADE INFECTION IN THE SETTING OF REVISION SHOULDER INSTABILITY SURGERY: A PROSPECTIVE MULTICENTER CONSECUTIVE COHORT STUDY

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Background: Recurrent shoulder instability after primary surgical stabilization is the main reason for revision surgery. The aim of this study was to document the positive culture rate in shoulder instability revision cases and describe its clinical impact.

Methods: All consecutive patients with primary shoulder instability surgery needing revision were included in our prospective cohort. Minimum follow-up after revision surgery was 1 year. Data collected included demographics, infection evaluation (clinical evaluation and proper culture sampling), functional assessment with WOSI (Western Ontario Shoulder Instability Index) and Quick DASH (Disabilities of Arm, Shoulder and Hand), osteoarthritis at last follow-up.

Results: Thirty-seven patients met the inclusion criteria with a mean follow-up of 1.4 years. One patient was lost to follow up. Among all revisions, 22 had cultures taken. Ten patients had confirmed microbiological infection, all with *C. acnes*. Alcohol consumption was found to be a statistical risk of infection in revision surgery (70% versus 22%, $p=0.017$). Patients with infection at revision surgery had worse clinical outcomes at the last follow-up compared to those without infection, although not statistically significant (WOSI= 1125 (\pm 303) 95% CI: [844.83; 1405.31] versus 855 (\pm 562) 95% CI: [591.53; 1117.81] respectively, $p=0.128$); (Quick DASH=32.8 (\pm 8.9) 95% CI: [24.49; 41.1] versus 25.3 (\pm 18.7) 95% CI: [16.59; 34.07], $p=0.323$). There was a significant difference for osteoarthritis at the last follow-up with a 100% rate for infected patients compared to 55% for non-infected patients ($p=0.018$). At the last follow-up, there was no persistent clinical infection or dislocation recurrence.

Conclusions: *C. acnes* infection was identified in 45% of recurrent anterior shoulder instability (RASI) revision surgeries when cultures were taken. Alcohol consumption was the only risk factor associated with infection in our study. Positive cultures at reoperation seem to be associated to osteoarthritis onset. Patients can expect significant improvement in stability and function after revision, even in the presence of infection and osteoarthritis. *C. acnes* cannot be treated lightly when it comes to failed RASI surgery and should always be considered in revisions. We recommend systematic tissue sampling with clean instruments and cultures to rule out or treat infection in patients undergoing RASI surgery.

EP.02.082

IS ALLOGRAFT A GOOD OPTION FOR LARGE HILL- SACHS INJURIES?

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Background: Compressive fracture in the posterolateral region of the humeral head (Hill Sachs) may happen between 65 to 71% of patients in the first episode and may increase in recurrent dislocations. It is one of the main factors of glenohumeral instability, influencing both the length and the depth of the injury.

The presence of an associated glenoid defect (bipolar lesion) makes easier engaging Hill- Sachs.

Methods: This is a 37 years old female that, after a traumatic trauma, presents a right shoulder dislocation. On examination a shoulder deformity is observed without hematoma and with parestesias in deltoid region.

After several attempts of reduction it is imposible to keep the reduction.

Different radiological tests conclude that there is an antero-inferior shoulder dislocation with a severe Hill- Sachs and Bankart lesion without the presence of rotator cuff tears.

Electromyogram indicate compatible signs with a chronic involvement of the right axillary and suprascapular nerves with the presence of signs of reinnervation.

Results: After observing progressive improvement of neurological clinic, the patient underwent surgery. A deltopectoral approach was performed seeing anteroinferior dislocation of humeral head with a large Hill Sachs injury (3 x 3.5 cm). The lesion bed is prepared and a reconstruction of the humeral head was performed with allograft fixed with three self- drilling screws. Finally a Latarjet technique was performed fix with two cannulated screws observing glenohumeral congruence and stability. After 6 weeks with a cast the patient starts with physiotherapy. She presented complete range of movement with no more episodes of dislocation.

Conclusions: There are several techniques that look for increase the glenoid surface as the Latarjet technique or the use of allografts described by Eden-Hybinette which in recent years has gained great popularity.

However there are few publications about the use of allografts to reconstruction of massive defects of the humeral head. It is an anatomic technique in which the humeral surface arch is recovered.

Some of the complications described are non- consolidation, resorption and revision due to osteosynthesis problems.

This technique is an option for those young patients that present large Hill Sachs injuries observing good functional results.

EP.02.083

ARTHROSCOPIC INFERIOR TO SUPERIOR CAPSULAR SHIFT RESULTS IN SUPERIOR CLINICAL OUTCOMES COMPARED TO ARTHROSCOPIC BANKART REPAIR FOR THE TREATMENT OF ANTERIOR CAPSULOLABRAL TEARS AFTER DISLOCATION

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Background: In anterior shoulder instability, bony and soft tissue structures are at risk of injury, often resulting in injury to the anterior capsulolabral complex. This pathology is typically treated with an arthroscopic Bankart repair, but the open Bankart is regaining popularity with surgeons reporting fewer re-dislocations compared to its arthroscopic counterpart. We recently developed an arthroscopic capsular shift technique. The purpose is to compare clinical outcomes in patients with traumatic anterior shoulder instability treated the arthroscopic capsular shift and arthroscopic Bankart repair. Our objective is to compare clinical outcomes, Western Ontario Shoulder Instability (WOSI) scores, complication, and re-dislocation rates. We hypothesize that patients treated with arthroscopic capsular shift will have similar clinical outcomes and a lower failure rate at 1-year compared with the other surgical cohort.

Methods: Patients were included if they underwent an isolated primary soft-tissue stabilization performed arthroscopically with an above-mentioned technique, between 2012-2021. Patients were excluded if they had concomitant glenoid fractures, <1-year follow-up, posterior instability, multidirectional instability, and presence of HAGL lesions. Demographic information, WOSI scores, pre-operative glenoid and humeral head dimensions, and new dislocations were recorded.

Results: 63 patients were included, 27 in the Bankart group, 36 in the capsular shift group. Both groups had similar demographics and baseline characteristics, except for length of clinical follow-up (the capsular shift technique was developed more recently) ($p < 0.001$). Both groups had similar pre-operative glenoid AP and Hill-Sachs depth measurements ($p = 0.358$ and 0.329 , respectively). Patient-reported outcomes were similar at baseline ($p = 0.602$) and post-operatively ($p = 0.621$). Both groups improved in WOSI post-operatively ($p < 0.001$), more patients met MCID in the capsular shift group compared to the Bankart group (93% vs 75%). Lower re-dislocation rates were found in patients who received a capsular shift compared to the Bankart group (6% vs 22%).

Conclusions: The arthroscopic capsular shift technique results in better post-operative clinical outcomes compared to arthroscopic Bankart repair and lower recurrence, lower rate of post-operative apprehension, and increased proportion of patients who meet MCID for WOSI. This technique could be a better alternative for Bankart repair in patients with soft-tissue pathologies following anterior shoulder dislocations, longer-term studies are necessary to determine the longevity of these outcomes

EP.02.084

OUTCOMES OF ACUTE OPEN LATARJET PROCEDURE FOR THE SURGICAL MANAGEMENT OF INSTABILITY RELATED ANTERIOR GLENOID FRACTURES

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Background: Limited evidence is available for the management of recurrent glenohumeral instability caused by acute anterior glenoid fractures (AAGF). We present a retrospective review of patients treated with an acute open Latarjet procedure for recurrent instability due to comminuted AAGF.

Methods: 19 patients were operated on by a single surgeon at a single centre, undergoing standardised rehabilitation. 18 patients with complete clinical and radiological data (pre- and postoperative CT scans) and minimum 2 years follow-up were available. Preoperative fracture characteristics including glenoid involvement (PICO method), displacement and associated injuries were documented. The recorded outcomes included range of motion (ROM), Visual Analogue Score (VAS) for pain, Walch-Duplay score (WDS), Rowe score (RS), Oxford Shoulder Instability Score (OSIS), Subjective Shoulder Value (SSV), satisfaction rating and documentation of complications.

Results: The patients had a median number of 2.5 preoperative instability episodes with 50% involving the dominant shoulder and 63% were males. The injury to surgery time was 10.6 days with a median age at surgery of 58 years and median follow-up of 28 months. Preoperative CT scan confirmed comminuted AAGF with median 8mm displacement involving 16% of the glenoid. 2 patients had associated greater tuberosity fractures and another 2 had full thickness rotator cuff tears, which were also treated accordingly. After surgery, the median range of motion showed elevation of 160°, external rotation in adduction of 50° and internal rotation to T12 level (8 points) with external and internal rotations in abduction 75° and 75°. 88% were satisfied, postoperative VAS was 2 with WDS 85, RS 85, OSIS 43 and SSV 88%. There were 2 (11%) elderly females with recurrent instabilities: 1 due to bone-graft fracture and 1 due to rotator cuff re-tear, both required revisions to reverse shoulder arthroplasty with final SSV of 90%. Other complications included: a delayed bone-graft union (due to partial fixation failure) and 2 patients with frozen shoulder required hydrodilatation injection.

Conclusions: The acute open Latarjet procedure provides good outcomes with acceptable complication rates in the short-term, for symptomatic AAGF lesions. It is an effective treatment option and a safe alternative to arthroscopic or open glenoid fracture fixations.

EP.02.085

ARTHROSCOPIC RECONSTRUCTION OF ANTEROINFERIOR GLENOID RIM FRACTURES: MEAN 10-YEAR CLINICAL AND RADIOLOGIC RESULTS

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Background: To date, long-term results of arthroscopic reconstruction of glenoid rim fractures are missing. The aim of this study was, to evaluate clinical and radiographic results following arthroscopic reconstruction of anteroinferior glenoid fractures using anchors or bioabsorbable compression screws after a mean follow-up period of 10 years.

Methods: 22 patients (7 female, 15 male, mean age 50 (range, 20-74) years at surgery) with an acute substantial solitary (n=12) or multifragmented (n=10) anteroinferior glenoid rim fracture, were enrolled. Clinical outcome measures included evaluation of recurrent instability, Constant Score (CS), Subjective Shoulder Value (SSV), Rowe Score (RS), Western Ontario Shoulder Instability Score (WOSI) and Melbourne Instability Shoulder Score (MISS). X-ray images were obtained for assessment of an instability arthropathy (IA).

Results: After a mean follow-up period of 10 (range, 6-13) years, patients reached a mean CS of 92 (range, 59-100) points, SSV of 93 (range, 50-100)%, RS of 85 (range, 25-100) points, WOSI of 98 (range, 91-99)% and MISS of 90 (range, 69-100) points. No patient suffered recurrent dislocation. Radiographic results were obtained of 17 patients. Signs of IA were noted in nine patients with a progression of IA in all cases in comparison to the preoperative status according to the Samilson and Prieto classification modified by Buscayret. Patients with IA were significantly older than patients without (52 versus 36 years, p=0.04). Clinical score results did not show a significant difference in patients with versus without IA except for the RS (74 versus 96 points, p=0.01). No intra- or postoperative complications were observed, and no patient required revision endoprosthetic surgery.

Conclusions: Arthroscopic reconstruction of acute anteroinferior glenoid rim fractures shows good clinical long-term results. High rates of IA were especially observed in older patients. However, the presence of IA did not seem to influence the subjective shoulder score outcomes.

EP.02.086

RISK FACTORS AND INCIDENCE OF REVISION POST-ARTHROSCOPIC CAPSULORRHAPHY

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Background: Capsulorrhaphy is a surgical technique that utilizes suture anchors and capsular plication in order to reduce capsular redundancy and address capsular laxity. Capsulorrhaphy through an open reconstruction technique has historically been a widely used procedure as it yields a more secure repair and provided surgeons with improved anchor orientation. Arthroscopic stabilization techniques as an alternative to open reconstruction have gained prominence recently, due to a less invasive risk profile. The purpose of this study is to evaluate the incidence of and the risk factors for revision surgery after an arthroscopic capsulorrhaphy.

Methods: Database mining was conducted on the patient record database compiled by the Pearl Diver Database. The database provides access to de-identified information from 91 million patients spanning 2007 to 2020 and was chosen for this study because its ability to provide large scale data that is diverse and representative of the United States population. Information is sorted based on International Classification of Diseases, 9th Revision (ICD-9) diagnoses and procedures, 10th Revision (ICD-10), Current Procedural Terminology (CPT) codes.

Results: Of the 23,071 arthroscopic capsulorrhaphy procedures, 21,247 (92.1%) patients did not need a revision within the minimum follow-up period of 3 years. 548 of the procedures conducted (2.4%), received a revision arthroscopic capsulorrhaphy. There was a total of 255 arthroscopic capsulorrhaphy procedures that were transferred to an open approach for the revision capsulorrhaphy (1.1%). The remaining 1,021 patients (4.4%) had shoulder surgery but it was not a capsulorrhaphy. The risk factors that were statistically significant for having any shoulder surgery on the same shoulder post capsulorrhaphy were the Charlson Comorbidity Index (CCI) (OR=1.0), tobacco use (OR=1.4), the female gender (OR=1.2), being younger than 20 (OR=1.5), and humeral avascular necrosis (OR=4.1)

Conclusions: Capsulorrhaphy as a procedure, yields higher success rates than previously postulated. Arthroscopic methods are preferred by American surgeons, while open methods continue to be gold-standard in Europe. The most common shoulder surgery an arthroscopic capsulorrhaphy patient had post-capsulorrhaphy was a total shoulder arthroplasty, not a revision of the original capsulorrhaphy. Young age and humeral avascular necrosis seemed to be the biggest risk factor for requiring another shoulder surgery post-arthroscopic capsulorrhaphy.

EP.02.087

IS THERE ANY FACTOR THAT INFLUENCES THE APPEARANCE OF COMPLICATIONS AFTER LATARJET SURGERY?

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Background: The Latarjet procedure is a common procedure to treat recurrent shoulder instability particularly in young, active patients and contact athletes with bone loss.

The complication rates are describe from 7%as high to25%.The objective of this study is to carry out a survival analysis over time to study the factors that influence the early appearance of complications.

Methods: We present a retrospective study in which we included patients who underwent open Latarjet surgery from January2017 to October2022. The inclusion criteria were: operated on between this period of time in our center, ISIS >3 points, with 20% bone loss of the glenoid in the CT, treated with an open primary Latarjet and with a minimum follow-up of 6 months. Patients who underwent a second Latarjet operation or if a non-standard surgical technique was used were excluded.

Results: We collected a total of 173 interventions with a mean age of 31.8 years(+/- 11.0 years).The patients were predominantly male/female (83.8%). In the analysis of the rate of complications, a drastic decrease in the number of complications was obtained from the year 2019(from 60% to 22%) and substantially from the year 2021, these differences being statistically significant($p=0.022$). In addition, in the survival analysis, significant differences were observed in the distribution of time until complications between the patients who practiced professional, amateur or non-sports($p=0.007$, Log-Rank Test) and that this is the only significant variable that influences the time in which complications occur ($p=0.015$). On the one hand, a greater number of complications was observed in patients who practiced contact activities professionally with a rate of 38.1%($p=0.08$). The mean time to onset of complications in professional athletes was 10 months with a CI of 6.9and14.299. In contrast, amateur athletes had a complication rate of 10.6%($p=0.08$) and it seems to have a protective effect since they have a 24.1%lower risk of complications (HR: 0.241; 95% CI HR: 0.090-0.646)

Conclusions: Practicing contact sports at a professional level seems to be a risk for the appearance of complications after Latarjet surgery, and on the contrary, practicing sports at an amateur level seems to have a protective effect. However, more research is required.

EP.02.088

ANALYSIS OF THE LEARNING CURVE OF THE OPEN LATARJET FOR RECURRENT SHOULDER INSTABILITY IN OUR CENTER

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Background: Anterior shoulder instability is a common problem in young, active patients and contact athletes. Although the arthroscopic Latarjet procedure is becoming increasingly popular, it is not widely used in routine practice due to its low accessibility, we believe that it is important to continue studying the open Latarjet procedure to minimize the complication rate. The objective of this study is to identify the learning curves of the Latarjet procedure in our center and relate it to our rate of complications in the short and medium term.

Methods: We present a retrospective study in which we included patients who underwent open Latarjet surgery by 4 surgeons from our center from January 2017 to October 2022. The inclusion criteria were: operated on between this period of time in our center, with clinical symptoms of unidirectional anterior instability shoulder with an ISIS score >3 points, with 20% glenoid bone loss on CT, treated with an open primary Latarjet and with a minimum follow-up of 6 months.

Data were collected on the characteristics of the study, demographics, intervention time, postoperative hospital stay, opioid requirement and complications associated with the technique.

Results: 196 patients were collected, finally 173 interventions with a mean age of 31.8 ± 11.0 years were included in the data analysis. The patients were predominantly men (83.8%). Regarding surgical time, a significant decrease is observed from the year 2020, going from 125.3 ± 30.1 to 111.3 ± 19.3 minutes ($p=0.003$). Therefore, after an average of 45 open Latarjet procedures (representing 26% of all surgeries), the surgeons achieved a level of competence measured by the reduction in operating time. Likewise, the number of complications decreased drastically from 2019 (from 60% to 22%) and substantially from 2021, these differences being statistically significant ($p=0.022$). Regarding opiate requirements, 18% of the total required opiates. There were no significant differences in the opioid requirement in relation to surgical time or the surgeon, and no variations were observed over the years

Conclusions: The Latarjet procedure is a safe procedure with low complication rates, with which a good experience is achieved after 45 procedures. However, more research is required to truly characterize this learning curve.

EP.02.089

TIME TO ACHIEVEMENT OF CLINICALLY SIGNIFICANT OUTCOMES FOLLOWING OPEN LATARJET

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Background: To comprehensively define the time required to achieve outcomes (CSOs) after open Latarjet. The primary outcome was to identify an evidence-based timepoint for functional recovery, including the time needed to attain minimally clinically important difference (MCID) and patient acceptable symptomatic state (PASS) for open Latarjet.

Methods: Patients who underwent open Latarjet between 2016 and 2022 were collected. Those with completed preoperative and at least 1 post-operative (3-month, 6-month, 1 year, and 2 years) Patient-Reported Outcome Measures (PROMs), including American Shoulder and Elbow Surgeons (ASES), Single Assessment Numeric Evaluation (SANE), or Western Ontario Shoulder Instability (WOSI) were included. Exclusion criteria included patients with significant concomitant procedures. MCID and PASS for each PROM were identified from prior literature and utilized as a threshold needed to attain functional recovery. The time needed to achieve CSO was then calculated and plotted using Kaplan-Meier survival analysis.

Results: The average patient was 27 years old, male (85%), and white (87%). The majority of patients (62%) had prior ipsilateral arthroscopic instability surgery. Instability symptoms either failed to resolve or patients experienced resolution of symptoms for an extended period of time, until subsequent trauma. Of the 79 included patients, 69 patients had completed SANE forms, and 43 had completed WOSI forms. Patients attained SANE achievement rates of 68% for MCID and 49% for PASS, and WOSI achievement rates of 83.7% for MCID and 55.8% for PASS. Median achievement time across all surveys (SANE, WOSI, and ASES) ranged between 5.0-5.7 months for MCID, and between 5.2-5.9 months for PASS. Averages for achievement time for MCID ranged from 5.8-7.7 months, and for PASS from 6.4-8.2 months, in respective PRO surveys.

Conclusions: The majority of patients undergoing open Latarjet achieved benefit within 6 months of surgery (overall median: 5.5 months; overall average: 7.4 months), with diminishing proportions at later timepoints. The timeline for achieving improvement that was established by this study may aid in setting patient expectations and designing future outcome studies involving open Latarjet.

EP.02.090

ASSOCIATION BETWEEN PREOPERATIVE GLENOID BONE LOSS AND CLINICAL OUTCOME AFTER CORACOID TRANSFER COMBINED WITH OPEN BANKART REPAIR: A COMPARISON OF THE BRISTOW AND LATARJET

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Background: Whether the extent of glenoid bone loss (GBL) affects clinical outcome after coracoid process transfer (CPT) is still unclear. This study aimed to elucidate the relationship between the extent of GBL and postoperative outcome of CPT combined with open Bankart repair in young rugby players with comparing the Bristow and Latarjet technique.

Methods: We investigated a total of 101 shoulders in 91 competitive rugby players who underwent CPT by the Bristow (group B; 66 shoulders) or Latarjet (group L; 35 shoulders) procedure combined with a Bankart repair between 2007 and 2017. GBL was calculated from en face view of the glenoid in preoperative 3-dimensional computed tomography, and the GBL value was used to assign shoulders to 1 of 4 grades (grade 0, 0%; grade 1, > 0%, < 10%; grade 2, > 10%, < 20%; grade 3, > 20%). We analyzed the relationship between GBL or its grade and postoperative clinical scores (American Shoulder and Elbow Surgeons score, Rowe score, Western Ontario Shoulder Instability index, and patient satisfaction rate) at the final follow-up, time to return-to-play (RTP), and graft failure.

Results: Mean GBL in all shoulders was $10.9 \pm 9.1\%$ and was not significantly different between the 2 groups. GBL showed no significant correlations with any postoperative scores in either group. Mean RTP time was significantly shorter in group L (group L, 4.8 ± 1.1 months; group B, 5.8 ± 1.8 months; $p = .002$), but it was also not associated with GBL. In group B, the rate of graft failure (insufficient union or translocation) was numerically higher in shoulders with grade 0 or 1 GBL than in those with grade 2 or 3 (8 [25.0%] vs 4 [11.8%], respectively; $p = .21$); in group L, only 1 graft failure occurred (translocation in a shoulder with grade 2 GBL).

Conclusions: The extent of GBL does not affect clinical scores after CPT regardless of operative procedure, but a small amount of GBL is disadvantageous in terms of graft union in the Bristow procedure.

EP.02.091

USE OF 3D PRINTED PATIENT SPECIFIC GUIDE FOR LатарJET PROCEDURE IN PATIENTS WITH ANTERIOR SHOULDER INSTABILITY - TECHNICAL NOTE.

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Background: Anterior shoulder instability can lead to anterior glenoid bone loss associated with humeral posterior deformity (bipolar bone loss). Latarjet procedure is a commonly used surgical option in such cases. However, the procedure is associated with complications in 15% of the cases often associated with inadequate positioning of coracoid bone graft and screws. Considering that acknowledgment of patient anatomy and surgical planning intraoperatively can reduce such complications, we describe the use of 3D printing tools to obtain a 3D Patient Specific Surgical guide to aid in the Latarjet procedure. Such tools present advantages and limitations compared to other tools available

Methods: Considering its potential to reduce complications and improve graft positioning, as observed in other shoulder procedures, we aimed to develop a patient-specific guide for the Latarjet procedure. In this Technical Note, we describe the surgical technique of a Latarjet procedure with the use of a 3D Printed patient-specific instrument (PSI).

Results: In the technique described, we aimed to implement a method that consider patient anatomy and allow to reproduce what is digitally planned, we observed a good positioning of the graft and screws, in addition to important reproducibility with what was digitally planned. The perception of the team involved in the procedure was that the use of the guide made the surgical steps faster and less technical demanding in comparison to the conventional technique and reduced and the need for fluoroscopy images

Conclusions: We present an innovative tool for positioning and fixing the coracoid process graft in the Latarjet procedure. We understand that, together with other resources, three-dimensional planning and the use of 3D guides is a natural evolution of classic orthopedic surgical planning and consequent improvement in technical execution.

EP.02.092

CLINICAL OUTCOMES AFTER ARTHROSCOPIC REPAIR OF GLAD (GLENOLABRAL ARTICULAR DISRUPTION) LESION AND ACUTE BANKART LESION: OUR EXPERIENCE

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Background: The original definition attributed the development of GLAD lesions to adduction trauma without instability; however, numerous have since described articular lesions in the setting of instability after acute trauma with dislocation. In our opinion acute GLAD lesions and Bankart lesions represent different conditions associated with the same pathophysiology mechanism. The purpose of our retrospective study is to compare outcomes between acute anterior shoulder instability with and without glenolabral articular disruption (GLAD) lesions after undergoing arthroscopic repair.

Methods: 10 patients with acute GLAD lesion (with a mean age of 32.0 ± 10.9 years and analyzed at mean 18.25 ± 7.73 years follow-up) were treated with labrum medialization to cover the defect (Group 1), 10 patients with bankart lesion (with a mean age of 25.44 ± 10.04 years and analyzed at mean 30.89 ± 14.32 years follow-up) were treated with all-suture anchor repair (Group 2). Simple shoulder test, Rowe score, VAS scale (preoperative and postoperative) and range of motion of both groups were evaluated.

Results: Patients showed significant differences in SST (64.65 ± 4.73 in Group 1 vs 87.97 ± 11.19 in Group 2) and Rowe score (89.38 ± 9.84 in Group 1 vs 97.22 ± 2.48 in Group 2) at final follow-up. Regarding VAS scale, Group 1 showed higher levels of pain before surgery compared to Group 2 (7.88 ± 0.87 in Group 1 vs 2.33 ± 1.05 in Group 2) as well as after surgery (2.38 ± 1.33 in Group 1 vs 1.44 ± 1.34 in Group 2). Range of motion was satisfactory for both groups, a mean deficit of external rotation was observed in Group 1 (10°) at the final follow-up.

Conclusions: Patients with acute GLAD lesions showed higher level of pain compared to those with bankart lesion. Clinical results after surgery are satisfactory in both groups but in case of GLAD lesions patients should be informed regarding the risk of external rotation deficit, that could be significative for elite throwing athletes.

EP.02.093

ARTHROSCOPIC LатарJET WITH CORTICAL BUTTONS VS OPEN LатарJET WITH SCREWS: A COMPARATIVE STUDY

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Background: The arthroscopic Latarjet remains a controversial subject and few comparative studies have demonstrated the benefit of arthroscopy over open surgery. The aim of this study was to compare short-term clinical outcomes of arthroscopic and open Latarjet; The hypothesis was that the arthroscopic procedure is superior to the standard open procedure.

Methods: This was a retrospective comparative study of prospectively collected data. Patients treated for chronic anterior instability by arthroscopic Latarjet with double cortical buttons (Group A) or open Latarjet with screws (Group O) with a minimum follow-up of 12 months, were included. Intraoperative (duration, complications) and postoperative (complications, pain, mobility, functional scores, resumption of sport, POSAS scar aesthetics, satisfaction) data were compared.

Results: 50 patients were included, n=24 in group A, and n=26 in group O. Operating time was longer in group A (102 vs 60 min; p=0.001). The average number of days on analgesics was higher in group A (8.9 vs 5.3 days; p=0.05). The complication rate was similar for the 2 groups (12.5% vs 27%; p= 0.46). In 3 months, the loss of external rotation was greater in group A (-33 vs -18°; p=0.01), resumption of sports was less frequent (11% vs 48%; p=0.01). In 12 months, the average scores were excellent with no significant difference between the 2 groups: Walch Duplay average 90 points, Rowe 94 points, SSV 92.5% and sport SSV 85%, POSAS score 17.2 points.

Conclusions: Over the short term, this comparative study did not prove the superiority of the cortical-button arthroscopic procedure over the open procedure. A delay in the resumption of sports, longer recovery of range of motion and no benefit regarding postoperative pain or the aesthetic aspect of the scar are possible with the arthroscopic procedure.

EP.02.094

THE "PURSE STRING" TECHNIQUE FOR ANTERIOR GLENOHUMERAL INSTABILITY: LONG TERM RESULTS

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Background: The use of fewer anchors been cited as a cause of failure. However, this applies to the use of the suture anchors in conventional techniques. Horizontal mattress suture techniques restore better labral height and anatomy. The "purse-string" technique (PST), creates 3-fold repair: Bankart repair, tightening of the capsule with south-to-north capsular shift, and creation of anterior glenoid bumper, using only 1 suture anchor at 4-o'clock position with passing the sutures through the labrum and capsule at 2 and 6-o'clock positions.

We report the long-term (7-13 years) results of PST, a simple arthroscopic stabilisation that addresses both the Bankart lesion and capsular stretching.

Methods: 69 individuals (70 shoulders) with anteroinferior post-traumatic instability treated with PST. 55M/14F. Mean age at surgery 30.4 years (16-58).

All patients assessed by independent investigator clinically or by telephone interview at a mean of 116 months postop (84-156 months). Constant score (CS), Rowe score (RS), Walch-Duplay score (W-DS) and return to sport were assessed. Recurrence instability recorded.

Results: At final follow up, mean CS was 94, RS 93 and W-DS 90. 58/69 participated regularly in sport prior to their dislocation. 55 (97%) returned to the same sport, 67% to the preinjury level.

14 patients participated in high-level competitive sports, 9 returned to full activity, whereas 5 either reduced their level of sport or stopped. 9 patients participated competitively in contact sports - 5 returned to their preinjury level, 4 had stopped. Seven patients had recurrent dislocation post-operatively (10% failure). Of these, 3 had revision arthroscopic stabilization, 1 had revision arthroscopic stabilization with remplissage, 2 had Latarjet procedure, and one patient decided to seek no further treatment.

Conclusions: The long-term results with PST are very encouraging, with high rate of patient satisfaction, high level of return to preinjury sporting activities and a low failure rate.

EP.02.095

RETURN-TO-PLAY FOLLOWING LATARJET PROCEDURE IN YOUNG CONTACT ATHLETES

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Background: Young athletes that play a contact sport are susceptible to anterior glenohumeral instability due to high-velocity impacts and repetitive dislocations. Few studies have examined return-to play and patient outcomes following the Latarjet procedure in this patient population.

Methods: 67 consecutive contact athletes (72 shoulders), age under 35, that underwent Latarjet procedure for recurrent shoulder instability between 1/1/2018 and 3/31/2022 were retrospectively identified. Demographic information, medical history, surgical history, number of dislocations prior to surgery, and post-operative complications up to 6 months after surgery were reviewed. 46 patients were interviewed with an average follow-up of 25.5 months. Outcomes evaluated include return to play, competition level, patient satisfaction, and patient-reported outcomes including American Shoulder and Elbow Surgeons (ASES) Score, and Disabilities of the Arm, Shoulder, and Hand (DASH) Score.

Results: Mean age at time of surgery for the total cohort was 19.7 years. 19/72 (26.4%) of patients had prior shoulder surgery, most commonly arthroscopic stabilization. 8/72 (11.1%) of shoulders had unresolved pain or stiffness six months after surgery and 2/72 (2.7%) required re-operation after Latarjet. Only one patient experienced hardware failure. 46 patients (51 shoulders, 70.8%) were interviewed with mean follow-up of 25.5 months, of which 23 played football. 16/46 (35%) athletes competed at the collegiate level, and 24/46 (52%) at the high school level at the time of surgery. 35/46 patients (76%) returned to sport, of which 30/35 (65%) returned to playing at the same competition level; 15/23 (65.2%) of football players returned to sport. 3/46 (7%) reported recurrent dislocation. Mean ASES score was 92.2, DASH score 5.6, and visual analog scale 4. 43/46 (93%) patients reported improvement in quality of life after undergoing Latarjet procedure for shoulder instability.

Conclusions: The Latarjet procedure allows young contact athletes with shoulder instability to return to competitive play at strong rates. Although there is high patient satisfaction with the Latarjet procedure, recurrent instability and unresolved pain and stiffness are significant post-operative complications.

EP.02.096

THE ARTHROSCOPIC BANKART-PLUS PROCEDURE AND ASA REPAIR IN HETEROLOGOUS GLENOID BONE GRAFTING FOR RECURRENT ANTERIOR INSTABILITY. A PRELIMINARY CLINICAL AND RADIOLOGICAL MULTICENTRIC STUDY

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Background: Several open and arthroscopic surgical techniques have been described to treat shoulder instability and the choice is based on the damage of the soft tissue and the glenoid bone loss

Methods: The aim of this study is to investigate the clinical and radiographic outcomes of patients undergoing to arthroscopic xenograft bone block procedure plus soft tissue augmentation with the upper third of the subscapularis tendon at 2-year follow-up. Twenty patients with chronic antero-inferior instability and glenoid bone loss >10% underwent to arthroscopic xenograft bone block procedure plus Bankart and soft-tissue augmentation. Clinical outcomes were evaluated according to the Western Ontario Shoulder Instability Index (WOSI) and the Rowe scale. A 4-item questionnaire was administered to calculate the MCID and PASS of the WOSI. Computed tomographic (CT) results were evaluated to assess any signs of resorption or displacement of the xenograft.

Results: The mean preoperative Rowe score was 38.3 points and it significantly improved ($p < .001$), increasing to 95.5 points. ROWE score at follow up was excellent for eighteen patients (90%), fair for one patient (5%), and poor for another patient (5%). The mean preoperative WOSI score was 1242 points and it improved significantly ($p < .0001$), with a mean score of 120 points at follow-up. In all patients, the comparative study of all between 2D-CT scans performed did not reveal a volume reduction of the xenografts ($p > 0.05$) with graft resorption areas and signs of breakage. The mean glenoid surface augmentation was 34.4%.

Conclusions: The combination of the bone block procedure with xenograft and soft tissue augmentation with the upper third of the subscapularis tendon allows an all arthroscopic anatomic reconstruction of the glenoid, as well as the restoration of capsulolabral deficiency. The absence of radiographic signs of resorption, major displacement of the xenografts and absence of secondary osteoarthritis were observed at 24 months follow-up.

EP.02.097

RELIABILITY OF A THREE-DIMENSIONAL EVALUATION OF BIPOLAR BONE DEFECTS IN ANTERIOR GLENO-HUMERAL INSTABILITY

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Background: Three-dimensional (3D) computed tomography (CT) for assessing glenoid and humeral head bone defects has been largely proved. Previous knowledge has been recently called into question. The aim of the present study is to describe a new CT method to quantify bipolar bone defects volume on a virtually generated 3D model and to evaluate its reproducibility.

Methods: A cross-sectional observational study has been conducted. Forty CT scans of both shoulders were randomly selected from a series of exams previously acquired on patients prospectively enlisted for an imaging study on anterior shoulder instability. Inclusion criterion was unilateral anterior shoulder instability with at least one episode of dislocation. CT exams of both shoulders were acquired at the same time following a standardized imaging protocol. The CT data sets were analyzed on a standard desktop PC using the software 3D Slicer (<https://www.slicer.org>). Computer-based reconstruction of the Hill-Sachs and glenoid bone defects were performed through Boolean subtraction of the affected side from the contralateral one, resulting in a virtually generated bone fragment accurately fitting the defects. The volume of the virtual bone fragments was then calculated. All measurements were conducted by two fellowship-trained orthopaedic shoulder surgeons. Inter and intra-observer reliability were calculated. Intraclass Correlation Coefficients (ICCs) were calculated using a two-way random effect model and evaluation of absolute agreement. Confidence intervals (CI) were calculated at 95% confidence level.

Results: The study included 34 males and 6 females. Mean age (+ SD) of patients was 36.7 + 10.10 years (range: 25 - 73 years). A bipolar bone defect was observed in all cases. Reliability of humeral head bone fragment measurements showed excellent intra-observer agreement (ICC: 0.92, CI 95%: 0.85 - 0.96) and very good interobserver agreement (ICC: 0.89, CI 95%: 0.80 - 0.94). Similarly, glenoid bone loss measurement resulted in excellent intra-observer reliability (ICC: 0.92, CI 95%: 0.85 - 0.96) and very good inter-observer agreement (ICC: 0.84, CI 95%: 0.72 - 0.91).

Conclusions: Matching affected and intact contralateral humeral head and glenoid by reconstruction on a computer-based virtual model allows identification of bipolar bone defects and enables quantitative determination of bone loss.

EP.02.098

THREE-DIMENSIONAL MORPHOMETRIC ANALYSIS OF GLENOID AND CORACOID PROCESS IN AN AUSTRALIAN POPULATION

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Background: The Latarjet procedure is an established method in management of recurrent shoulder instability characterised by glenoid bony defects. Literature shows that the best implant choice for coracoid graft fixation depends on patients' morphometric considerations. However, current fixation designs for this procedure have been developed for generic sizes and to the best of our knowledge, there is limited literature reporting on glenoid and coracoid morphometric analysis of the Australian population. The purpose of this study is to assess morphometric measurements of the coracoid and glenoid of an Australian population.

Methods: Bilateral Computed Tomography (CT) scans from forty-two patients eligible for primary stabilisation procedures were selected from our institutional surgical database (mean age 37 ± 10 years, 21 males and 21 females). 3D models of contralateral healthy scapulae were segmented using Mimics 25.0 (Materialise NV, Leuven, Belgium), and 3-matic 17.0 (Materialise NV, Leuven, Belgium) was used to measure glenoid version, inclination, width, height, and coracoid length and prominence. Coracoid width and height were also measured at a quarter of their respective length medially. For each morphometric measurement, sex dimorphism was assessed using an unpaired t-test with a p value lower than 0.05 indicating a statistically significant difference between male and female.

Results: Mean (\pm STD) values for glenoid retroversion were $5.98^\circ \pm 4.52^\circ$, ($6.08^\circ \pm 5.42^\circ$ for male and $5.89^\circ \pm 3.39^\circ$ for female). Mean glenoid inclination was $6.26^\circ \pm 3.84^\circ$, ($6.49^\circ \pm 4.31^\circ$ for male and $6.04^\circ \pm 3.30^\circ$ for females). Mean glenoid width was $26.51\text{mm} \pm 2.84$, ($28.45\text{mm} \pm 1.65$ for male and $24.59\text{mm} \pm 2.45$ for female).

For coracoid measurements, the mean values were $44.29\text{mm} \pm 3.84$ for length, $14.31\text{mm} \pm 1.83$ width, and $10.2\text{mm} \pm 1.67$ for thickness, respectively.

There is a statistically significant difference ($p < 0.05$) between male and female groups for glenoid height and width, and all coracoid measurements. For glenoid version and inclination, we found that there is no statistically significant difference ($p > 0.05$) between the two groups.

Conclusions: This study provides reference values of glenoid and coracoid measurements for an Australian population. Ongoing work of this project aims to include a higher sample size to provide a better understanding of population-based shoulder morphometry that can help guide in development of a more patient specific implants.

EP.02.100

NOVEL TECHNIQUE FOR ARTHROSCOPIC REPAIR OF HILL-SACHS LESION DURING GLENOID RECONSTRUCTION WITH DISTAL TIBIA ALLOGRAFT

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Background: Traumatic anterior shoulder instability includes a wide spectrum of disease. Typically, allograft and autograft-based procedures are reserved for more severe bone loss of glenoid, and those cases with larger amounts of glenoid bone loss are more often associated with off-track bipolar lesions. Since the first description of the use of distal tibia allograft (DTA) for glenoid bone loss by Provencher, et al and later description of arthroscopic technique by Wong, et al, the use of DTA has gained popularity for the treatment of traumatic shoulder instability with significant bone loss. A variety of methods have been described for repair of surgically indicated Hill-Sachs defects including use of a talus allograft which is done in conjunction with a DTA. Here we describe a novel method that utilizes unused bone from a distal tibia allograft in the setting of a DTA glenoid augmentation. The technique uses the medial malleolus which is on the opposite side of the graft from the portion harvested for the glenoid reconstruction and obviates the need for additional allograft such as talus allograft. The medial malleolus allograft (MMA) is a convenient option for reconstruction of a Hill-Sachs lesion and is unused in the glenoid reconstruction.

Methods: A case series of use of this novel technique was prospectively collected.

Results: In this novel technique, intraoperative imaging and video demonstrate the use of the medial malleolus as a space filling allograft to treat Hill-Sachs lesions in patients with glenoid bone loss undergoing glenoid reconstruction with use of distal tibia allograft. Case series of two patients show excellent outcome and incorporation of the distal tibia allograft reconstruction of the glenoid as well as the Hill-Sachs lesion.

Conclusions: The medial malleolus is not utilized when performing distal tibia allograft reconstructions for glenoid bone loss. This structure can be used as an allograft to treat a Hill-Sachs lesion requiring treatment. This is an effective and successful technique and does not require use of additional allograft material such as a talus allograft.

EP.02.101

OPEN REDUCTION AND POSTERIOR BONE BLOCK PROCEDURE WITH POSTERIOR CAPSULORRHAPHY IN CASES OF NEGLECTED POSTERIOR DISLOCATION WITH POSTERIOR GLENOID BONE DEFECT

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Background: Neglected posterior instability is a challenging condition. Soft tissue procedures alone don't always provide satisfactory outcomes. In this study we present the results of open reduction and posterior bone block procedure with posterior capsulorrhaphy in management of such cases

Methods: Inclusion criteria:

Neglected posterior shoulder dislocation with posterior glenoid bone defect more than 15%

Operative Procedure:

Under general anesthesia (in addition to interscalene regional block), the patient is placed in the semi-sitting position. Then, open reduction of the locked posteriorly dislocated head was achieved. Then, Iliac crest posterior bone block procedure with Neer's posterior cruciate capsular repair was performed in 17 cases. The graft was placed opposite the defect (between 7 and 10 o'clock). The graft was secured in place using 2 cancellous 4 mm partially threaded screws. The patient was placed in an immobilizer for 8 weeks in neutral rotation and 20 degrees abduction. Only passive range of motion was allowed in the first 3 weeks. Then active assisted exercises were allowed. After 8 weeks radiographs were performed to assess graft stability. Only after that was progression to gradual strengthening exercises allowed. CT study was performed to all cases 4 months post-operatively to confirm graft union.

Results: After a follow up of a minimum of 4 years, the results were satisfactory with significant improvement in the Rowe, Subjective Shoulder Value and the Walch Duplay Scores. There were 2 cases of re-dislocation, one of which was the result of major motor vehicle accident 3.5 years postoperatively.

Conclusions: In cases of neglected posterior shoulder dislocation with posterior glenoid bony defect, open reduction with posterior Iliac crest bone block and Neer's posterior capsular repair provides satisfactory mid term results

EP.02.102

KNOTTED VERSUS KNOTLESS FIXATION FOR POSTERIOR LABRUM REPAIR; A RETROSPECTIVE SINGLE-CENTER COMPARATIVE STUDY

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Background: Injuries to the superior and anterior labrum occur more frequently, however, posterior labral injuries have become increasingly recognized clinically. Posterior labral tears may result from acute incident, but they are more often related to repetitive microtrauma and capsular contracture. Surgical treatment with arthroscopic labral repair has been successful in restoring stability and function in the absence of glenoid bone loss. Studies have suggested that there are no significant differences in the clinical outcomes or return to play (RTP) of knotted versus knotless anchoring of labrum repair. The purpose of this study is to compare the surgical failure rates, rates for RTP, and range of motion (ROM) between knotted and knotless posterior labral repair.

Methods: Patients were excluded if they did not undergo either a knotted or knotless posterior labral repair. Demographic and surgical data were collected including age, sex, race, laterality, characterization of the labral tear, number of anchors and anchor location. Patient participation in sport, if any, ability to RTP, and operative times were also collected.

Results: Average ages of patients with knotted (n=14) and knotless (n=10) fixation of the posterior labrum repair was 20.7 (\pm 8.0) and 22.7 (\pm 8.2), respectively. There were no significant differences in the number of revisions required or ability to return to play (RTP) following surgery ($p > 0.999$, $p > 0.999$). There were no significant differences in external rotation or abduction ROM preoperatively or 6-, 12-, 24-weeks postoperatively. Knotted fixation of the posterior labrum required a significantly longer operative time than knotless fixation (106 ± 27 vs 79.8 ± 20.0 , respectively, $p = 0.013$).

Conclusions: Patients who underwent knotted vs knotless fixation for posterior labrum instability had no difference in ROM at any of the time points collected. Patients did not show differences in the ability to return to sports. Patients with knotless fixation had less operative time, therefore, less time under anesthesia, and potentially fewer complications. This adds to the current literature comparing knotless and knotted fixation for posterior instability, demonstrating no preference for long-term functionality and RTP. This serves as a baseline to compare other potential outcomes from lower operative times and to determine if this influences patient outcomes.

EP.02.104

ARTHROSCOPIC BONE GRAFTING OF THE HUMERAL HEAD FOR TREATMENT OF A LARGE REVERSE HILL-SACHS LESION, A NEW TECHNIQUE USING TRANSOSSEOUS SUTURE FIXATION.

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Background: Recurrent posterior shoulder dislocation can lead to the presence of a reverse Hill-Sachs lesion. A large reverse Hill-Sachs lesion compromises shoulder stability. This study will report the technical challenge and the outcome of a new technique of arthroscopic bone grafting and transosseous suture fixation of a reverse Hill-Sachs Lesion.

Methods: The procedure includes allograft placement via anterior superior portal and graft suspension fixation using transosseous suture for bone graft compression. The procedure is combined with arthroscopic posterior L-cut inferior capsular shift in treatment of complicated anterior shoulder instability with large Hill Sachs defect. Five cases of recurrent posterior shoulder dislocation were treated between 2019 and 2022 by one surgeon in two centers. There were 5 males with an average age of 23 years. Arthroscopic inferior capsular shift plus arthroscopic bone grafting was done in all cases. We were able to evaluate all 5 cases with an average follow up of 14 months (between one and three years).

Results: The postoperative rehabilitation took 4 months. The range of motion and function in all cases was normal. No symptoms of subluxation or dislocation had occurred in any of cases. The strength compared to the opposite normal side was similar. The x-rays done 3 months after surgery showed filling of the empty bone spaces. According to Neer score all cases were rated excellent.

Conclusions: Conclusions

The clinical and radiographic result strongly encourage using Arthroscopic Bone Grafting for recurrent posterior shoulder dislocation with large reverse Hill-Sachs defect.

EP.02.105

ANTERIOR SHOULDER INSTABILITY WITH EPILEPSY; ARTHROSCOPIC BANKART REPAIR VERSUS LATARJET PROCEDURE

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Background: The purpose of this study was to compare the results of arthroscopic Bankart repair and open Latarjet procedure in epilepsy patients who had anterior shoulder instability and to compare the results of open Latarjet procedure in epilepsy and non-epileptic groups.

Methods: A total of 57 shoulders of 55 patients (18-50 years, 45 males, 10 females) of anterior glenohumeral instability patients were included in the study and average follow-up was 24 months. The average number of dislocations before surgery of all patients was 8.9. Eleven shoulders out of 23 epilepsy patients were treated with Latarjet procedure and 12 with arthroscopic Bankart repair, and 34 non-epileptic patients who treated with Latarjet procedure were compared with each other.

Results: In the epilepsy group, all 12 cases who received Bankart repair were On-track lesion, and all 11 cases who received Latarjet procedure were Off-track lesion. In the non-epilepsy group, all cases were Off-track lesion. In the epilepsy group, there was no significant difference in postoperative clinical outcome and recurrence rate in the Bankart repair and Latarjet procedure groups. Comparing epilepsy and non-epilepsy patients in the Latarjet group, there was a difference in postoperative pFF ($145.0 \pm 20.2^\circ$ vs. $160.4 \pm 14.0^\circ$; $p=0.026$), aER ($60.0 \pm 13.9^\circ$ vs. $73.5 \pm 14.1^\circ$; $p=0.008$), Abd ($121.8 \pm 28.5^\circ$ vs. $143.0 \pm 26.8^\circ$; $p=0.027$) and UCLA function score (6.8 ± 1.7 vs. 8.1 ± 1.8 ; $p=0.039$), but there was no difference in other scores. In non-epilepsy Latarjet procedure group, postoperative re-dislocation rate was 14%, and in Latarjet procedure with epilepsy group, recurrent dislocations occurred in 5 patients (45%), of which 4 occurred during seizures. Relatively, it was 41% in the Bankart repair group

Conclusions: After Latarjet procedure in patients with epilepsy when compared to patients without epilepsy, functional results are similar to those although the rate of re-dislocation is higher. In patients with epilepsy, the rate of re-dislocation due to seizures is high with any treatment. However, considering the high recurrence rate in patients with epilepsy despite the On-track lesion arthroscopic Bankart repair, Latarjet procedure can reduce the recurrence rate.

EP.02.106

AN INVESTIGATION INTO THE RELATIONSHIP BETWEEN UNIDIRECTIONAL SHOULDER INSTABILITY AND GLENOID VERSION

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Background: Glenohumeral instability is a common pathology. There are many aspects of glenoid morphology that have been investigated to assess their contribution to instability.

Glenoid morphology is subject to variation between individuals. Glenoid version is the degree to which the glenoid tilts anteriorly or posteriorly. There are many methods of measuring glenoid version, each method using different reference points from which to measure the degree of version and there are pros and cons to each method. There is a clear association between unidirectional posterior instability and glenoid retroversion. The relationship between unidirectional anterior instability is less poorly understood.

Methods: A retrospective review of the operative notes of all patients that had undergone arthroscopic Bankart repair between January 2017 and May 2022. MRI scans of eligible patients were then analysed and glenoid version was measured using various methods of measurement by a single blinded observer and recorded. Quantitative statistical analysis of the data was performed.

Results: There were 100 patients included in the ASI group, 65 in PSI group and 100 in the control group. The mean glenoid versions for the ASI group were -16 degrees, -9.1 degrees, -9.2 degrees for the vault version, simplified vault version and chondrolabral version respectively. The mean glenoid versions for the PSI group were -21 degrees, -13.4 degrees, -16.6 degrees for the vault version, simplified vault version and chondrolabral version respectively. The mean versions for the control group were -17.8 degrees, -9.5 degrees, -9.8 degrees for the vault version, simplified vault version and chondrolabral version respectively. ANOVA testing and Post Hoc Comparisons were carried out revealing the PSI group to be significantly more retroverted than both other groups. The ASI group's degree of glenoid version was not significantly different to that of the control.

Conclusions: Patients with PSI have a higher degree of retroversion in comparison to those with ASI and control. There is a need for a standardised method of measurement of glenoid version in the literature to facilitate comparison between papers.

EP.02.107

PSYCHOLOGICAL BACKGROUND AFFECTS FUNCTIONAL RECOVERY AFTER SURGICAL TREATMENT OF SHOULDER INSTABILITY

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Background: In the salutogenetic approach, it is assumed that the tendency to recover depends on the amount of resources available to the individual. In the present study, it was hypothesized that the greater the amount of psychological resources, the easier/quicker the recovery after shoulder instability surgery.

Methods: The scores of 22 patients 4 months after shoulder instability surgery were used for the analysis.

A quantitative study of psychological resources was carried out using seven psychological questionnaires covering the thematic areas of psychology most frequently mentioned in the context of health. These were: Framingham Type A Behaviour Pattern Measure, D-Scale, Perceived Stress Scale, The Multidimensional Health Locus of Control Scale, Generalized Self-Efficacy Scale, The Sense of Coherence Scale (SOC-29) and The Multidimensional Scale of Perceived Social Support. Six of them relate to fixed traits, which do not change much under the influence of the experience of the moment.

The psychological test results were correlated with the most common questionnaires measuring patient recovery after shoulder surgery: Constant Score, UCLA, ASES and WOSI.

Results: 4 months after surgery, recovery as examined with the WOSI has the significant correlations with: negative affectivity ($r=-0,52$), currently perceived level of stress ($r=-0,57$), sense of resourcefulness (manageability) ($r=0,61$) and sense of meaningfulness ($r=-0,52$).

The return to activities of daily living measured by the Constant Score is negatively influenced by the currently perceived level of stress ($r=-0,49$) and the tendency to rush and rivalry ($r=-0,51$). The sense of resourcefulness (manageability) on the other hand, has a positive impact on Constant Function ($r=0,46$).

Pain is particularly associated with lack of perceived social support (UCLA Pain $r= 0,49$).

Conclusions: The study finds evidence supporting the association between psychological resources and postoperative outcomes of patients with shoulder instability. Understanding both the effect of emotional and cognitive approach on surgical outcomes and the potential benefits of psychological intervention may represent an opportunity to improve patient outcomes following instability surgery.

EP.02.108

DEVELOPMENT OF THE TAMPA-SCALE OF KINESIOPHOBIA FOR ANTERIOR SHOULDER INSTABILITY: AN EXPERT CONSENSUS STUDY USING A MODIFIED DELPHI TECHNIQUE (TSK-SI)

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Background: This study aimed to assess content validity and when necessary, to modify the Tampa Scale of Kinesiophobia (TSK) to make it suitable for application in Dutch patients with anterior shoulder instability (TSK-SI) using an expert-based consensus Delphi method and patient interviews.

Methods: A four-round Delphi Method was performed to establish expert consensus on the development of the Tampa-Scale of Kinesiophobia for Anterior Shoulder Instability (TSK-SI). The expert group was composed of Dutch shoulder experts, both orthopedic surgeons and physical therapists . During round one, experts were asked to score the 17 items of the original Tampa Scale of Kinesiophobia (TSK) on relevance and construction of the questions using the COSMIN (COnsensus-based Standards for the selection of health Measurement INstruments) checklist. With the expert feedback, questions were reviewed and modified by a working group of four specialists (physician, psychiatrist, psychologist in training and epidemiologist). During round two, experts were asked to score the modified items. This process was repeated until expert consensus was established. After expert consensus was reached, patients were asked to participate in a moderator guided three-step-test interview using an online web-based platform to assess the modified scale. Patients were asked to think out loud and give feedback regarding the questions.. The scale was finally adjusted based on the feedback of these patients.

Results: Thirty shoulder experts across the Netherlands were included, of which 13 orthopedic surgeons, 16 physiotherapist and one physician assistant. Of these 30 experts, 25 completed all four rounds, after which expert consensus was established. One question was added to the modified 17 items based on the expert feedback in round one, establishing the 18 item version of the TSK-SI. Sixteen patients with (a history of) anterior shoulder instability were included. All 16 patients completed the web-based three-step-test interview. After the patient interviews question four (changed to present tense) and question seven (hypothetical component added) were adjusted, resulting in the final TSK-SI.

Conclusions: This expert and patient consensus modification of the TSK to TSK-SI can support assessing fear of movement in patients with anterior shoulder instability. This may assist healthcare professionals during their patient assessment before and after treatment.

EP.02.109

CORTICAL SUTURE-BUTTON FIXATION FOR GLENOID BONE LOSS: A SYSTEMATIC LITERATURE REVIEW

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Background: Suture button fixation of a bone block in patients with anterior instability associated with glenoid bone loss has grown in popularity as an alternative to screw fixation in recent years. The purpose was to systematically review the safety and effectiveness of a commercially available suture-button fixation device in the fixation of bone block for anterior instability associated with glenoid bone loss.

Methods: A systematic review of PubMed and Embase was conducted to identify published English-language studies that reported on the use of a suture-button fixation device (Double Endobutton, Smith+Nephew) for the fixation of bone block in patients with anterior instability. Outcomes of interest included recurrence rate, re-operation rate, patient- or observer-reported outcomes, return to sport, bone healing and complications. Meta-analyses were used to compare these outcomes between techniques.

Results: Fourteen articles were identified which represented 10 independent cohorts (454 independent patients). The recurrence of instability was 3.5% (95% CI, 2 – 5.9) and need for re-operation 0.9% (95% CI, 0.3–2.7). Post-operative Rowe scores and Walch-Duplay scores averaged 91 (95% CI, 87–96) and 90 (95% CI, 86–95), respectively. On average, 82% (95% CI, 69–90) of patients returned to their pre-injury level of sport, and satisfaction ranged from 88 – 100%. Bone healing occurred in 93% (95% CI, 90–96) of patients and no hardware- or shoulder-related nerve complications were reported.

Conclusions: Suture-button fixation demonstrates favorable clinical outcomes without the known risk of hardware and nerve complications associated with screw fixation.

EP.02.110

EVALUATION OF SCREWS POSITIONING IN LATARJET SURGERY: IS THERE A CORRELATION BETWEEN PARALLELISM TO GLENOID AND RADIOGRAPHIC COMPLICATIONS?

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Background: To evaluate whether the parallelism of screws with glenoid in Latarjet surgery interferes in the positioning of the graft and to verify the reproducibility of a method of measuring screws positioning.

Methods: Retrospective, multicenter study, of patients with anterior shoulder instability submitted to modified Latarjet surgery and at least one year of postoperative follow-up. Two radiologists analyzed the postoperative tomographic images, acquired in a database, to evaluate the positioning of screws and radiographic complications.

Results: We evaluated 34 patients, aged between 21 and 60 years, one of them with bilateral shoulder involvement, totaling 35 shoulders evaluated. The tomographic evaluation of the inclination angles of the screws showed no difference between the observers. There was intra- and interobserver agreement to evaluate the following surgical parameters: graft position, presence or not of radiographic complications.

Conclusions: The technique described for measuring the parallelism of screws in Latarjet surgery presented a very good and excellent intra-observer agreement, respectively. Screw parallelism with glenoid is recommended; however, it is not a mandatory and unique condition to avoid radiographic complications.

EP.02.111

ELHERS DANLOS SYNDROME & POSTERIOR GLENOHUMERAL INSTABILITY: IS SURGERY A GOOD OPTION?

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Background: The incidence of posterior glenohumeral dislocations ranges from 2% to 10%. In patients with connective tissue pathology such as Ehlers Danlos disease, posterior instability may be atraumatic and predisposes to posterior capsule injury as a result of generalized laxity.

Although conservative treatment is the initial treatment of choice, there are cases in which surgical treatment is necessary and there is no consensus in the best therapeutic option.

Methods: We present a case of a twenty two year old woman with a history of Ehlers-Danlos type III. Since her childhood she presented more than 20 episodes of atraumatic posterior glenohumeral dislocation.

Physical examination revealed a Beighton classification score of 6/9 with full shoulder range of motion, pain in the back of the shoulder, anterior apprehension and repositioning test (-), posterior drawer (+) and kim test (+)

Radiological test indicated detachment of the posterior labrum from the junction with the cartilage with no retroversion of the glenoid.

Results: After years of conservative treatment and surgical treatment was decided.

Shoulder arthroscopy was performed in which detachment of the middle and lower part of the posterior labrum was observed.

One year after surgery, the patient began to present episodes of posterior glenohumeral dislocation.

Physical examination was similar to initial situation. Radiological tests (RX, arthro-MRI and CT) indicated post-surgical changes in the reinsertion of the posterior inferior labrum with mild chondropathy without retroversion of the glenoid.

A posterior bone block with autograft and fixation with screws and an anterior and posterior capsular plication were performed, obtaining stability of the joint. Clinical and radiological results were satisfactory after one year follow-up.

Conclusions: The management of recurrent posterior shoulder dislocation is a challenge for the surgeon even more if the affected patients present connective tissue pathology.

Stabilization of the joint using soft tissue techniques does not provide sufficient stability and tends to repeat. Performing a posterior bone block using the arthroscopic technique is a minimally invasive technique that allows increasing posterior support. It is a demanding technique which offers a good alternative in this type of patient although long-term follow-up is important to control stability and glenohumeral osteoarthritis.

EP.02.112

UNDERSTANDING OUTCOMES AND RISK FOR PROGRESSION TO SURGERY FOR ANTERIOR SHOULDER INSTABILITY PATIENTS OVER THE AGE OF 50: A STUDY OF 179 PATIENTS WITH A MEAN 11 YEARS FOLLOW UP

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Background: The goals of this study were to i) compare the clinical outcomes of operative and non-operative management, ii) identify risk factors for recurrent instability, and iii) identify risk factors for progression to surgery after failed nonoperative management for patients over 50 years old with first time anterior shoulder dislocations.

Methods: An established geographic medical record system was used to identify patients who experienced ASI after 50. Patient medical records were reviewed to identify treatments and outcomes of interest. Outcomes were evaluated using Chisquare tests and survivorship curves were generated using Kaplan-Meier methods. A Cox model was developed to evaluate for potential risk factors of recurrent instability and progression to surgery.

Results: 179 patients were included with a mean follow-up of 11 years. 14% (n=26) underwent early surgery within 3 months and 86% (n=153) were initially treated nonoperatively. The surgical cohort had an increased rate of full thickness rotator cuff tears (82% vs. 55%, p=0.01), labral tears (24% vs. 8.0%, p=0.01) and humeral head fracture (23% vs. 8.5%, p=0.03). While progression to osteoarthritis (20% vs. 14%, p=0.40) was more common in surgical patients, they experienced decreased recurrent instability after surgical intervention (0% vs. 15%, p=0.03). 14% (n=21) failed initial non-operative treatment and proceeded to surgery at an average of 4.6 years after the initial instability event. The greatest risk factors for progression to surgery was recurrent instability (HR 3.41, p<0.01).

Conclusions: Although the majority of patients > 50 that experience ASI are treated non-operatively, those that require surgery tend to have more significant pathology, a lower risk of recurrent instability after surgery, but a higher progression to osteoarthritis. A history of multiple instability episodes was the greatest predictor of recurrent instability and failure of non-operative treatment.

EP.02.113

GLENOID BONE LOSS AND PATIENT HISTORY INFLUENCES SURGICAL DECISION-MAKING FOR BONY BANKART LESIONS

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Background: Bony Bankart lesions are common in patients with chronic anteroinferior instability. However, an optimal treatment algorithm that guides surgical intervention remains unclear. This study aims to investigate the role that patient history, glenoid bone loss (GBL), and the size of residual glenoid bone fragment (GBF) play in the decision-making of the surgical technique used (arthroscopic Bankart repair versus open Latarjet procedure) in patients affected by anteroinferior glenohumeral instability with bony Bankart lesions.

Methods: A retrospective review was conducted of patients with bony Bankart lesions who underwent surgical intervention for anteroinferior glenohumeral instability. Patient cohort was divided in three independent groups defined by the percentage of GBL and GBF as group A (GBL < 10% and GBF < 10%); group B (GBL > 10% and GBF < 10%); and group C (GBL > 10%, GBF > 10%). Patient history variables, Western Ontario Shoulder Index (WOSI) score, the location of Hill-Sachs lesion (HSL) as central or peripheral, and HSL track (ON-/OFF-track) were comparatively investigated.

Results: 298 patients with a mean age of 26.7 (range, 17- 46 years) (239 males, 59 females) were included in the final analysis (258 arthroscopic Bankart, 40 Latarjet). The mean follow-up among both groups was 41.5 months (range 36-50 months). Patients with GBL < 10% were primarily treated with an arthroscopic repair; in cases with GBL > 10%, an arthroscopic procedure was performed primarily when GBF was > 10%. The Latarjet procedure was performed when GBF was < 10% and GBL > 10%; these were associated with the longest time elapsed since the dislocation episode and a higher number of preoperative dislocations. Among patients treated with arthroscopic Bankart repair, patients with worse WOSI scores had a significantly greater number of peripherally located HSLs ($p < .001$).

Conclusions: The factors that drove intervention with Latarjet versus arthroscopic Bankart repair included the amount of preoperative GBL and bone fragment size, both with a threshold of 10%, time elapsed since dislocation event, and number of preoperative dislocations. Although peripherally located HSLs were associated with worse postoperative WOSI scores in patients treated with arthroscopic Bankart repair, HSL location or track did not influence surgical treatment decisions.

EP.02.114

SHOULDER INSTABILITY RECURRENCE AFTER BANKART REPAIR AND REMPLISSAGE

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Background: Shoulder instability is a common problem in our community and due to its complexity there are so many questions about the recurrence after the arthroscopic stabilization. Studies had reported high rates of recurrence after only bankart repair, especially in patients with high functional demands. Arthroscopic bankart repair is a well established technique for the treatment of shoulder instability. Failure rates are considerable high when significant bony defects are not addressed. For those with an off-track and engaging hill-sachs lesion, remplissage can be used in conjunction with arthroscopic bankart repair to reduce the rates of recurrence. Results of arthroscopic remplissage have so far been promising with good functional outcomes and low recurrent instability when used for correct indications. However, there is concern that this procedure can limit range of motion, particularly in external rotation, in our study, we present the tripod-pulley technique, which we feel that increases the surface contact area and decreases the infraspinatus damage. Our hypothesis is that patients who undergo bankart repair and remplissage will decrease shoulder instability recurrence and will not be a significant loss of strength or external rotation.

Methods: A total of 14 patients from 2018 to 2022 at a single institution in a prospective study with shoulder instability underwent arthroscopic bankart repair with tripod-pulley remplissage. Strength and ROM were assessed 6 months and 1 year after surgery with ASES and Rowe scales. 10 males, 4 females, mean age 27

Results: At 1 year, there were no patients with anterior apprehension on physical examination, so far with our small series with this technique, we have not detected a significant loss of external rotation. And there were no shoulder dislocations recurrence. No statistical difference was found between all the 14 patients in terms of ASES and Rowe scales.

Conclusions: The present study has found strong evidence that bankart repair and tripod-pulley remplissage leads to excellent results in terms of clinical scores and a decrease of recurrence in the short term. The addition of remplissage procedure is an excellent surgical option to treat hill-sachs deformity with large defects.

EP.02.115

ANALYSIS OF BIPOLAR BONE DEFECTS PATTERN IN ANTERIOR SHOULDER INSTABILITY

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Background: The predictive value of the "on-track/off-track" concept has been recently called into question by the introduction of a new threshold between peripheral and central on-track lesions: the so-called "Hill-Sachs interval to glenoid track width ratio" (H/G ratio). The aim of the present study was to analyze which pattern of bipolar lesion increases the risk of recurrent anterior gleno-humeral instability after arthroscopic Bankart repair.

Methods: A retrospective study was conducted. Patients affected by recurrent anterior gleno-humeral instability who underwent arthroscopic Bankart repair with a minimum of 12 months follow-up were included. A preoperative computed tomography (CT) scan was performed in all patients. Only patients with on-track bipolar defects were included. Subsequently, three-dimensional computer-based reconstruction of the Hill-Sachs and glenoid bone defect were performed using a dedicated software in order to obtain the H/G ratio following the formula: Hill Sachs interval/glenoid track width. Included patients were then divided into two groups according to the H/G ratio: group 1, patients with H/G ratio < 0.7; group 2, patients with H/G ratio > 0.7. The primary outcome was recurrent instability after surgery. Secondary outcomes were: Quick-DASH, ASES and WOSI score. Comparison between groups was performed by use of chi-square test for categorical variables and unpaired t-test for discrete variables. Significance was set at $p < 0.5$.

Results: The study included 36 males and 4 females. Mean age (+ SD) of patients was 25.7 ± 7.6 years. Each group was composed of 20 patients. Mean follow-up in group 1 was 54.6 ± 30.68 ; while mean follow up in group 2 was 51 ± 34.65 . Comparison between groups did not show significant differences nor for baseline characteristics, neither at follow-up. Two recurrent instabilities occurred in group 2 (H/G ratio > 0.7) ($p < 0.147$).

Conclusions: Although two recurrent instabilities occurred only in group two, no significant differences could be found between central and peripheral track lesions.

EP.02.116

CLINICAL EVALUATIONS OF ARTHROSCOPIC REPAIR BY USING U-HA/PLLA PINS OF GLENOID FRACTURES

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Background: Ideberg type 1a glenoid fracture is a rare intra-articular fracture. However, there are some cases of the inverted bone fragment in Type 1a. Glenoid fractures will affect the stability of the shoulder joint, resulting in subluxation or dislocation of the glenohumeral joint. The reduction and internal fixation are significant for the restoration of shoulder joint function. Arthroscopic fixation is minimally invasive. However, in the case of the inverted bone fragment, it is impossible to fix with anchors because it protrudes into the articular surface. A resorbable pin might be useful to fix the inverted or large bone fragment. The purpose of this study was to evaluate the clinical results of glenoid fracture of the scapula with Ideberg type 1a treated arthroscopic surgery by using unfired-hydroxyapatite/poly-L-lactic acid (u-HA/PLLA) pins.

Methods: The patients who underwent arthroscopic repair using u-HA/PLLA pins with completed follow-up were included. Clinical evaluations were active ROM, Constant score, and bone union by CT. Arthroscopic surgery was performed. First, reposition displaced bone fragments. Second, fix the bone fragment with u-HA/PLLA pins from the anterior portal or 5 o'clock portal. Third, suture under the bone fragment ant through the labrum by anchors.

Results: All cases had a bone union. Constant score and active ROM in forward flexion, abduction, external rotation, and internal rotation were significantly improved compared to preoperatively.

Conclusions: Glenoid fractures with inverted bone fragments were difficult to repair with anchors. They were firmly fixed using u-HA/PLLA.

Arthroscopic fixation using u-HA/PLLA pins was an effective treatment in cases of large fragments or translocated fragments and achieved good clinical results.

EP.02.117

THE HUMERAL HEAD IS POSITIONED MORE ANTERIORLY RELATIVE TO THE GLENOID IN THE NEUTRAL CT POSITION FOLLOWING TRAUMATIC ANTERIOR SHOULDER DISLOCATIONS

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Background: A reliable measurement of the position of the humeral head relative to the glenoid could serve as a derivative for shoulder stability. Therefore, the aim of this study was to compare position of the humeral head relative to the glenoid, humeral translation and joint space thickness during passive motion between instable shoulders due to traumatic anterior dislocations and contralateral uninjured shoulders in a standardized setting.

Methods: A prospective cross-sectional pilot 3D-CT study was performed and included patients between 18 and 50 years old with unilateral instability. Patients were scanned on both the injured and uninjured side in neutral position (0° abduction and 0° exorotation) and in 60°, 90° and 120° of abduction with 90° of exorotation. Subsequently, 3D polygons were created of the humerus and the scapula and a glenoid coordinate system was defined with poster-anterior, inferior-superior and lateral-medial directions. Humeral translation was defined as position of the humeral head within the glenoid coordinate system in the neutral position relative to the 60°, 90° and 120° of abduction positions. Humeral position and translation and joint space thickness were compared between injured and uninjured shoulders.

Results: Fifteen consecutive patients were included. The humeral head was positioned more anteriorly (1.58mm vs -0.05mm; $p=0.002$), inferiorly (-0.63mm vs 0.04mm; $p=0.027$) and laterally (25.87mm vs 24.99mm; $p=0.020$) in the injured compared to the uninjured shoulder in the neutral position. No differences could be observed in any of the other positions. Furthermore, the injured shoulder demonstrated more posterior translation in 90° ($p=0.012$) and 120° ($p=0.019$) of abduction and more superior translation in 60° of abduction ($p=0.002$). No differences could be observed in the other positions. There was no difference in mean joint space thickness between the injured and uninjured shoulders in the neutral position ($5.02\pm 0.6\text{mm}$ vs 5.38 ± 0.33 ; $p=0.077$) or other positions ($5.11\pm 0.58\text{mm}$ vs $4.89\pm 0.49\text{mm}$; $p=0.076$).

Conclusions: The humeral head was positioned more anteriorly relative to the glenoid in the neutral position following traumatic anterior shoulder dislocations. This difference seemed to be lifted when the shoulder was moved to passive exorotation and abduction. Future studies should determine if the difference in position is associated with a higher risk of recurrence.

EP.02.118

ARTHROSCOPIC LABROCAPSULAR REPAIR AND HILL SACHS REMPLISSAGE FOR RECURRENT ANTERIOR SHOULDER INSTABILITY OUTCOMES, RELATIONSHIP TO ISIS SCORE AND PREDICTORS OF RANGE OF MOTION DEFICITS

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Background: Remplissage has been proposed as a treatment option for large, off-track or engaging Hill Sachs lesion (HS) in the presence of recurrent anterior shoulder instability. However, a possible limitation relates to limited external rotation (ER). Purposes of the study were to: 1) evaluate clinical outcomes after arthroscopic labrocapsular repair (LR) and Hill-Sachs remplissage (HSR), 2) test relationship to preoperative ISIS score, and 3) determine whether independent risk factors exist which affect ROM deficits postoperatively.

Methods: Fifty-one patients with recurrent anterior shoulder instability (mean age 27; SD 7.1; 84% male) underwent arthroscopic LR with HSR. Recurrent instability, clinical scores (Rowe, ASES, WOSI, OSS, and OSIS), and range of motion (ROM) were retrospectively assessed at mean follow-up 34 months (SD 14; range 14-70). Separate ANOVA tests were performed for ASES, WOSI, OSS, and OSIS with time (pre/post surgery) as the within group factor and preoperative ISIS score group (0-3=group 1, 4-6=group 2, greater than 7=group 3) as the between group factor. Predictors of postoperative stiffness were assessed with multivariable regression model. The α level was set a priori at 0.05.

Results: There were significant improvements for all outcome variables after surgery ($p < 0.001$). There were no effects of ISIS score group ($p = 0.287, 0.913, 0.146, 0.864$) or of the interaction of group*time ($p = 0.160, 0.636, 0.300, 0.606$) for ASES, WOSI, OSS, OSIS, respectively. Mean (SD, range) ROM deficits were: ER1(0° abduction), 4.9° (5.2, 0-20); ER2 (90° abduction), 5° (4.5, 0-20); IR, 0.46 vertebral levels (0.9, 0-4).

The model for ER1 deficit explained only 11.3% of the variability ($p = 0.026, b = -4.6$ and 4.3 , for labrocapsular detachment at articular level of glenoid (A) and professional overhead athletes respectively) while for the ER2 deficit model the best predictor was labrocapsular detachment (C) which explained 10.5% of the variability ($p = 0.042, b = 3.37$).

Conclusions: A careful selection of candidates for arthroscopic labrocapsular repair with Hill-Sachs remplissage results in successful outcome for patients with recurrent anterior instability and an engaging (off track) Hill-Sachs lesion without significant anterior glenoid bone loss (>20%), regardless of ISIS score groups. ER deficits were identified, particularly in patients with labrocapsular detachment medialized to glenoid and healed, particularly among professional overhead athletes.

EP.02.119

DEFINING AND PREDICTING THE "OPTIMAL OBSERVED OUTCOME" FOLLOWING SURGICAL TREATMENT OF ANTERIOR SHOULDER INSTABILITY: A MACHINE LEARNING CLUSTERING ANALYSIS OF 200 PATIENTS WITH 11-YEAR MEAN FOLLOW UP

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Background: Although desirable outcomes following surgery for anterior shoulder instability (ASI) include a multitude of functional and clinical functions, it is unclear if all of these idealized outcomes are simultaneously achievable or if some may be mutually exclusive (i.e. can patients have full motion and no instability or does excellent stability more commonly occur with some stiffness?). The purpose of this study is to employ unsupervised machine learning techniques to define the actual observed 'optimal observed outcome for patients undergoing surgical treatment for ASI and to identify predictors of obtaining this optimal outcome.

Methods: Patients <40 years of age with initial diagnosis of ASI between 1994 and 2016 were included. Four unsupervised machine learning clustering algorithms were evaluated to partition subjects into 'optimal observed outcome' or 'suboptimal outcome' based on combinations of outcomes actually observed (not just those that are desired). Demographic, clinical, and treatment variables were compared between these groups using descriptive statistics and Kaplan-Meier survival curves. Variables were assessed for prognostic value through a multivariate stepwise logistic regression.

Results: 200 patients with a mean follow-up of 11 years were included. 146 (64%) obtained the 'optimal observed outcome', characterized by significantly ($P < 0.001$) lower rates of: recurrent postoperative pain (23% vs 52%), recurrent instability (12% vs 41%), revision surgery (10% vs 24%), progression to osteoarthritis (OA) (5% vs. 19%), and preserved motion. Stepwise multivariate logistic regression identified increased time from initial instability to presentation (OR: 0.96) and habitual instability (OR: 0.17) as negative predictors of 'optimal outcome.' Type of surgery performed was not a significant predictor.

Conclusions: Following surgical treatment for ASI, an appropriate 'optimal observed outcome' can be defined as: minimal postoperative pain, absence of recurrent instability, low rates of revision surgery, absence of OA, and increased ROM, and this can be achieved in approximately two-thirds of patients. The most significant predictors of achieving the 'optimal observed outcome' included shorter time to presentation and a predilection towards subluxations rather than frank dislocations pre-operatively. While we should all still strive to achieve a 'perfect outcome,' this 'optimal observed outcome' would be more appropriate for setting expectations.

EP.02.120

TRENDS AND PROJECTIONS IN SURGICAL STABILIZATION OF GLENOHUMERAL INSTABILITY IN THE UNITED STATES FROM 2009 TO 2030: RISE OF THE LATARJET AND FALL OF THE OPEN BANKART

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Background: Advances in surgical techniques have improved the ability to address recurrent glenohumeral instability via arthroscopic capsulolabral repair and bone restoring procedures such as Latarjet. Given the paucity of studies analyzing temporal trends in surgical management of glenohumeral instability, the purpose of this study was to assess trends in treatment of anterior, posterior, and multidirectional instability over a 10-year period and model projections to 2030.

Methods: Using IBM Watson MarketScan national database, all patients that underwent glenohumeral instability procedures from 2009 to 2018 were identified. These included open Bankart Repair, Latarjet, anterior bone block, posterior bone block, multidirectional capsular shift, and arthroscopic Bankart procedures. Sample weights were utilized to calculate national estimates. The United States (U.S.) Census Bureau annual population data were utilized for calculating incidence. Future projections to 2030 were modeled using Poisson and linear regression.

Results: 446,072 glenohumeral instability cases were identified from 2009-2018. Incidence (per 100,000) remained constant, from 14.8 in 2009 to 14.5 in 2018. Arthroscopic Bankart comprised the highest number of procedures throughout the study period, accounting for 89% of all procedures in 2009 and 93% in 2018. Open Bankart procedures decreased by 65% from 2009 to 2018, while there was a 250% increase in Latarjet procedures over the same period. Patient demographics did not change over the study period, and males aged 18-25 comprised the largest demographic group undergoing anterior instability procedures. Multidirectional instability procedures exhibited the least pronounced gender differences. Future modeling from 2018-2030 projected continued steady rise in arthroscopic Bankart (40,000-49,000 case/yr), rapid growth in Latarjet (1370-4300 cases/yr), and continued decline in open Bankart (1000-250 cases/yr) procedures.

Conclusions: Arthroscopic Bankart continues to be the most common glenohumeral instability procedure in the U.S. From 2009 to 2018, incidence of open Bankart procedures declined while Latarjet procedures markedly increased. Future projections to 2030 mirrored these findings. These data may provide an enhanced understanding of the evolution of surgical treatment of glenohumeral instability within the U.S. laying the foundation for continued prospective studies into the appropriate indications and advancements in surgical techniques.

EP.02.121

ARTHROSCOPIC TRILLAT TO TREAT ANTERIOR GLENOHUMERAL INSTABILITY IN PATIENTS WITH IRREPARABLE POSTERIOR SUPERIOR ROTATOR CUFF TEAR. CLINICAL AND RADIOGRAFIC RESULTS

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Background: The Trillat procedure is a closed-wedge osteotomy to lower and medialize the coracoid process to treat anterior shoulder instability; in this procedure, the coracoid process is fixed with a nail or screw. The aim of the study was to evaluate the clinical and radiographic results in patients with recurrent anterior instability with irreparable rupture of the postero-superior cuff undergoing arthroscopic Trillat using 1 Bicortical Roud-Button.

Methods: Patients undergoing arthroscopic TRILLAT surgery were recruited from 2020-2022. The pre-op evaluation included a clinical evaluation, ROM apprehension test and a radiological evaluation with CT scan, MRI. The surgical technique used was that described by Prof. Boileau.. with the use of 1 bicortical Round-button for the fixation of the coracoid. Post-operative evaluation included a post-operative CAT scan, Clinical follow-up included a clinical evaluation, ROM apprehension test, and a CT scan beyond 6 months to evaluate coracoid union. The scores used were the SSV and constant.

Results: From 2020 to 2022, 6 patients with recurrent anterior instability with irreparable posterosuperior cuff tears were operated on with this arthroscopic procedure. The median age was 52 years (IQR 42-60). Follow-up was 12 months (IQR 12-18). The surgical time was 60 min. Statistically improvement. Significant Constant and SSV with preserved ROM in all patients. Negatization of the apprehension test was observed in all patients. No infections and no hardware complications related.

Conclusions: Arthroscopic Trillat stabilizes the shoulder in patients with irreparable tears of the posterosuperior cuff. Suture button fixation achieves healing of the coracoid and avoids the complications previously reported with screw fixation.

EP.02.122

AN AMAZING FORM OF SHOULDER IRREDUCIBILITY

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Background: Anterior shoulder dislocation is common and can be associated with glenoid and humeral fractures but is usually easily reducible. Otherwise the soft tissues may be the cause of irreducibility. In that case the subscapularis tendon is one possible cause. Even less common is the way described in this work in which the subscapularis tendon did not allow reduction because it involved the humeral head - boutonnière like lesion.

Methods: The describe the case of a 64-year-old patient, seen at the emergency department after a fall from his own height, with a diagnosis of an irreducible fracture dislocation of the left shoulder.

Results: A first attempt with closed reduction with manipulation failed. A second attempt with closed reduction under general anesthesia failed. In the third attempt, by deltopectoral approach, it was immediately verified the interposition of the long head of the biceps tendon (LHB) and rupture of the transverse ligament. A tenotomy of the LHB was performed but maintaining the impossibility of reducing it remained. After more careful exploration, the found that the humeral head was surrounded by the subscapularis tendon, almost like a collar, with the insertion in the lesser tuberosity. The reduction maneuver was achieved using the fingers as a lever. Finally, it was possible to observe a longitudinal rupture of the subscapularis tendon, performing its reinsertion, tenodesis of the LHB and reinsertion of the greater tuberosity. The joint remained stable, without complications or neurovascular injury.

Conclusions: Fazer depois

EP.02.123

ALL-ARTHROSCOPIC RECONSTRUCTION OF MALUNITED ANTEROINFERIOR GLENOID RIM FRACTURES

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Background: A medially displaced Glenoid fracture fragment malunited to the glenoid rim is described by Bigliani as Type II Glenoid fracture. Many arthroscopic procedures for the treatment of glenoid rim fractures have been described in recent years, including fixation with screws, transglenoid suture fixation, suture anchor fixation, and double-row bony Bankart bridge fixation. To our knowledge no all arthroscopic treatment of Bigliani Type II malunited Glenoid rim fracture has been described. The aim of this paper is to describe an all-arthroscopic approach to release, reduce and reconstruct the fragment with transosseous suture fixation when the width of the fragment is more than 1 cm. It was done in five cases of recurrent anterior shoulder dislocation with type II Bigliani Glenoid fracture.

Methods: After release of the fragment with an arthroscopy osteotome, the fragment is mobilized and reduced to its anatomical position, then with the help of a guide and a penetrating suture wire, the fragment is fixed to its anatomical position after abrading the two surfaces to get a bleeding site. After fixation an arthroscopic L-cut inferior capsular shift is done to treat the anterior capsular redundancy. All cases were immobilized for 3 weeks followed by partial immobilization for another three weeks. Then 3 to 4 months rehabilitation. Five males with an average age of 26 years were treated with an average follow up of 17 months. All cases had recurrent anterior dislocation after a trauma with anterior glenoid rim malunited fracture.

Results: All patients were able to normally use the arm in all daily activity and 3 of the m were able to practice high-performance sport. No complication was noticed. All cases had a good radiological healing.

Conclusions: It is a safe procedure avoiding complications of use of potentially harmful hardware such as screws and in cases of failure or recurrence, a less-difficult revision surgery is needed. Advanced arthroscopic skills are required.

EP.02.124

POSITIONING OF SCAPULA AND CLAVICLE IN ACUTE ACROMIOCLAVICULAR JOINT DISLOCATIONS: DEPRESSED SCAPULA OR ELEVATED DISTAL CLAVICLE?

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Background: Increased coracoclavicular distance (CCD) due to acute acromioclavicular joint (ACJ) instability is often described as a pseudo-elevation of the clavicle due to inferior hanging of the scapula, while the distal clavicle remains in its position. The aim of this study was to analyze whether the elevation of the distal clavicle, depression of the scapula or both are associated with vertical instability and to evaluate the impact of weighted stress radiographs on the clavicle and scapular position in acute ACJ instabilities.

Methods: The cohort consisted of 505 patients (f=52, m=453; mean age 46 years) which presented to our emergency department or outpatient clinic from 2006 to 2019 displaying an acute ACJ injury. The panorama views that displayed at least two vertebrae with visible spinous processes were evaluated. Two raters assessed the views twice regarding the clavicular and coracoidal angle of both sides in relation to the spine and the difference in height of both clavicles and coracoids.

Results: In our cohort, five types of displacement were distinguished: Type A, only clavicle is elevated (N=46); B, only scapula depressed (N=36); C, the clavicle elevated and the scapula depressed (N=67); D, both depressed (N=133); E, both elevated (N=223). 123 patients had non-weighted radiographs and 353 patients stress views with 10 kg of axial load, whereas 29 patients had both radiological modalities. Among these 29 patients, a significant increase in CCD difference, clavicle and scapula height ($p < .05$, respectively) was observed, when non-weighted radiographs were compared with weighted. A total of 13 shifts could be observed during the Rockwood type comparison of non-weighted radiographs with the weighted: Six from Rockwood type II to III, two from type III to V and five from type V to type III.

Conclusions: Acute injury to the ACJ does not exclusively lead to a depression of the scapula or an elevated distal clavicle, but rather leads to various vertical displacement combinations, however mostly to the elevation of both structures possibly due to muscle spasm and pain. Comparing both radiological modalities of same patients, the routine use of weighted views should be questioned, since often a shift of Rockwood stage can be observed.

EP.02.125

LONG TERM OUTCOMES OF THE CONGRUENT ARC LATARJET PROCEDURE EVALUATION OF 96 PATIENTS WITH A MINIMUM FOLLOW UP OF 10 YEARS

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Background: Purpose: The objective of the following study was to evaluate the functional outcomes, complications and revisions of a consecutive series of athletes with recurrent glenohumeral instability treated with the Congruent Arch Latarjet procedure with a minimum follow-up of 10 years.

Methods: Between June 2008 and April 2012, 106 athletes with recurrent glenohumeral instability were treated with the congruent arc Latarjet procedure. In total, 63 revision procedures and 43 primary procedures were included. We evaluated Return to sport and used the ROWE, EVA, ASOSS and SANE scores to assess functional outcomes. Complications and revisions were evaluated. Graft consolidation was evaluated with CT at 3 months. Osteoarthritis was evaluated at the final follow-up with radiographs

Results: The final analysis included 90 patients (Follow-up 91%). The average follow-up was 140 months (120-158 months) and the average age at the time of surgery was 23.2 years (range 17-35 years). Overall, 94% of patients returned to sports and 90% returned to the same level as before surgery. At the last follow-up, 40% of the patients had changed sports or abandoned sports. No patient reported having left the sport for reasons related to the shoulder. The two main causes of abandonment referred to were labor demand (50%) and studies (30%). The mean Rowe, VAS, and ASES scores at 140-month follow-up were 85, 1.5, and 80, respectively, all improved significantly compared to the preoperative ($P < .01$). The average SANE score was 85%. Moreover, 94% and 96% of the patients had a Rowe and ASES score that exceeded the MCID, respectively. The bone graft consolidated in 90% of the patients. The recurrence rate was 5.5% and the revision rate was 3%. At the end of follow-up, 20% of the patients had osteoarthritic changes.

Conclusions: The Congruent arc Latarjet procedure is associated with a high percentage of return to sport, excellent functional outcomes and a low rate of recurrences after a minimum follow-up of 10 years. Although 20% of patients had osteoarthritic changes at the end of follow-up, most were mild and moderate, without significant differences in functional scores between patients who presented arthritic changes and those who did not.

EP.02.126

ARTHROSCOPIC SCREW REMOVAL AFTER ANTERIOR BONE BLOCK SURGERY FOR SHOULDER ANTERIOR INSTABILITY: TECHNIQUE AND OUTCOMES

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Background: In patients with anterior instability that need an anterior bone block procedure, fixation with screws is frequent, open techniques for screw removal in screw related complications have been described and is the standard of treatment. Performing arthroscopic screw removal is an option.

Methods: This was a retrospective study of consecutive patients who underwent arthroscopic screw removal after anterior bone block surgery for shoulder anterior instability at a single institution (2007–2022). A arthroscopic screw removal technique was described associated with related procedures depending on the diagnosis of the patient. The primary outcome was assessment of complications (intraoperative). The secondary outcome was clinical outcomes. The mean follow-up was 45.7 months (6-137 months).

Results: Forty-four patients with a mean age of 30.3 years at time of surgery were analyzed. The 44 patients present associated related pain, 59% (26) have anterior instability recurrence, and 41% (18) have no anterior instability recurrence. The time between primary and revision surgery was 2.3 years (12-246 months). Screw related complications previous to the surgery were present in 32.4% (12) of the cases, mainly: screw migration (18.9%), humeral head lesions (5.4%), fracture of the screw (5.4%) and long screw that protrudes (2.7%). There were 64 screws removed and 11% (4) of fracture of the screw during removal, no neurologic or vascular lesions were identified. Associated procedures during the removal were described in all the patients mainly anterior bankart repair (100%) because this is part of the removal technique. The mean clinical follow up was 45.7 months (6-137 months) with a mean SSV 78.5% (35-100), VAS 2 (0-6) and good range of movement outcomes.

Conclusions: Arthroscopic Screw Removal is an option for screw removal in patients with previous anterior bone block surgery that present anterior pain with and without recurrent anterior instability, it provides an option for screw removal and treatment with associated procedures if needed.

EP.02.127

LATARJET PROCEDURE IN FEMALE PATIENTS: DOES IT CHANGE SOMETHING?

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Background: Latarjet procedure is a common procedure to treat anterior shoulder instability associated with glenoid bone loss. It has been reported that female gender was a risk factor of postoperative adverse events. Therefore, the purpose of this study was to evaluate clinical and radiographic outcomes of Latarjet in a specific female patient population with a minimum follow-up of 2 years.

Methods: In a retrospective study, we included 23 female patients (mean age 33 years) treated with Latarjet from 2014 to 2019, arthroscopically with cortical-button (n=9) or open with screws (n=14). Six had a previous arthroscopic Bankart repair that failed with recurrent instability. Hyperlaxity was present in 8 (35%). Preoperatively, the mean glenoid bone defect was 15.6% and an engaging Hill-Sachs was identified in 70%. Patients were reviewed to assess clinical outcomes using Subjective Shoulder Value (SSV), Rowe and Duplay score. A radiological analysis was performed on A/P and Bernageau view.

Results: At mean follow-up of 48 months, the mean SSV was 86.9 %, Rowe 89.5 points and Duplay 90 points. One (4%) patient experienced a recurrence of instability following a high energy trauma. Four (17%) complained of anterior shoulder pain in open group (comparing to 0% arthroscopic group; p=0.07) that required screw removal in one. Two (8%) bone block were non-united at follow-up without any clinical consequences. Of the 19 patients who practiced sport prior to surgery, 14 (61%) were able to return at the same level or higher.

Conclusions: Female patients with anterior shoulder instability treated with Latarjet, either open or arthroscopically, have very low recurrence rate, with satisfactory clinical outcomes. Anterior shoulder pain seems to be more frequent than previously reported, and would be a screw related complication.

EP.02.129

ARTHROSCOPIC CAPSULOLABRAL REPAIR FOR POSTERIOR SHOULDER INSTABILITY WITH SUTURE ANCHORS USING A BEACH CHAIR APPROACH

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Background: Posterior shoulder instability is a relatively rare cause of recurrent instability with its incidence at 2 to 10%. It is often associated with a posterior capsulolabral tear for which Arthroscopic repair has shown good outcome. In terms of approach, there is a lack of consensus among surgeons regarding the most optimal position to perform the Arthroscopy with earlier studies favoring the use of the Lateral Decubitus (LD) over the Beach Chair (BC) position. This study is a mini-case series describing a surgical technique using the BC position in Arthroscopic posterior capsulolabral reconstruction. The of this study hypothesize that the use of the BC position is adequate in Arthroscopic posterior capsulolabral reconstruction so long as the surgeon is cognizant of its limitations.

Methods: A retrospective analysis of prospectively collected data was performed for 9 shoulders with posterior capsulolabral injury in 8 patients, who underwent an Arthroscopic posterior capsulolabral reconstruction using the BC position by a fellowship trained shoulder Orthopaedic surgeon at a tertiary hospital. They were prospectively followed up for two years and assessed preoperatively and at 2 years postoperatively for range of motion (ROM), isometric strength and various outcome measures. These included the Constant Shoulder Score (CSS), UCLA Shoulder Score (UCLASS), Oxford Shoulder Score (OSS), and visual analogue scale (VAS) for pain assessment.

Results: All patients were male, and the mean age was 25.1 (Range 20 -33). 4 out of 9 (44.4%) patients suffered a traumatic event and the mechanism of injury varied among these patients. All patients had a posterior labral tear with 7 out of 9 having concomitant capsular laxity. There was significant improvement in UCLA scores (18.4 vs 29.8) ($P=0.001$), Oxford Shoulder Score (37.8 vs 16.1) ($P<0.001$) and VAS score (3.9 vs 1.3) ($P=0.017$) at 2 years postoperatively. There was no significant improvement in Range of motion (Forward flexion and abduction), Isometric strength and Constant Shoulder Scores.

Conclusions: The of this study hypothesize that the use of the BC position is adequate in posterior capsulolabral reconstruction so long as the surgeon is familiar and comfortable with the technique.

EP.02.130

ARTHROSCOPIC LатарJET PROCEDURE, AN UPDATE

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Background: The Latarjet procedure is a reliable operation to restore shoulder stability in patients with (recurrent) anterior shoulder dislocations. This procedure is indicated for patients at high risk of failure after common soft tissue repairs as typically evaluated by the ISIS score. Furthermore, in the presence of relevant bone defects on the humeral and/or glenoid side, certain concomitant soft tissue lesions as well as in revision procedures patients benefit from the Latarjet procedure. The arthroscopic Latarjet combines the success rates of this operation with the advantages of minimally invasive interventions such as better visualization of the defect site, the treatment of concomitant pathologies and the reduction of peri- or postoperative complications. The original technique described in 2007 has undergone several modifications since its first publication. Therefore, it was the purpose of this study to give an update of this technique and to point out important pearls and pitfalls to consider when applying this technique.

Methods: Since 2010, based on the original arthroscopic surgical procedure, we have improved several points that we consider essential to optimize the surgical procedure of shoulder stabilization by bone block with 2 screws.

Results: In this surgical update, we describe the modifications to the arthroscopic portals, the various tips to be aware of and the possible complications that may arise, in order to enable the surgeon to perform a reliable and reproducible technique.

Conclusions: In conclusion, even if this technique should be limited to surgeons with sufficient experience and the indications should be adapted to the functional needs of the patients, the arthroscopic Latarjet technique is a reliable, reproducible technique, not inferior to the open technique and which can be learned step by step by respecting the learning steps.

EP.02.131

ASTANDARDIZEDASSESSMENTOFPREVALENCE, LOCATIONANDPOTENTIALPREDICTIVEFACTORS FOR LESIONS ASSOCIATED WITH ANTERIOR SHOULDER INSTABILITY: A CASE-CONTROL STUDY

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Background: There is a high variety in prevalence reporting of lesions associated with shoulder instability in the literature. In addition, there is little evidence available regarding the prevalence of lesions in specific patient groups.

Methods: This retrospective case-control study included patients aged 16 years or older with a first-time or recurrent anterior shoulder dislocation or subluxation evaluated with >1.5T MR arthrography at the OLVG hospital between January 1st 2010 and December 31st 2021. Baseline characteristics and outcomes were collected through a questionnaire, from medical files and through re-evaluation of MRAs by an experienced musculoskeletal radiologist. Outcomes included the location and extent of bone and soft tissue lesions. Univariable analysis was used to identify factors that differed between patients with (cases) and without (controls) a specific lesion and logistic regression to determine associations.

Results: In total, 151 shoulders were included. The most prevalent labrum lesions were the ALPSA (34.0%;n=52), Bankart (30.5%;n=46) and Perthes lesions (27.2%;n=41). The most prevalent bony lesions were the Hill-Sachs (74.8%;n=113) lesion and glenoid bone loss (43.1%;n=65). Labrum lesions or their extensions were found in the anterior quadrant of 74.8% (n=113) of glenoids, the inferior quadrant of 76.2% (n=115), the posterior quadrant of 27.8% (n=42) and the superior quadrant of 36.4% (n=55). All glenoid lesions (n=66) were located anteriorly and 89.4% (n=59) extended inferiorly. Strong positive associations were found for being male with the presence of glenoid bone loss and increased Hill-Sachs size, for having 5 or more dislocations before MRA with the presence of glenoid bone loss and for having a complete dislocation with increased Hill-Sachs size. Strong negative associations were found for high-energetic trauma with the presence of GLAD and HAGL lesions and for reposition by a health-care provider with glenoid bone loss size.

Conclusions: The prevalence of ALPSA and Perthes lesions was higher than previously reported in the literature, whereas the prevalence of Bankart lesions was lower. The prevalence of other lesions was similar to expected. Labral and bony lesions were mostly observed in the anterior and inferior glenoid quadrants. Specific patient groups showed strong associations with the presence or size of lesions.

EP.02.132

METHODOLOGICAL QUALITY AND LEVEL OF EVIDENCE OF BANKART REPAIR FOR ANTERIOR SHOULDER INSTABILITY - A SYSTEMATIC REVIEW

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Background: Purpose: To assess the quality and level of evidence of studies reporting on Bankart repair for anterior shoulder instability.

Methods: A search was performed using the PubMed/Medline database for all studies that reported clinical outcomes on Bankart repair for anterior shoulder instability. The search term "Bankart repair" with all results being analyzed via strict inclusion and exclusion criteria. Two independent investigators scored each included study based on the 10 criteria of the Modified Coleman Methodology Score (CMS) out of 100 and gave each study a score out of 25 based on the ASI Methodology criteria.

Results: Two hundred and sixty-six studies were included in the analysis. Encompassing a total of 19,156 patients and 19,317 surgical procedures for Bankart repair for shoulder instability. Overall, 81.6% of the studies were of Level III or IV evidence. The mean CMS score for the studies was 55.3 out of 100, and the mean ASI Methodology score for the studies was 12.1 out of 25. Weaknesses in the studies were identified in sample size, description of pre-operative investigations and diagnoses, reporting of mean glenoid bone loss, non-subjective clinical outcome reporting and description of associated pathologies.

Conclusions: A large proportion of studies reporting the clinical outcomes of Bankart repair for anterior shoulder instability are of low methodological quality and have a low level of evidence. Level of Evidence: Level IV, a systematic review of Level I through IV studies

EP.02.133

GLENOID BONE RESORPTION AFTER BANKART REPAIR -FINITE ELEMENT ANALYSIS OF POSTOPERATIVE STRESS DISTRIBUTION OF THE GLENOID-

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Background: There are various modifications of the Bankart repair and the postoperative glenoid morphology changes after Bankart repair. The lateral diameter of the glenoid width decreases because of glenoid bone resorption after surgery that involves removal of articular cartilage in cases without significant bony Bankart lesions. This study aimed to compare glenoid rim stress after Bankart repair using two methods of finite element analysis (FEA); a method of removing the antero-inferior cartilage and repairing the glenohumeral ligament complex on the glenoid, and a method of preserving the cartilage and repairing the glenohumeral ligament complex on the glenoid edge.

Methods: We used five preoperative computed tomography scans of patients with traumatic anterior instability who underwent arthroscopic Bankart repair. Two models simulating different surgical procedures were created as follows: In model G, 5-mm width of cartilage on the glenoid rim was removed at 2-7 o'clock, and the glenohumeral ligament complex was repaired on the medial edge of the glenoid bone where the cartilage was removed. In model E, the cartilage of the glenoid rim was not removed, and the glenohumeral ligament complex was repaired on the glenoid edge. The load stresses on the antero-inferior area of the glenoid after Bankart repair with model G and E were measured using FEA.

Results: The stress of the glenoid at 3-4 o'clock was 3.16 Mpa in model G and 3.16 Mpa in model E ($p < 0.05$). The stress at 4-5 o'clock was 1.68 Mpa in model G and 4.53 Mpa in model E ($p < 0.05$). The stress at 5-6 o'clock was 2.26 Mpa in model G and 3.93 Mpa in model E ($p < 0.05$).

Conclusions: Significantly lower load stresses at that anterior-to-inferior rim of the glenoid were observed in model G than in model E.

EP.02.135

CROSS-CULTURAL ADAPTATION AND VALIDATION OF THE POLISH VERSIONS OF THE WOSI, OXFORD SHOULDER INSTABILITY SCORE, AND WALCH-DUPLAY SCORE

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Background: The WOSI, OSIS, and WD are disease-specific patient-reported outcome measures for patients with shoulder instability. To date, no Polish validated versions of the presented scales exist. The purpose of this study was to translate into Polish, culturally adapt and validate the Polish versions of the Western Ontario Shoulder Instability Index (WOSI-PL), Oxford Shoulder Instability Score (OSIS-PL), and Walch-Duplay Score for Instability of the Shoulder (WD-PL).

Methods: The original versions of the WOSI, OSIS, and WD were translated into Polish following international recommendations of the cross-cultural adaptations. The group of 63 patients (average age: $30,1 \pm 9,6$) with unilateral anterior shoulder instability were recruited for this study. Each patient filled in the WOSI-PL, OSIS-PL, WD-PL, Disability of Arm, Shoulder and Hand assessment (DASH), and Short-Form 36 (SF-36). In 2-14 days intervals, 30 patients repeated the WOSI-PL, OSIS-PL, and WD-PL to determine test-retest reliability (intraclass correlation coefficient ICC). The internal consistency was assessed by Cronbach's alpha and construct validity was evaluated by comparing the Polish versions of questionnaires with DASH and SF-36.

Results: The Polish versions of the WOSI, OSIS, and WD showed good internal consistency with $\alpha=0,95$, $\alpha=0,89$ and $\alpha=0,63$ respectively. Reliability in test-retest was excellent: WOSI-PL ICC=0,98, OSIS-PL ICC=0,97 and WD-PL ICC=0,98. In assessment of construct validity the correlation with DASH was strong and statistically significant. DASH vs. WOSI-PL $r=-0,76$ $p<0,0001$, OSIS-PL $r=-0,55$ $p<0,0001$ and WD-PL $r=-0,59$ $p<0,0001$. The correlations with SF-36 were weaker, and were significant not for every SF-36 domain. The strongest correlations were between SF-36 bodily pain vs. WOSI-PL $r=0,63$ $p<0,0001$, OSIS-PL $r=0,63$ $p<0,0001$; and SF-36 physical functioning vs. WOSI-PL $r=0,57$ $p<0,0001$, OSIS-PL $r=0,50$ $p<0,0001$, WD-PL $r=0,50$ $p<0,0001$. No floor or ceiling effects were found.

Conclusions: The Polish versions of WOSI, OSIS, and WD showed good reliability and validity, therefore they can be used for shoulder assessment among patients with anterior shoulder instability.

EP.02.136

CO-OCCURRENCE OF POSTERO-INFERIOR GLENOHUMERAL SUBLUXATIONS AND SOFT TISSUE INTRA-ARTICULAR IMPINGEMENT

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Background: The objective of this case-report was to gain insight into the potential pain-inducing mechanism of a 25-year-old right-handed physiotherapy-student, visiting our university outpatient clinic with persistent atraumatic left shoulder complaints. The past year, she experienced increasing pain in the posterosuperior deltoid region and painful clunking of her shoulder with daily overhead activities. Initial radiographs and axial T1-weighted Magnetic Resonance (MR) imaging showed mild glenoid hypoplasia, but no apparent soft tissue damage.

Methods: We physically examined her glenohumeral joint mobility and evaluated her shoulder girdle dynamics during painful forward shoulder elevation. Additionally, we conducted dynamic X-rays and unconventional MR-imaging with the patient's shoulder in the pain-inducing position. Eventually we treated the patient based on our findings.

Results: On physical examination, the Jerk-test and the Hyperabduction Test were both positive.

With active shoulder flexion there was limited scapular abduction and upward rotation. The humeral head deviated out from the mid-axillary line with a painful clunk at approximately 150 degrees active shoulder flexion and relocated when her arm lowered. Dynamic X-rays confirmed glenohumeral subluxations during arm elevation. T1-weighted MRI of the patient in supine position with her left shoulder in the pain-inducing position of approximately 150 degrees shoulder flexion again showed the humerus in subluxed position and intra-articular impingement of tissue consisting of joint capsule, rotator cuff tendon and bursal epithelium.

Within 8 weeks, after 5 physiotherapy visits, focusing on regaining scapulothoracic mobility and using it properly during activities of daily living, clunking and pain resolved, and have not returned to date (5 years post-treatment).

Conclusions: In this case, unconventional MR imaging showed that a postero-inferior glenohumeral subluxation co-occurred with intra-articular impingement of soft tissue.. Nociceptive stimuli can be elicited if such tissue, richly supplied with free nerve endings, is subjected to excessive shear and compression loads, as with subluxations in overhead activities. Subluxations may occur with posterior and inferior capsular hyperlaxity and glenoid hypoplasia, if the scapula contributes only limitedly to shoulder flexion. A short-term physiotherapy intervention targeting this pathomechanism can effectively resolve persistent symptoms and may prevent the need for surgical stabilization.

EP.03.002

THE 'LIVED EXPERIENCE' OF PEOPLE WITH LARGE TO MASSIVE ROTATOR CUFF TENDON TEARS AND HEALTHCARE PROFESSIONALS MANAGING THEIR CARE. A QUALITATIVE STUDY

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Background: Large to massive rotator cuff tendon tears (LMRCTTs) have an increasing prevalence inextricably linked with an aging population. Increasing life expectancy and functional demands coupled with an eagerness to stay active is highlighting the significant negative impact these tears are having on maintaining independence and quality of life. Additionally, do we use the same treatment pathway for a cohort who are inactive, overweight with circulating low grade inflammation. With only one qualitative synthesis to date exploring treatment-related experiences of shoulder pain, this novel study aimed to describe the 'lived experience' of people with LMRCTTs and gain an insight into the healthcare professionals (HCPs) approach to managing their care.

Methods: Audio-recorded focus groups (n=3) with people with LMRCTTs (n=13) and semi-structured interviews (n=11) with HCPs were conducted between June and September 2022. All Transcribed interviews were exported to NVIVO Software (Version 12) and analysed using a reflexive approach to thematic analysis.

Results: Three main themes were identified; 1) Confidence; patients needed to feel confident in their HCPs to trust and adhere to the treatment pathway however many HCPs expressed limited confidence in their management of people with LMRCTTs. 2) Focus on function; Patients felt that there was too much focus on pain relief and less on restoring their function whilst some HCPs reported resorting to pain relief when they were unsure what else to do. 3) Role of Exercise; exercise was seen to be essential by many patients but support is needed for HCPs to identify a safe entry point to prevent time loss and avoid exacerbating the patients symptoms.

Conclusions: These findings help to give a deep understanding of the impact of large to massive rotator cuff tendon tears on peoples quality of life and independence. It provides a novel insight into the experiences and interactions between this cohort and their treating health care professionals. This enhanced awareness will prove crucial for future planning and implementation of evidence-based recommendations.

EP.03.004

EFFICACY OF AUTOLOGOUS DERMAL FIBROBLAST INJECTION TO ENHANCE BONE-TENDON INTERFACE HEALING AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR - PROSPECTIVE RANDOMIZED CONTROLLED HUMAN TRIAL -

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Background: There is growing interest in various biological supplements for improving bone-tendon interface (BTI) healing in patients after arthroscopic rotator cuff repair (ARCR). Dermal fibroblasts, known to express collagen synthesis similar to tenocytes, have been reported to be effective in BTI healing after surgical repair of chronic RC tear model of rabbit. However, there have been no human clinical trials so far, and we aimed this study to evaluate the clinical efficacy of autologous dermal fibroblasts (ADF) for BTI healing after ARCR in patients with full-thickness rotator cuff tear of more than 2 cm.

Methods: Eighty-six patients were prospectively enrolled and randomized into two groups; additional ADF injection between bone and tendon during ARCR (Group I), or ARCR alone (Group II). Skin biopsy for obtaining ADF was performed from the buttock, and ADF were cultured for about 4 weeks before surgery. Surgical technique of ARCR was unified as double-row suture-bridge technique to decrease the heterogeneity from different repair methods. Primary variable for the efficacy of ADF was to evaluate the retear rate by using MRI at 6 months postoperatively. Secondary variable was to compare clinical outcomes between two groups including range of motion (ROM), American Shoulder and Elbow Surgeons (ASES) score, Constant score and simple shoulder test (SST) at baseline, 6 and 12 months postoperatively.

Results: Fourteen patients were dropped out for reasons such as involved subscapularis tendon tear, follow up loss or withdrawer of consent (8 in Group I, 6 in Group II). Demographics and preoperative clinical scores were not significantly different between two groups (all $p > 0.05$). The retear rate was significantly lower in Group I (2.9%, 1 of 35) than Group II (16.2%, 6 of 37) ($p=0.012$). Clinical outcomes were not statistically different between two groups at 6 months and 12 months (all $p > 0.05$).

Conclusions: ADF application into BTI during ARCR demonstrated to decrease the retear rate in full-thickness rotator cuff tear of more than 2 cm. Therefore, ADF injection could be a promising biological supplements to enhance BTI healing in patients with rotator cuff tear.

EP.03.005

DEVELOPMENT AND VALIDATION OF A MODEL PREDICTING POST-OPERATIVE SHOULDER STIFFNESS BY PATIENTS UNDERGOING AN ARTHROSCOPIC ROTATOR CUFF REPAIR IN SWITZERLAND

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Background: Post-operative shoulder stiffness (POSS) is one of the most frequent adverse events (AE) after an arthroscopic rotator cuff repair (ARCR). Predicting POSS occurrence could support healthcare in closely monitoring patients with a high risk of occurrence of AE after surgery. We aimed to update and validate a clinical prediction model for POSS, using data from a multicenter cohort setting (ARCR_Pred study).

Methods: ARCR_Pred cohort recruitment between June 2020 and November 2021 included 973 patients. POSS was defined as a composite outcome (1/ limitation in range of motion at 6 months, or 2/ symptomatic stiff shoulder leading to deviation from the routine postoperative management up to 6 months). A set of 35 factors was firstly identified via a Delphi consensus process involving 44 surgeons of the study. These factors were assessed for inclusion in a multivariable logistic regression model. To identify the set of factors maximizing the apparent and bootstrap validated area under the receiver-operating characteristics curve (AUC), a backward elimination procedure was performed. Associations were reported in terms of Odds Ratio (OR) along with their 95% confidence intervals.

Results: Overall, 105 patients (10.8%) out of 973 had a POSS occurring within the six months postsurgery. The backward elimination procedure led to retaining 10 factors in the final model. Being a female (OR = 1.52 [0.96;2.40]), being a current (OR = 1.56 [0.91;2.61]) or former smoker (OR = 1.70 [0.98;2.90]), drinking alcohol daily (OR = 1.78 [0.92;3.27]), carrying moderate (OR = 1.56 [0.97;2.53]) or heavy (OR = 1.71 [0.91;3.17]) loads in working activities under the head, pre-operative medication (OR = 1.58 [1.03;2.43]), traumatic tears (OR = 1.56 [0.94;2.60]) and longer symptoms duration (OR = 1.79 [1.09;2.98]) were associated with a higher risk of POSS. Greater acromiohumeral distance (OR = 0.85 [0.77;0.93]), better pre-operative functional scores (OR = 0.95 [0.93;0.98]) and greater passive motion in abduction (OR = 0.99 [0.97;1.00]) were associated with lower risk of POSS. The apparent and bootstrap-validated model performances were AUC = 0.73 and 0.68, respectively.

Conclusions: This model combining ten baseline factors is useful for healthcare eager to provide their patients with individualized predictions of risks of post-operative AE.

EP.03.006

EFFECT OF INTERNAL POLYPROPYLENE MESH AUGMENTATION ON THE MRI MATURITY SIGNAL INTENSITY OF FASCIA LATA AUTOGRAFT AFTER ARTHROSCOPIC SUPERIOR CAPSULAR RECONSTRUCTION

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Background: The potential effect of polypropylene mesh (PM) augmentation on the fascia lata autograft (FLA) maturity has not been examined. This study aimed to evaluate the difference of graft maturity by comparing magnetic resonance imaging (MRI) signal intensity of FLA with and without a PM augmentation after superior capsular reconstruction (SCR).

Methods: Thirty-three patients (15 in the FLA group and 18 in the FLA + PM group) who underwent SCR using FLA between March 2013 and December 2019 were retrospectively analyzed. Follow-up MRI at postoperative 3 and 12 months were analyzed. The values of signal/noise quotient at the humeral (SNQh), mid-substance (SNQm), and glenoid (SNQg) site were calculated to evaluate the signal intensity of fascia lata. Statistical analysis was conducted to compare SNQ between time points and groups.

Results: The SNQ of the FLA group was significantly higher than that of the FLA + PM group on 3-month MRI (31.163 ± 18.751 vs 13.787 ± 9.423 , respectively; $P = .000$). However, there was no difference in SNQ between groups on 12-month MRI (22.039 ± 7.900 vs 18.818 ± 10.909 , respectively; $P = .168$). In the FLA group, there was a significant decrease in SNQ between 3- and 12-month postoperative MRI (31.163 ± 18.751 vs 22.039 ± 7.900 , respectively; $P = 0.042$). However, there is no difference between the 2-time points in the FLA + PM group.

Conclusions: The results suggest better remodeling and maturation of FLA with PM augmentation compared with the FLA at 3 and 12 months postoperatively.

EP.03.010

COMPARATIVE STUDY OF CATHETER INDWELLING POSITION IN CONTINUOUS INTERSCALENE BRACHIAL PLEXUS BLOCK USING PIG-TAIL SHARPED CATHETER

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Background: We reported that continuous interscalene block using a pig-tail shaped catheter is useful for pain management after shoulder arthroscopic surgery. However, we observed 33% of patients with inadequate pain relief despite the catheter hole being placed near the nerve root 24 hours after surgery. Based on the report that C4 and C5 are important nerves innervating the shoulder joint, we hypothesized that catheter placement above C5 would provide more effective pain relief than the conventional placement below C5. The purpose of this study was to compare the pain-relieving effects between the C5 above indwelling position group (A group) and the C5 below indwelling position group (B group).

Methods: The subjects were 30 shoulders (15 men and 15 women) who underwent continuous interscalene block using a pig-tail shaped catheter during arthroscopic shoulder surgery. The mean age at surgery was 61 years old. In all patients, after induction of general anesthesia, a catheter was placed near the C5 nerve root under ultrasound guidance in the supine posterior position. The catheters were placed at 15 shoulders in the A group and 15 shoulders in the B group. After catheter placement, 0.375% ropivacaine was administered continuously at 4 ml/hour. The distance between the catheter hole and the nerve root was measured by injecting saline into the catheter using ultrasound immediately after surgery and 24 hours after surgery in both groups and compared. VAS values were also measured and compared immediately after surgery and 24 hours after surgery in both groups.

Results: There was no significant difference in the distance between the catheter hole and nerve root between the two groups immediately after surgery and 24 hours after surgery. The VAS values immediately after surgery were 1.34 ± 3.02 for the A group and 1.49 ± 3.57 for the B group, showing no significant difference. On the other hand, the VAS values on 24 hours after surgery were 6.47 ± 9.58 and 28.3 ± 26.8 in the A and B group, respectively, showing a significant difference.

Conclusions: As a catheter placement method, the C5 above indwelling position is a useful method that can provide good pain relief even 24 hours after surgery.

EP.03.011

MORE THAN PAIN AND PHYSICAL LIMITATION: THE DECLINED COGNITIVE PERFORMANCE ASSOCIATED WITH ROTATOR CUFF INJURIE

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Background: Shoulder pain, physical limitation, sleep disturbance, and emotional distress are common clinical symptoms of rotator cuff (RC) injuries. These symptoms are negatively correlated with cognitive functions in studies regarding chronic pain. However, there is currently a paucity of literature discussing the association between these symptoms and cognitive performance in patients with RC injuries. The clinical symptoms of RC injuries would be negatively correlated with cognitive performance. Which factor contributed to the presence of early cognitive impairment—mild cognitive impairment (MCI)?

Methods: We recruited 150 patients with RC injuries scheduled for surgery. Clinical symptoms were measured with the visual analog of scale (VAS) for pain intensity, American Shoulder and Elbow Surgeons scale (ASES), Rotator Cuff Quality of Life index (RCQOL), Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), Beck Depression Inventory II (BDI-II), and State-Trait Anxiety Inventory (STAI). Cognitive performance tests included the Montreal Cognitive Assessment (MoCA) as the cognitive screening test, Trail Making Test (TMT) for visuomotor speed and executive function, Digit Span for working memory, and Digit Symbol Substitution Test (DSST) for processing speed. Multiple linear regression and logistic regression analyses were performed to study the impact of RC injuries on cognitive performance.

Results: Among the 150 patients, 54% were scored as having MCI, 64.7% showed sleep disturbance, and 28%–30% revealed anxious mood. A multiple linear regression model showed that trait anxiety and education predicted TMT-A performance (adjusted $R^2 = 0.38$, $p < .001$), while state anxiety, age, and education predicted TMT-B (adjusted $R^2 = 0.43$, $p < .001$). The PSQI, age, and education predicted DSST performance (adjusted $R^2 = .68$, $p < .001$). Furthermore, multiple logistic analysis revealed that the ASES score was the predictor for diagnosing MCI (odds ratio = 0.97, $p = 0.01$) in addition to age.

Conclusions: We demonstrated the negative impact of RC injuries on cognitive performance. Additionally, physical limitation due to shoulder pain increased the risk of developing MCI.

EP.03.012

QUANTIFYING MINIMAL CLINICALLY IMPORTANT DIFFERENCE AND PATIENT ACCEPTABLE SYMPTOMATIC STATE AFTER ARTHROSCOPIC MASSIVE ROTATOR CUFF REPAIR

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Background: Minimal clinically important difference (MCID) and patient acceptable symptomatic state (PASS) are emerging criteria for assessing clinical significance of improvements in patient reported outcomes (PROs). To date, many studies have identified MCID and PASS values for arthroscopic rotator cuff repair, however these studies are limited by short-term follow-up and inclusion of heterogeneous patient populations. The purpose of this study was to establish MCID and PASS values for commonly used PROs in patients undergoing arthroscopic massive rotator cuff repair (aMRCR) and to determine factors associated with achieving MCID or PASS.

Methods: A retrospective review at 2 institutions was performed to identify patients undergoing aMRCR with minimum 4-year follow-up. Data collected included patient characteristics (age, sex, length of follow-up, and tobacco use), radiological parameters (Goutallier fatty infiltration and modified Collin tear pattern), and 4 PROs (collected preoperatively and postoperatively): American Shoulder and Elbow Surgeons (ASES) score, Subjective Shoulder Value (SSV), Veterans Rand-12 (VR-12) score, and visual analog scale (VAS) pain. The MCID and PASS for each outcome measure were calculated, and Pearson and Spearman coefficient analyses were used to determine correlations between preoperative variables and MCID or PASS thresholds.

Results: A total of 101 patients with a mean follow-up of 64 months were included in the study. The MCID and PASS values for the ASES scores were 14.5 and 69.4, respectively; for SSV, 13.7 and 81.5; for VR-12, 6.6 and 40.3; and for VAS pain, 1.3 and 1.2. Poorer preoperative ASES, SSV, and VR-12 were associated with achieving MCID, while better preoperative ASES, VR-12, and VAS pain scores were associated with reaching PASS. Greater fatty infiltration and a 3-tendon tear (involvement of the supraspinatus, infraspinatus, and entire subscapularis tendons) were associated with failing to reach clinically significant values.

Conclusions: This study defined MCID and PASS values for commonly used PROs in patients undergoing aMRCR with minimum 4-year follow-up. Greater preoperative rotator cuff disease severity was associated with failure to achieve clinically significant outcomes. These findings are important for incorporating patient perspectives into the clinical effectiveness of this procedure and provide valuable parameters for the design and interpretation of future clinical trials.

EP.03.013

SINGLE-SHOT LIPOSOMAL BUPIVACAINE INTERSCALENE NERVE BLOCK PROVIDES EQUIVALENT PAIN RELIEF COMPARED TO CONTINUOUS CATHETER INTERSCALENE NERVE BLOCK FOR ARTHROSCOPIC ROTATOR CUFF REPAIR

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Background: Liposomal Bupivacaine has been recently approved for use in interscalene nerve blocks and has the potential to provide long-acting pain control without the associated complications and cost of an indwelling catheter. The purpose of this study is to compare early post-operative pain control, patient satisfaction, narcotic consumption, and cost in patients undergoing elective arthroscopic rotator cuff repair with the use of a single shot interscalene block with liposomal bupivacaine (SSLB) or a continuous catheter interscalene nerve block with standard bupivacaine (CCIB).

Methods: Patients undergoing outpatient arthroscopic rotator cuff repair (ARCR) at a single ambulatory surgery center were randomized to receive either SSLB or CCIB. Inclusion criteria included patients undergoing ARCR with any associated procedure and agreement to participate in the study. Patients were given a pain log to record VAS pain scores, duration of the block, narcotic consumption, and any complications for the first 5 days after surgery. Narcotic consumption was standardized using morphine milligram equivalents (MME). Secondary outcomes included block related complications, patient satisfaction, anesthesia provider time to administer the block, and cost of materials. Continuous variables were assessed with a Student's t-test while categorical variables were assessed with a chi-square test. Significance was set at a p-value of <0.05. Dexamethasone was not used.

Results: 90 patients met inclusion criteria and consented to randomization (45 SSLB, 45 CCIB). There was no statistical difference in VAS pain scores, opioid consumption (60 MME for SSLB, 48 MME for CCIB), complications, or patient satisfaction between the groups. 89% of patients in the SSLB group and 96% of patients in the CCIB group would have the same block again. Patients in the CCIB group reported that the block lasted an average of 92 hours after surgery compared to 48 hours for the SSLB group which was statistically significant ($p < .00001$). The SSLB costs \$112 less in materials and medications in our system.

Conclusions: Both SSLB and CCIB provided similar pain relief, opiate use, and satisfaction in patients undergoing ARCR. CCIB had a longer duration of pain control compared to SSLB, however the SSLB was faster to perform and more cost effective.

EP.03.014

MASSIVE IRREPARABLE ROTATOR CUFF TEARS: A PROSPECTIVE ANALYSIS OF OUTCOMES FOLLOWING PARTIAL REPAIR WITH 2 YEAR FOLLOW-UP

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Background: Prior studies have demonstrated improved outcomes following partial rotator cuff repair (PRCR) for massive irreparable tears (MIRCT), but these have been predominantly level III and IV evidence. This study prospectively evaluated 2 year clinical outcomes of patients undergoing PRCR for MIRCT as well as evaluated rotator cuff muscle changes at 1 year following PRCR.

Methods: This was a multicenter, prospective study evaluating patients who underwent PRCR for a MIRCT. Patient characteristics and outcomes measures were evaluated pre-operatively and at 2 years. Outcomes measures evaluated were the Western Ontario Rotator Cuff Index (WORC), American Shoulder and Elbow Surgeons Shoulder Score (ASES), Constant-Murley Shoulder Outcome Score (CMS), EQ-5D-5L, and the Visual Analog Pain Score (VAS). Pre-operative MRIs and at 1 year post-operatively were obtained and fatty infiltration was evaluated via Goutallier grade on T1 weighted sagittal images. Univariate analysis was utilized ($P < 0.05$ considered significant).

Results: 91 patients met inclusion criteria. Average patient age was 64.7 years (range 56-83). There was no significant change in forward flexion ($p = 0.07$), abduction ($p = 0.24$), or external rotation ($p = 0.19$). No significant change in the Goutallier grade of the supraspinatus ($p = 0.10$) or infraspinatus ($p = 0.33$) was observed in the subset of 43 patients with a 1 year postoperative MRI. There was a significant improvement in WORC (30.33 to 75.33, $p = 0.009$), ASES (42.5 to 84.58, $p = 0.008$), CMS (45.75 to 62.25, $p = 0.037$), EQ-5D-5L (66.75 to 90, $p = 0.047$), and VAS (58.5 to 10, $p = 0.015$) at 2 year follow-up.

Conclusions: PRCR for MIRCT provides significant improvement in patient reported outcomes measures at 2 years with a low clinical failure rate of 3.2% requiring reoperation. We found no significant improvement in muscle fatty infiltration following PRCR, however there was also no significant progression of muscle fatty infiltrate at 1 year post-operatively. PRCR is a viable treatment option with significant improvement in patient reported outcomes and should be offered as a potential treatment option when counseling patients with MIRCTs.

EP.03.016

THE USE OF INTRAVENOUS ZOLEDRONATE MAY REDUCE RETEAR RATE AFTER ROTATOR CUFF REPAIR IN OLDER FEMALE PATIENTS WITH OSTEOPOROSIS: A FIRST IN-HUMAN PROSPECTIVE STUDY

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Background: The objective of this study was to demonstrate the effect of intravenous (IV) zoledronate administration on rotator cuff healing, retear rate, and clinical outcomes in osteoporotic patients who underwent arthroscopic rotator cuff repair (ARCR) compared with patients with normal bone densities.

Methods: In this prospective nonrandomized comparative study with propensity score matching, 30 patients who were postoperatively administered IV zoledronate (5 mg) were enrolled as the study group. The control group was matched using 1-to-2 propensity score matching. Radiologic and functional outcomes were evaluated 6 months after surgery.

Results: The functional scores in both groups exhibited significant improvement 6 months after surgery. Compared with Group 1 (osteoporosis with IV zoledronate injection) Group 2 (normal bone density) showed significant improvement in their University of California, Los Angeles (UCLA) shoulder score and Constant Shoulder Score (CSS) at 6 months postoperatively. The range of motion improved in both groups at 6 months after surgery. The retear rates according to Sugaya's classification (IV and V) were 13.3% (4 of 30 patients) and 25% (15 of 60 patients) in Groups 1 and 2, respectively, which established a non-inferiority of Group 1 to the control group. The retear pattern according to Rhee's classification in Group 1 was type I in all cases, whereas eight cases of type I and seven cases of type II patterns were observed in Group 2, which was statistically insignificant between the groups.

Conclusions: In conclusion, anti-osteoporotic drug use is beneficial for patients with osteoporosis to reduce the failure rate after an ARCR of length > 2 cm, especially in older female patients. Moreover, thorough scrutiny is required to detect osteoporosis in patients with rotator cuff tears, especially in female patients.

EP.03.018

SIMILAR CLINICAL AND PATIENT RECORDED OUTCOMES AMONGST OLDER PATIENTS OVER 65 YEARS OF AGE COMPARED TO YOUNGER PATIENTS UNDERGOING ARTHROSCOPIC ROTATOR CUFF REPAIR

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Background: The purpose of our study was to determine if patients greater than or equal to 65 years of age (older group) who underwent rotator cuff repair (RCR) meet the minimally clinically important difference (MCID) for Patient Reported Outcomes Measurement Information System (PROMIS) Upper Extremity (UE), Pain Interference (PI), and Depression (D) at similar rates compared to a younger cohort of patients.

Methods: A retrospective review of a prospectively collected database of patients undergoing arthroscopic RCR was performed. Patients who completed both preoperative and at least 6 month postoperative PROMIS assessments were included. A cohort of patients aged 65 years and older was compared to a cohort less than 65 years in terms of their clinical outcomes and PROMIS scores. A propensity matched analysis was then performed, which matched patients in the older group to a cohort of patients 50 years of age and less via tear size and BMI in a 1:1 ratio.

Results: Overall, 318 patients were included with 79 patients in the older group and 239 patients in the less than 65 group. The older cohort had significantly lower BMI compared to the younger cohort (29.4 ± 5.2 vs 31.1 ± 6.1 , $P=0.04$). No significant differences were found in gender, tear size, retear rate, preoperative and postoperative PROMIS UE, PI, and D scores. Patients less than 65 were more likely to reach MCID in improvement of PROMIS D scores (40.3% in younger vs 23.9% in older cohort, $P=0.04$). There was no difference in PROMIS UE or PI. In the sub analysis, 44 patients aged 65 or greater were propensity matched to 44 patients less than 50. Older patients experienced larger changes (improvement in pain) in PROMIS PI ($P=0.005$) from preoperative to 6 months postoperatively but not in PROMIS UE or D. The proportion of patients that met MCID for PROMIS D was significantly lower in the older cohort (26% vs 47%, $P=0.03$) compared to the younger cohort.

Conclusions: Elderly patients were more likely to have a larger improvement in pain scores but less likely to have improvement in their depression scores. This should be considered as one factor in careful patient selection.

EP.03.019

THE AVAILABILITY ON THE CRITICAL AREA OF ROTATOR CUFF TEAR USING RADIAL MRI AND THE RELATIONSHIP WITH COFIELD CLASSIFICATION

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Background: As for the preoperative evaluation of rotator cuff tear, Cofield classification has been popularized since 1982. But clinically, even in the moderate tear patients, we occasionally see retear case. In previous study, we reported the good predictor of postoperative cuff integrity: the tear area on radial MRI. The purpose of this study is to evaluate the risk of retear comparing Cofield classification and tear area.

Methods: One hundred two complete rotator cuff tear patients two years after undergoing arthroscopic primary repair were included in this study. Referring to the previous study, 6.3cm² of a preoperative rotator cuff tear was defined as critical area. All of cuff tear size were measured on coronal plane and categorized into three groups; small, medium and large to massive, derived from Cofield classification. The mean tear area was calculated in each group, and each area were plotted relative to the coronal measurement in each case. And then, postoperative retear rate against critical area was evaluated. For validation analysis, Inter-rater reliability in both methods was calculated.

Results: Inter-rater reliability in Cofield classification and in tear area was 0.80 and 0.97, respectively. The mean tear area and retear rate in Cofield classification was 0.8 cm², 0% in the small; 2.6 cm², 7% in the medium; 8.9 cm², 58% in the large to massive. Whereas, retear rate under and over critical area was 2% and 87% ($P < 0.001$). In the medium group, two cases had over critical area and all retear. In the large to massive, 13 cases had over critical area and 11 retear, and 6 cases had under critical area and all healing.

Conclusions: Critical area was better predictor than Cofield classification in this study. Even if the coronal measurement showed the medium size tear, the cases over critical area had all retear. Meanwhile, the large to massive tear under critical area showed good integrity. Based on the reliability as well, critical area might be more appropriate evaluation than Cofield classification with a high degree of accuracy.

EP.03.021

AGE COULD BE AN IMPORTANT FACTOR FOR CHOOSING THE GRAFT TYPE BETWEEN TENSOR FASCIA LATA AUTOGRAFT AND DERMAL ALLOGRAFT IN SUPERIOR CAPSULAR RECONSTRUCTION

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Background: Superior capsular reconstruction (SCR) became one of the treatment options for irreparable rotator cuff tear. Though, previous studies reported that grafts of dermal allograft and fascia lata autograft showed safe and effective clinical outcomes, there was little research of direct comparison of clinical outcome SCR depending on the grafts. We aimed to analyze clinical outcomes of SCR depending on the grafts: HDA, and FLA, and to determine the independent factors related to patient's satisfaction and re-tear rate.

Methods: The patients who performed SCR using HDA (group 1, n=25) were enrolled prospectively, and compared with the other group using FLA (group 2, n=34), retrospectively based on selection criteria. The clinical and radiological outcomes were evaluated preoperatively and at 1-year follow-up. The graft maintenance was scrutinized using serial ultrasonograph and magnetic resonance imaging (MRI) at 6-12 months. Univariate and multivariate logistic regression analyses were performed to identify the factors affecting patient satisfaction, and re-tear. Furthermore, analysis of the correlation between graft thickness and age was conducted.

Results: Both group showed improvement in clinical and radiological outcomes. In logistic regression analysis, re-tear was independent factor for patient's satisfaction ($p=0.002$, OR 0.032, 95% CI 0.004-0.295), and tear size (medial to lateral) and graft thickness were independent factors for re-tear (tear size, $p=0.025$, OR 1.262, 95% CI 1.030-1.546; graft thickness, $p=0.020$, OR 0.400, 95% CI 0.185-0.864). The negative correlation between age and graft thickness was found in FLA, but not in HDA. (FLA: $r=-0.449$, $p=0.0009$, HDA: $r=0.077$, $p=0.734$). In subgroup analysis based on the age, FLA had more re-tear rates in old age group, and HDA had more in young age group (FLA: old age group, 53.8% vs young age group, 19.0%, $p=0.035$, HAD: old age group, 0% vs young age group, 25.0%, $p=1.000$).

Conclusions: SCR using different grafts (HDA and FLA) showed comparable outcomes and re-tear rates. Considering the importance of the thickness of the graft for survival of SCR, FLA might not be suitable option for old age.

EP.03.022

FUSSI VERSUS SUBSCAPULARIS REPAIRS: A COMPARATIVE STUDY

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Background: FUSSI lesions, for frayed upper edge subscapularis (SSC) lesions with impingement due a thickened middle glenohumeral ligament (MGHL), are a rare subtype of SSC tears. It distinguishes itself from the more frequently described insertional tear, as it occurs on the medial upper edge of the tendon and its insertion site remains intact. Recommended treatment consists of arthroscopic resection of the MGHL \pm anterior glenoplasty, to allow proper gliding of the tendon. However, treatment' results remain still unknown. Thus, the aim of this study was to analyze 1) outcomes of FUSSI lesions' treatment and 2) compare them to SSC repairs. We hypothesized that the proposed treatment of FUSSI lesions would improve outcomes and that the results would be at least equivalent to SSC repairs.

Methods: This was a retrospective comparative study from prospectively collected data. Data were retrieved from our rotator cuff database. All patients who underwent an arthroscopic procedure for an SSC tear (Lafosse <3) and returned to 6-month follow-up were eligible. Patients were divided in 2 groups according to tear location (FUSSI group vs SSC group). A single surgeon performed all surgeries by, either resecting the MGHL \pm glenoplasty or a single-row repair with a lasso-loop technique, respectively. A single observer assessed all patients preoperatively and at last follow-up. Outcome measures included active range of motion and various patient-reported outcome measures (PROMs).

Results: 79 SSC tears could be included, 11 FUSSI lesions and 68 SSC insertional tears. Compared with the SSC group, the FUSSI group was significantly older (58,8 vs 51.7 years old, $p=0.017$) and had a longer interval delay between symptoms onset and surgery (63.7 vs 15.8 months, $p=0.004$). At 6 months, the FUSSI group showed significant improvement in anterior elevation (135° to 150°), external rotation (39° to 45°) and internal rotation (L5 to T12), VAS pain (6.3 to 1.8), SANE (48.2 to 83,0%), ASES (51.6 to 80%) and Constant score (56.1 to 78.6). Moreover, these results were similar between both groups.

Conclusions: Arthroscopic treatment of FUSSI lesions provided good functional outcomes similar to standard SSC repairs.

EP.03.023

RELIABILITY AND ACCURACY OF THE CRITICAL SHOULDER ANGLE MEASURED BY ANTEROPOSTERIOR RADIOGRAPHS: USING DIGITALLY RECONSTRUCTED RADIOGRAPH FROM THREE-DIMENSIONAL COMPUTED TOMOGRAPHY IMAGES

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Background: The critical shoulder angle (CSA) is a novel radiologic measurement of the angle between the inclination of the glenoid and the lateral extension of the acromion, which was first described by Moor et al.. Many studies have reported that higher CSA are significantly associated with RCT. However, some studies have found no correlation of a larger angle with a greater incidence of RCT. This study analyzed the reliability and accuracy of the CSA measurements obtained via anteroposterior (AP) radiographs, using a digitally reconstructed radiograph (true AP view) generated from a computed tomography image as the gold standard.

Methods: The CSA was measured on the radiographs and true AP views of 88 consecutive patients who had undergone shoulder arthroscopy for rotator cuff tears. Intraobserver and interobserver reliabilities of the CSA, measured by two orthopedic surgeons, were evaluated, and the average deviation of the CSA between radiographs and true AP views was calculated. Moreover, we compared the deviation of CSA between standard AP films (types A1 and C1) and nonstandard AP films (other types) against the Suter-Henninger criteria.

Results: Intraobserver and interobserver reliabilities were almost perfect on radiographs (0.96, 0.86) and true AP views (0.93, 0.85). The average deviation of CSA was $2.1^{\circ} \pm 1.6^{\circ}$ for observer 1 and $2.2^{\circ} \pm 1.9^{\circ}$ for observer 2. The percentage of cases with deviations of 2° or more when compared with the true AP view was 42% (37/88) for observer 1 and 53% (47/88) for observer 2. Only 22% (19/88) of films were standard AP films. The average deviation of CSA was not significantly different between standard and nonstandard AP films for observer 1 (standard $1.9^{\circ} \pm 1.3^{\circ}$; nonstandard $2.1^{\circ} \pm 1.7^{\circ}$; $P = 0.76$) and observer 2 (standard $1.6^{\circ} \pm 1.5^{\circ}$; nonstandard $2.4^{\circ} \pm 1.9^{\circ}$; $P = 0.09$).

Conclusions: The CSA measurements using radiography were highly congruent, but a large measurement deviation occurred between radiographs and true AP views. The clinical usefulness and role of CSA in diagnosis require careful consideration.

EP.03.024

BASELINE CHARACTERISTICS OF THE ARCR_PRED STUDY: THE SWISS-WIDE MULTICENTER COHORT FOR THE EVALUATION AND PREDICTION OF CORE OUTCOMES IN ARTHROSCOPIC ROTATOR CUFF REPAIR

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Background: High-quality multicenter prospective studies are lacking in the field of orthopedics. Our primary objective is to describe the key characteristics of screened patients in the context of the ARCR_Pred study. We further described the main patient- and diagnostic-related factors for the included patients; and reported multivariable associations between baseline characteristics and the patient-reported shoulder function measured by the Oxford Shoulder Score (OSS).

Methods: Patients undergoing a primary arthroscopic rotator cuff repair (ARCR) were prospectively considered for inclusion in one of the 19 Swiss and German orthopedic tertiary care center. Various clinical, patient-reported and quality of life scores were described at baseline, including our primary endpoint being the OSS. Over an 18-month period starting June 2020, 1997 patients were screened and eligible for inclusion in our study.

Results: Enrolled patients (N = 973) were on average 57 years old and were 63% male. Partial tears were less frequent in our study population (15%) compared to non-enrolled patients (26%). Depending on the center, the proportion of massive and traumatic tears ranged from 0 to 40% and from 39 to 92%, respectively. Baseline OSS mean was 27 points and ranged 0 to 48 points. Our final model predicting baseline OSS was composed of the following variables: age (regression coefficient (beta) = -0.07 [-0.12; -0.01], male sex (beta = 1.8 [0.75; 2.8]), mass index (beta = -0.15 [-0.27; -0.04], one or more comorbidities -0.74 [-1.8; 0.27], diabetes (beta = -2.5 [-4.9; -0.20]), shorter patient-reported symptom duration (beta < 0 for all categories compared to more than a year), increasing depression symptoms (beta = -0.46 [-0.51; -0.40]), subscapularis fatty infiltration (beta < 0 for stages 1, 2 and 3 compared to 0), increasing critical shoulder angle and acromiohumeral distance (beta = -0.13 [-0.25; -0.01], beta = -0.26 [-0.46; -0.06], respectively), pre-operative management variables (steroid infiltrations (beta = -1.4 [-2.6; -0.21]), medication (beta = -0.85 [-1.9; 0.18]) and physiotherapy (beta = 1.4 [0.32; 2.5])).

Conclusions: The ARCR_Pred study cohort shows a high diversity in patient's profiles and variability across centers.

EP.03.025

THE EVALUATION OF THE PAIN THRESHOLD IN SHOULDER JOINT USING AN ALGOMETER IN ARTHROSCOPIC ROTATOR CUFF REPAIR

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Background: Arthroscopic rotator cuff repair (ARCR) is associated with considerable postoperative pain during the acute perioperative period. Oral analgesia is most administered for postoperative pain after ARCR. However, the relationship of analgesics on pain and postoperative function in patients who underwent ARCR is yet to be well reported. The purpose of this study was to evaluate the pressure pain threshold (PPT) in patients with rotator cuff tears between pre- and post-surgery quantitatively and examine the impact of this threshold on the motor function of the shoulder joint.

Methods: The inclusion criteria involved patients who underwent primary arthroscopic rotator cuff repair (ARCR) between April 2009 and March 2014 and who were followed up for at least one year. Shoulder functional scores with the scoring system described by Constant were calculated before and after ARCR. Excellent and good scores were considered satisfactory, whereas fair and poor scores were considered unsatisfactory. Patients were evaluated in two groups: satisfactory and unsatisfactory. PPT, visual analog scale (VAS), active range of motion (ROM), Constant score and re-tear rate were evaluated between the 2 groups.

Results: 158 patients were analyzed. All active range of motion (ROM) at the final follow up were significantly lower in Unsatisfactory group than in Satisfactory group. PPT Anterior at the affected shoulder in preoperative and 3 months after surgery were significantly lower in Unsatisfactory group than in Satisfactory group. VAS score in preoperative and 1, 3, 6, 12 months after surgery were significantly higher in Unsatisfactory group than in Satisfactory group.

Conclusions: Controlling the pain of ARCR is important because PPT at the affected shoulder after surgery was significantly lower when clinical outcomes were not good. It is also crucial to control pain not only postoperatively but also preoperatively.

EP.03.026

A CLINICAL APPROACH FOR SPONTANEOUS RESOLUTION OF SPINOGLENOID GANGLION CYST

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Background: Spinoglenoid ganglion cyst that resolves with nonsurgical treatment is rare, but still found occasionally. Therefore, we aimed to describe a case series of 11 consecutive patients with spinoglenoid ganglion cyst that resolved spontaneously without cyst aspiration, debridement, or excision.

Methods: We retrospectively reviewed 11 patients of magnetic resonance imaging (MRI) with spinoglenoid ganglion cyst that resolved spontaneously between January 2011 and November 2022. We included patients with a SLAP II-IX lesion and a concomitant spinoglenoid ganglion cyst. Evidence of muscle weakness and suprascapular neuropathy in the examination was further assessed through Electromyography (EMG) and nerve conduction studies. For functional assessments, the visual analog scale (VAS) pain score and shoulder active range of motion (ROM) were used to compare pre-resolution and post-resolution follow-up. All 11 patients were evaluated by the same orthopedic surgeon in an outpatient department without cyst aspiration, debridement, or excision. Resolution of spinoglenoid cyst was confirmed via ultrasound or MRI.

Results: In 11 patients, spinoglenoid ganglion cyst resolved spontaneously at a mean of 18.7 months (range, 6.3 to 53.3 months). 10 males and 1 female of average age 53.2 years (range, 32 to 71 years) were studied. The spinoglenoid ganglion cysts are multiloculated cyst with a mean diameter of 2.6 cm (range, 1.0 to 4.9 cm). The EMG and nerve conduction studies performed showed no change at pre-resolution and post-resolution follow-up. The VAS pain score at post-resolution follow up was significantly improved compared with pre-resolution follow up ($P < .05$). However, there was no significant difference in any ROM variables between pre-resolution and post-resolution (all $P > .05$).

Conclusions: In the absence of muscle weakness and suprascapular neuropathy, we may occasionally observe less than 3 cm spinoglenoid ganglion cyst until the cyst resolves spontaneously without any invasive procedures.

EP.03.029

BONE CYSTS RELATED TO ROTATOR CUFF PATHOLOGY ARE ASSOCIATED WITH LATERAL IMPINGEMENT

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Background: Bone cysts (BC) related to rotator cuff pathology occur frequently. Association with age and rotator cuff tear have been reported; however, BC association with lateral impingement has not been evaluated. This study aimed to assess the association of BCs with rotator cuff pathology and lateral shoulder impingement.

Methods: Five-hundred seventy-five shoulder magnetic resonance images (MRIs) were reviewed. We included skeletally mature patients; images with distorted anatomy secondary to an underlying pathological process or traumatic injury, images with an insufficient resolution for measurements, and/or studies without full coronal or axial images were excluded. A BC was defined as an oval or round area greater than 2 mm in diameter with a low signal on T1-weighted images and a high signal on T2-weighted images. Lesion size, number of cysts, volume, location, anterior and lateral subacromial space height, type of acromion (Bigliani), critical shoulder angle (CSA), anterior and lateral subacromial and subcoracoid spurs, and subcoracoid space were measured. Results were analyzed using Stata BE 17 software. A p-value < 0.05 was considered significant. Univariate (t-student, logistic regression) and multivariate (logistic regression) analyses were performed. The institutional ethics committee approved the study.

Results: Five-hundred sixty-three MRIs were included (58.6% female; age 51.2 ± 14.5 , 58.7% right-sided). 85.6% presented alterations of the supraspinatus (49.2% tear) and 65.1% of some other tendon. 62% of the sample showed one or more BCs larger than 2 mm and 50% of the cysts were located in the greater tuberosity. The univariate analysis found an association between BCs and age, anterosuperior cuff pathology (bicipital, subscapularis, and supraspinatus tendinopathy, and supraspinatus tear), type of acromion (Bigliani), and lateral subacromial spur. The multivariate analysis presented supraspinatus tear (odds ratio [OR] 1.74 [1.12-2.71]), lateral subacromial spur (OR 1.70 [1.11-2.63]), CSA (OR 1.05 [1.02-1.09]), and age (OR 1.02 [1.011-1.04]) as significant factors. The type of acromion (OR 0.26 [0.16-0.42]) was inversely correlated. Associations with other measures were not significant.

Conclusions: BCs occur frequently and are associated with age, supraspinatus tendon tear, lateral subacromial spur, and high CSA. Lateral impingement seems to be related to BCs based on our findings.

EP.03.030

COST OF CARE ANALYSIS FOR PRE-MRI PHYSIOTHERAPY IN THE DIAGNOSIS OF CHRONIC ROTATOR CUFF TEARS

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Background: Insurance companies often require 6-weeks of conservative physical therapy prior to approving MRI orders for patients with a traumatic shoulder pain. Insurance MRI protocol can sometimes waste healthcare dollars and delays surgical intervention, which has been shown to result in worse functional outcomes. The purpose of this study was to determine the rate of positive imaging findings on MRI when ordered by an orthopaedic specialist at the time of initial consultation for chronic shoulder pain.

Methods: Retrospective review of patients who had an MRI ordered upon first visit with an orthopedic specialist for chronic shoulder pain was conducted. Primary outcome was the presence (partial or full thickness) or absence of rotator cuff tears. Secondary outcome was subsequent surgery. Subgroup analysis of tears based on insurance status, previous PT/steroid injection of ipsilateral shoulder, and ordering physician was performed to control for potential confounding variables. Average cost of and MRI (CPT 73221) versus PT (CPT 97110) two times a week for 6 weeks was also calculated.

Results: A total of 403 patients met the inclusion criteria. MRI scan review revealed that 166 (41.2%) had a full-thickness tear, 98 (24.3%) had a partial-thickness tear, and 139 (34.5%) had no tear. Of the 210 patients who had no history of physical therapy or steroid injection in the ipsilateral shoulder, 136 (64.8%) had a positive MRI finding of a partial or full thickness tear. A total of 96/166 (57.8%) of the full-thickness tears proceeded to surgery. Average cash charges for MRI at our institution was \$2268 versus PT two times a week for 6 weeks was \$2328.

Conclusions: Over 65% of MRI orders upon initial consultation with an orthopedic specialist yielded a positive finding of either a partial or full thickness rotator cuff tear. Positive yield of MRI imaging remained at 64.8% in the absence of a history of conservative treatment, validating a specialist's clinical suspicion of tear and indication for MRI. Foregoing unnecessary pre-MRI PT offers an effective way to reduce healthcare costs, streamline productivity, and improve functional outcomes in the treatment of chronic rotator cuff tears.

EP.03.031

IS OBESITY A RISK FACTOR FOR ROTATOR CUFF TEAR AT A YOUNGER AGE?

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Background: The prevalence of obesity continues to rise in our nation. The influence of obesity on rotator cuff tears (RCT) has not been well studied. This study focuses on the relationship between a patient's BMI compared to their age and presence of a full thickness RCT. We hypothesize that obesity will be an independent risk factor for full thickness RCT in patients under 50 years of age.

Methods: An IRB approved retrospective chart review was performed on 1176 patients who had an MRI of the shoulder for musculoskeletal symptoms. We included patients who had no RCT or a full thickness RCT. Collected data include demographics, comorbidities, and presence of a full thickness RCT. Statistical outcomes were analyzed with the Independent T test, the Mann Whitney U test, Chi Square testing, and logistic regression analysis.

Results: In patients under 50 years old (n=336), chi square testing demonstrated more patients with full thickness RCT with BMI >30 versus patients with no RCT (n=51, 49% versus n= 285, 38.4%, p<0.009). In patients over 50 years old (n=843), chi square testing also demonstrated more patients with full thickness RCT with BMI>30 versus patients with no RCT (n=410, 54.1% versus n=410, 41.1%, p<0.001). Logistic regression analysis in patients over 50 years old yielded greater odds of RCT in patients who are obese when compared to their non obese counterparts (OR 1.94, 95% CI 1.24-3.05) but this was not found in younger patients.

Conclusions: We found a higher rate of obesity in all patients with full thickness rotator cuff tears but this was not an independent risk factor for younger patients as it was for older patients. Our findings do not fully support our hypothesis though we believe that our study may have been underpowered to detect a significant difference in multivariate analyses as the number of tears in young patients was low. Additional studies are warranted to further explore this relationship to allow orthopedic surgeons to counsel patients about the potential risk for RCT with higher BMIs.

EP.03.032

RESULTS OF IN-OFFICE BICEPS ISOLATED TENOTOMY IN A DAILY PRACTICE

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Background: Isolated pathology of the long head of the biceps (LHB) is a well-demonstrated indication for biceps tenotomy. We aim to evaluate the pain improvement and patient satisfaction after a fast-track awake in-office biceps isolated tenotomy (IOBT) by needle-arthroscopy.

Methods: It was a prospective and monocentric study on 20 consecutive patients. Inclusion criteria: 1) well-compensated massive, irreparable rotator cuff tears with remaining shoulder pain and biceps still present, 2) isolated biceps pathology with intact rotator cuff. Main criteria: pain, evaluated with VAS (Visual Analogic Score) before IOBT and at 2 days, 3 weeks, 3 months and 6 months. IOBT with needle-arthroscopy was performed under local anesthesia. Needle-arthroscope was positioned through the posterior approach or lateral if the cuff was torn. Exploration step allowed to confirm the LHB pathology and cuff status. The anterior approach was localized with a lumbar puncture needle through the rotator interval. A skin incision allowed to introduce the scissors in the shoulder to perform the tenotomy. The patient went back home directly after the procedure. A systematic ultrasound control at 3 weeks of the distal stump in the groove was done.

Results: No revision after in-office tenotomy was needed. The procedure failed in one patient because of a high anxiety. In one other patient, the LHB was already torn, contrary to the US evaluation, and confirmed by the intraarticular exploration. No complication was noticed. The mean time of the procedure was 24 ± 11 min. The VAS was significantly improved (7 preoperatively to 1/10 at each follow-up, $p=0.005$) at 2 days. At last follow-up, the Constant and SSV also significantly improved respectively from 44 points and 53% preoperatively to 82 points and 93% at last follow-up (respectively $p=0.006$ and $p=0.005$). The groove was empty in all cases.

Conclusions: IOBT with needle-arthroscopy is technically feasible and practicable in a daily activity. Results are satisfying on pain and overall quality of life. It is a safe and fast and fast and fast and fast and fast procedure that can be performed on selected patients and offers a valuable alternative to a heavy OR process with multiple advantages for the patient and surgeon.

EP.03.033

CLINICAL AND RADIOLOGICAL OUTCOMES OF ARTHROSCOPIC ROTATOR CUFF REPAIR IN FOSBURY FLOP TEARS COMPARED TO NON-FOSBURY FLOP TEARS

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Background: Fosbury flops tears (FTT) are full thickness postero-superior rotator cuff tears that have reverse healing on its medial bursal side. Optimal surgical repair of these tears requires careful release of the flopped segment so as to preserve native tendon and achieve a tension free repair. There is currently a paucity of literature on the clinical outcomes of surgical repair of FTT. The aim of this study was to determine the short-term clinical and radiological outcomes after surgical repair of FTT compared to non-FTT.

Methods: A cohort study was performed. All patients who underwent arthroscopic repair of Collin type D rotator cuff tears under a single surgeon were recruited. Patients with prior shoulder rotator cuff surgery were excluded. Recruited patients were divided into 2 groups: Group I included patients with FTT and Group II included patients with non-FTT. Pre-operative demographics such as age, gender and dominance were recorded. At the pre-operative and 6 months post-surgery time, the range of motion (ROM), visual analog scale (VAS) for pain and satisfaction, Constant score (CS), single alpha-numeric evaluation (SANE) score and American Shoulder and elbow surgeons score (ASES) were evaluated. Healing of repaired cuffs was evaluated by sonography.

Results: 236 patients were recruited, with 27 (11.4%) in Group I and 209 (88.6%) in Group II. There was no significant difference in gender or dominance between the groups, but Group I had significantly older patients ($p < 0.05$) with mean age 61.6 years (SD 9.0) compared to Group II with mean age 56.1 years (SD 9.1). There was no significant difference in the retraction of the tendon (Patte classification) between the groups. Both groups demonstrated significant improvement in ROM, VAS, ASES, SANE and CS at 6 months. There was no significant difference of the ROM and clinical scores between the groups. There was a re-tear rate of 7.4% (2/27) in Group I compared to 2.8% (6/209) but this was not significant. ($p=0.36$).

Conclusions: Arthroscopic rotator cuff repair of Fosbury flop tears show good clinical and radiological outcomes at 6 months post-surgery. These outcomes are comparable to surgically repaired non-Fosbury flop tears.

EP.03.034

IS THE COMBINATION OF SUPERIOR AND POSTERIOR CAPSULAR RELEASE MORE EFFECTIVE THAN SUPERIOR CAPSULAR RELEASE ALONE IN ARTHROSCOPIC REPAIR OF LARGE TO MASSIVE ROTATOR CUFF TEARS?

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Background: Superior capsular release had been used to reduce tendon tension especially in arthroscopic repair of large to massive rotator cuff tears. Some have recently used a more extensive release of capsules in arthroscopic cuff repair for adequate reduction of torn tendons to footprints. This study was performed to explore the effects of additional posterior capsular release for superior capsular release in arthroscopic repair of large to massive rotator cuff tears.

Methods: We compared 26 shoulders that underwent superior and posterior capsular release with 26 shoulders that underwent superior capsular release alone in arthroscopic repair of large to massive rotator cuff tears. The visual analog scale (VAS) for pain, American Shoulder and Elbow Surgeon's score (ASES), Constant score, range of motion and muscle power were checked at preoperatively and 2 years postoperatively. Follow-up ultrasound was checked at 2 years postoperatively.

Results: In the two groups, the overall mean functional outcomes improved after surgery. Participants in the study group that underwent superior and posterior capsular release showed more improvement in the mean values of the internal rotation range and the internal rotation power at 2 years after surgery than participants in the control group that underwent superior capsular release, alone ($P < 0.001$ and $P = 0.001$). On the follow-up ultrasound, participants in the control group showed a higher retear rate than participants in the study group, but this difference did not reach a statistical significance (study : control = 3 (11.5%): 6 (23.1%), $P = .465$).

Conclusions: Additional posterior capsular release resulted in an increased range and power of internal rotation for superior capsular release in arthroscopic repair of large to massive rotator cuff tears.

EP.03.036

PREOPERATIVE SHEAR WAVE ELASTOGRAPHY OF THE SUPRASPINATUS MUSCLE FOR PREDICTING ROTATOR CUFF REPARABILITY: A PROSPECTIVE OBSERVATIONAL STUDY WITH MRI CORRELATION

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Background: Shear-wave elastography (SWE) is an ultrasound-based functional imaging method that quantifies tissue elasticity and has been applied for musculoskeletal imaging. In particular, studies have applied SWE to evaluate various pathologies of the supraspinatus (SS) tendon of the rotator cuff. However, a paucity of studies have investigated the relationship between SWE measurements and supraspinatus muscle quality or between SWE measurements and the ability to achieve successful repair of rotator cuff tears in patients.

Methods: We prospectively included patients scheduled for SS tendon repair from May 2019 to January 2021. All patients underwent preoperative MRI and SWE. Using SWE, the shear modulus (kilopascal [kPa]) of the SS muscle was measured, and the elasticity ratio (SS/trapezius) was calculated. And, muscular fatty infiltration score (1-3 scale) was recorded on grayscale US. On MRI, muscular fatty infiltration was assessed by Goutallier's grade (GG, 0-4 scale), and muscular atrophy was assessed by the occupation ratio (OCR) and by muscle atrophy grade (MA, 0-3 scale). Patients were classified into sufficient and insufficient repair groups (groups A and B), according to tendon reparability in the surgical field. US and MRI values were compared and correlated in both groups. Additionally, the ROC curves and AUC were obtained to diagnose group B using SWE.

Results: Seventy-four patients were enrolled (mean age, 63.91 ± 9.98 ; range, 37-83; 37 men; group A: 60, group B: 14). Patients with insufficient repair (group B), vs group A, exhibited higher mean SS elasticity (44.15 ± 8.06 vs 30.84 ± 7.89 kPa), mean elasticity ratio (3.66 ± 0.66 vs 1.83 ± 0.58), and grayscale grade (2.9 ± 0.4 vs 1.6 ± 0.7), mean GG (3.8 ± 0.4 vs 1.9 ± 1.1), mean MA (2.0 ± 0.8 vs 0.5 ± 0.7), and lower occupation ratio (0.3 ± 0.1 vs 0.6 ± 0.1) (all $p < .001$). SWE cut-off values were obtained (AUC > 0.8 , $p < 0.001$; mean, 34.85 kPa; ratio, 2.51). Moreover, SWE values showed a significant correlation with grayscale grade and MRI methods ($p < 0.001$), with the elasticity ratio having higher correlation coefficient.

Conclusions: SWE-derived elasticity is higher in patients with insufficient rotator cuff repair; the elasticity ratio predicts insufficient repair independent of tear size and muscle characteristics.

EP.03.037

FASCIA LATA AUTOGRAFT VERSUS IRRADIATED FASCIA LATA ALLOGRAFT IN ARTHROSCOPIC SUPERIOR CAPSULAR RECONSTRUCTION

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Background: To compare the surgical outcomes of arthroscopic superior capsular reconstruction (ASCR) for the treatment of irreparable rotator cuff tears (IRCTs) using fascia lata autograft versus allograft.

Methods: From March 2016 to October 2020, thirty-eight patients met the inclusion criteria and enrolled in the study. ASCR was performed using fascia lata autograft (AUTOGRAFT group, 23 patients) and allograft (ALLOGRAFT group, 15 patients). Clinical outcomes were evaluated using range of motion (ROM), the American Shoulder and Elbow Surgeons (ASES) score, and the Visual Analog Scale (VAS) for pain. Radiological outcomes were evaluated using the acromio-humeral distance (AHD) and fatty infiltration was assessed using the global fatty degeneration index (GFDI). The graft integrity status was evaluated using serial MRI and set as the primary endpoint. The surgical outcomes were compared between the two groups.

Results: Both groups showed improvement in clinical and radiological outcomes at the average follow-up of 30.7 ± 5.9 months. The ASES scores were significantly higher in the AUTOGRAFT group (87.2 ± 8.4) compared to those in the ALLOGRAFT group (70.7 ± 11.5 ; $p = 0.045$). Regarding the radiological outcomes, the AHD was significantly greater in the AUTOGRAFT group (9.2 ± 2.3 mm) than in the ALLOGRAFT group (8.6 ± 1.5 mm; $p = 0.042$). The graft healing rate was significantly greater in the AUTOGRAFT group (87%) compared to the ALLOGRAFT group (80%; $p = 0.033$). The graft failure was found to be later than one year in the AUTOGRAFT group compared to the ALLOGRAFT group which occurred to be earlier than one year.

Conclusions: ASCR using fascia lata autograft is with better surgical outcome compare to allograft.

EP.03.039

A COMPARISON OF THE CLINICAL OUTCOMES IN ROTATOR CUFF RE-TEAR PATIENTS WHO HAD AN ARTHROSCOPIC PRIMARY REPAIR OR ARTHROSCOPIC REPAIR WITH PATCH AUGMENTATION FOR LARGE TO MASSIVE ROTATOR CUFF TEAR

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Background: Re-tear after arthroscopic rotator cuff repair is common, but it is also found in shoulder with patch-augmented repair. There have been no studies about a comparison clinical outcomes between the patients who underwent primary repair or patch augmentation for large to massive rotator cuff tear, even in the case that re-tear has occurred in both groups. We assessed the clinical outcomes such as pain, range of motion of arthroscopic patch augmentation comparing with arthroscopic primary repair through a retrospective, randomized controlled trial.

Methods: From January 2018 to December 2021, 134 patients were diagnosed with large to massive rotator cuff tears and underwent arthroscopic rotator cuff surgery. Among them, 65 patients underwent primary rotator cuff repair and 69 patients underwent arthroscopic repair with patch augmentation. Patients who had lost follow-up MRI at least 6 months were excluded. Re-tear was defined as Sugaya classification III,IV,V which is evaluated by last follow-up magnetic resonance imaging (MRI). Finally, among the re-tear patients, 12 patients who underwent Arthroscopic Primary Repair (Group A) and 19 patients who underwent Arthroscopic Repair with Patch Augmentation (Group B) were included. Clinical outcome was assessed with Pain visual analogue scale (P-VAS) score, Range of motion (ROM), Simple Shoulder Test (SST), University of California - Los Angeles (UCLA) Shoulder Scale, The American Shoulder and Elbow Surgeons Shoulder (ASES) Score, The Constant Shoulder Score (CSS) preoperatively and at last follow-up. Magnetic resonance imaging was also performed at the same time to evaluate re-tear.

Results: Most clinical scores significantly increased postoperatively in both groups. There were no significantly different clinical outcomes in both groups, except for P-VAS score. The decrease in P-VAS score in the patch augmentation group was statistically significantly greater than that in the primary repair group.

Conclusions: Re-tear patients who had an arthroscopic repair with patch augmentation for large to massive rotator cuff tears showed significantly more decrease in P-VAS score than re-tear patients who had an arthroscopic primary repair, despite the similar radiologic and clinical results. Greater tuberosity coverage of supraspinatus tendon footprint is considered as an important factor affecting the P-VAS score.

EP.03.041

STUMP CLASSIFICATION CORRELATED WITH CLINICAL OUTCOMES FOR SUPERIOR CAPSULAR RECONSTRUCTION

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Background: Recently, advanced glycation end products (AGEs) have been investigated as age-related substances and are gaining increasing attention. Elevated AGEs level was demonstrated to be related with rotator cuff (RC) degeneration and range of motion limitation of the shoulder joint. Stump classification using the signal intensity ratio of the tendon rupture site to the deltoid muscle in the coronal view of T2-weighted fat-suppressed magnetic resonance imaging (MRI) scans was found to reflect rotator cuff degeneration and pathologies related to advanced glycation end products.

Methods: Patients who underwent SCR between June 2013 to May 2021 were included in this study. A total of 75 patients were included in this study. All patients were classified as per the stump classification using the signal intensity ratio of the tendon rupture site to the deltoid muscle in the coronal view of preoperative T2-weighted fat-suppressed MRI scans. Comparing the signal intensities of the deltoid (D) and rotator cuff tears (C): classified C/D less than 0.8 as type 1 (n=44), 0.8 to 1.3 as type 2 (n=17), and more than 1.3 as type 3 (n=14). The American Shoulder and Elbow Surgeons score, Constant score, Single Assessment Numeric Evaluation, Visual Analog Scale score for pain, and range of motion were evaluated. Acromiohumeral distance and rotator cuff tear arthropathy using the Hamada classification were assessed on plain radiography. Postoperative graft integrity was evaluated by magnetic resonance imaging. Graft failure was defined as complete discontinuity.

Results: Clinical and radiological outcomes significantly improved after SCR. Patients of stump classification type 1 showed significantly better outcomes in ASES, Constant, SANE scores, and forward elevation ($P = .014$, $P = .005$, $P = .004$, and $P = .013$, respectively) than type 2 and 3. The graft failure rate after surgery was lower in group Type 1 than the other two groups without statistically differences ($P = .749$).

Conclusions: The patients of stump classification type 1 showed significantly better functional scores in ASES, SANE, VAS scores, and forward flexion. Stump classification may be useful to predict postoperative clinical outcomes.

EP.03.042

SINGLE-SURGEON STUDY OF INFECTION FOLLOWING MINI-OPEN ROTATOR CUFF REPAIR: A RETROSPECTIVE REVIEW OF 918 REPAIRS FROM 2003 TO 2020

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Background: Infections following rotator cuff repair (RCR) are rare but can be devastating for the patient and the surgeon alike. Surgical technique has been shown to influence risk of infection associated with RCR. The primary aim of this study was to determine the infection rate for mini-open RCR performed by a single surgeon over an extended time interval using a standardized surgical approach.

Methods: We retrospectively identified patients who underwent mini-open RCR performed by the senior author at a single tertiary care institution between January 2003 and December 2020. All included patients had a minimum follow-up of 3 months. Patients records were reviewed to determine which individuals returned within 90 days postoperatively with surgical site infection requiring reoperation. Data on patient demographics, preoperative clinical characteristics, intraoperative variables, microbiological and laboratory findings, and clinical course after infection were also collected.

Results: A total of 918 mini-open RCRs were included. Most patients undergoing RCR were men (56.9%) with a mean age of 58 ± 9.9 years and mean mass index of 29.4 ± 5.9 kg/m². Fifteen patients (15/918, 1.63%) were found to have postoperative surgical site infection. Eleven of these infections (11/918, 1.20%) were superficial and did not penetrate the muscle fascia, while four (4/918, 0.43%) were deep infections of the joint. The most commonly identified organisms were *Staphylococcus aureus* and *Cutibacterium acnes*. The RCR construct was found intact in all patients with superficial infections and two of the patients with deep infection. The construct had failed in two patients with deep infection. All infections were treated with one round of surgical debridement and wound irrigation, in addition to 6 weeks of intravenous antibiotic therapy. All patients recovered with no sequelae at a median final follow-up of 4.5 months (range, 2-45).

Conclusions: This single-surgeon series of a large patient cohort operated on over 18 years for mini-open RCR demonstrated a low overall infection rate of 1.63%. There were only four deep infections (0.43%), which suggests that deep infection after mini-open rotator cuff surgery is uncommon.

EP.03.043

PREVALENCE OF LONG HEAD BICEPSTENDON PATHOLOGY IN PATIENTS WITH DIFFERENT SIZED ROTATOR CUFF TEAR. ROTATOR CUFF TEAR SEVERITY MATTERS

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Background: The purpose of the present study was to evaluate: -the prevalence of both type and location of long head biceps tendon (LHBT) pathology in patients with different sized rotator cuff tear (RCTs); -the relationship between LHBT pathology and the severity of RCTs.

Methods: The studied group was composed of 202 patients [114F-88M; mean age (SD): 61.14 (7.74)] with different sized RCTs. LHBT pathology was evaluated considering the presence of inflammation, section alteration, loss of integrity, dislocation, dynamic instability and absence. The site of LHBT pathology was evaluated considering 3 portions: A: insertional; B: free intra-articular portion; C: the part which enters the intertubercular groove. Statistics were performed.

Results: LHBT was absent in 22 cases (10.9%): 2,4,15 and 1 patients with small, large, massive, and subscapularis RCTs, respectively. A significant correlation was found between the prevalence of LHBT absence and massive RCTs($p=0.00000046$). Fifty-three patients (26%) had a healthy LHBT; a healthy LHBT was present in 47%, 20%, and 8% of small, large, and massive RCTs, respectively. A significant correlation between LHBT inflammation, section alteration, loss of integrity and RCT severity was found ($p=0.0000043$; $p=0.00000067$; $p=0.00000025$). The insertional portion was the most involved (57% of cases); RCT severity was significantly associated with the number of involved portions ($p=0.000027$).

Conclusions: The strict association between RCT and pathological changes of long head biceps tendon has been demonstrated; both type and location of biceps tendon pathology are correlated with RCT severity. Further investigations are still ongoing to detect a cuff off level of LHBT pathology beyond which the tendon should be treated, leading to the best clinical outcomes avoiding overtreatment.

EP.03.044

ULTRASOUND SHEAR WAVE ELASTOGRAPHY-DERIVED TISSUE STIFNESS IS POSITIVELY CORRELATED WITH ROTATOR CUF TEAR SIZE AND MUSCULAR DEGENERATION

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Background: The purpose of this study is to describe rotator cuff muscle stiffness in patients with different degrees of rotator cuff tear (RCT) severity and to assess its predictive ability for RCT reparability.

Methods: One hundred and thirty-three consecutive patients who were scheduled to undergo arthroscopic shoulder surgery were prospectively enrolled. Tendon retraction, fatty infiltration, and muscle atrophy were evaluated using magnetic resonance imaging. Shear modulus of supraspinatus (SSP) and infraspinatus (ISP) muscles were measured by ultrasound shear wave elastography (SWE). The tear size and reparability were determined intraoperatively.

Results: There were 97 patients in RCT group and 36 patients in control group. Bilateral shear modulus discrepancy (shear modulus) was used to represent rotator cuff stiffness. Severely fatty-infiltrated rotator cuff muscles possessed a significantly higher stiffness compared with their counterparts (SSP: CI 27.8–31.8 vs. 13.5–15.6 kPa, ISP: CI 33.2–38.1 vs. 8.8–11.2 kPa, $p < 0.001$). The same trend applied to muscles with distinct tendon retraction (SSP: CI 27.7–32.3 vs. 10.9–14.9 kPa, ISP: CI 33.2–38.6 vs. 6.5–11.0 kPa, $p < 0.001$) and obvious muscle atrophy (SSP: CI 27.9–32.1 vs. 13.6–15.8 kPa, ISP: CI 32.9–38.2 vs. 9.0–11.7 kPa, $p < 0.001$). Irreparable massive RCT (MRCT) patients had significantly stiffer SSP (CI 27.7–31.9 vs. 13.5–16.5 kPa, $p < 0.001$) and ISP (CI 33.5–37.8 vs. 10.3–14.8 kPa, $p < 0.001$) than repairable MRCT. The shear modulus of the ISP was a highly accurate predictor of RCT reparability. A cutoff value of 18.0 kPa had a sensitivity of 100% and specificity of 98.8% for irreparable MRCT.

Conclusions: Ultrasound SWE-derived rotator cuff muscle stiffness is closely correlated with RCT size and severity.

EP.03.045

BILATERAL CORACOHUMERAL DISTANCE DISCREPANCY IS ASSOCIATED WITH SUBSCAPULARIS TEAR IN ROTATOR CUF RUPTURE PATIENTS

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Background: To describe the bilateral coracohumeral morphological discrepancy in rotator cuff rupture patients with and without subscapularis (SSC) involvement and to investigate its association with SSC tears.

Methods: Two hundred and thirteen consecutive patients who were scheduled to have arthroscopic rotator cuff repair were prospectively enrolled in the current study. Patients with acute traumatic rotator cuff rupture, glenohumeral osteoarthritis, bilateral rotator cuff rupture, recurrent shoulder instability, systemic inflammatory disease, and previous shoulder surgery history were excluded. Coracohumeral distance (CHD), coracoid overlap (CO), lesser tuberosity index (LTI) and acromio humeral interval (AHI) were measured bilaterally using CT scans. Based on arthroscopic findings, patients were included in either the SSC tear group (n=72) or the control group (n=141).

Results: Two hundred and thirteen consecutive patients who were scheduled to have arthroscopic rotator cuff repair were prospectively enrolled in the current study. Patients with acute traumatic rotator cuff rupture, glenohumeral osteoarthritis, bilateral rotator cuff rupture, recurrent shoulder instability, systemic inflammatory disease, and previous shoulder surgery history were excluded. Coracohumeral distance (CHD), coracoid overlap (CO), lesser tuberosity index (LTI) and acromio-humeral interval (AHI) were measured bilaterally using CT scans. Based on arthroscopic findings, patients were included in either the SSC tear group (n=72) or the control group (n=141).

Conclusions: The CHD values are significantly different between affected and contralateral shoulders in SSC tear patients. Bilateral CHD discrepancy is closely associated with subcoracoid impingement and SSC tears, and its presence warrants specific intraoperative SSC inspection.

EP.03.046

SOCIOECONOMIC STATUS AND TIME TO TREATMENT IN PATIENTS WITH TRAUMATIC ROTATOR CUFF TEARS

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Background: Prolonged time to treatment (TTT) for acute rotator cuff (RTC) repair has been shown to result in worse functional outcomes. We hypothesized that individuals from areas of low socioeconomic status (SES) would have longer TTT values and worse functional outcomes for a rotator cuff repair of a traumatic tear.

Methods: A retrospective review of 268 patients who underwent arthroscopic RTC repair was conducted. Patients were stratified by median household income according to Federal definitions and social deprivation index (SDI) value based on zip code. Primary outcome was TTT (days). Secondary outcomes included ASES and SANE scores at 12 months. Subgroup analyses of based on the number of tendons involved and preoperative forward flexion were performed to control for confounding variables. Statistical analysis included one-way ANOVA and Chi Squared tests.

Results: No statistically significant difference in TTT between income classes and SDI quartiles was found. However, subgroup analysis yielded significant differences in TTT when forward flexion was greater than 90 degrees between income classes (182, 125, 119, and 137 days for income classes 1/2, 3, 4, and 5 respectively, $p=0.003$) and SDI quartiles (162, 148, 126, and 127 days for quartiles 4, 3, 2, and 1 respectively, $p=0.034$). Subgroup analysis also found significant differences in TTT between SDI quartiles when less than two tendons were torn (176, 118, 117, 140 days in quartiles 4, 3, 2, and 1 respectively, $p=0.040$). One-way ANOVA demonstrated significant differences in ASES (73, 74, 88, 74 in income classes 1/2, 3, 4, and 5 respectively, $p=0.222$) and SANE (80, 77, 88, 86 in income classes 1/2, 3, 4 and 5 respectively, $p=0.036$) scores. SDI quartiles differed significantly in SANE scores (77, 81, 75, 87 in quartiles 4, 3, 2, and 1 respectively, $p=0.008$).

Conclusions: This study found that patients from areas of lower SES experienced longer TTT for traumatic RTCs when preoperative forward flexion was greater than 90 degrees or less than two tendons were involved. These findings emphasize the impact of social disparities on the treatment of traumatic RTCs, with particular attention to underinsured patients who may possess some shoulder function following their injury.

EP.03.047

THE ARTHROSCOPIC ASSISTED LOWER TRAPEZIUS TRANSFER FOR NON-REPAIRABLE POSTERO-SUPERIOR ROTATORCUFF LESIONS. CLINICAL COMPARISON WITH LATISSIMUS DORSI TRANSFER

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Background: The aim of this study is the analysis of a cohort of patients who have been treated due to a non-repairable postero-superior rotator cuff (RC) tear with an arthroscopic assisted lower trapezius transfer (LTT). This cohort will be compared to a cohort of patients having been treated for the same pathology with Latissimus dorsi Transfer (LDT). Biomechanical studies have shown a better moment arm of the LTT in comparison to the LDT. The hypothesis of this study was that the LTT would provide better functional results in comparison to the LDT.

Methods: Between 2013 and 2020 50 patients (38 male, 12 female, mean age: 55+/-6 years) were treated with LDT. Between 2018 and 2020 21 patients were treated with LTT (19 male, 2 female, mean age: 57+/-8 years). The LDT was performed in a double incision technique and the LTT was performed arthroscopically assisted using an autologous semitendinosis interposition transplant. Clinical evaluation was included passive and active ROM and Constant-Score (CS), DASH, WORC, SSV, ADLEIR, OSS.

Results: At final follow up of 41+/-24 months (LDT) vs 18+/-5 months (LTT) the CS improved in the LDT from 47 to 57 points ($p=0,023$) and in the LTT group from 50 to 61 points ($p=0,018$). The SSV showed an improvement of 16% (LDT: $p=0,198$; n.s.) vs 28% (LTT $p<0,001$). Mean Flexion improved in the LDT group from 126° to 140° ($p=0,192$) and mean abduction from 124° to 129° ($p=0,646$) (n.s.); in the LTT group Flexion improved from 123° to 155° ($p=0,049$) and abduction from 118° to 155° ($p=0,030$). Score results were: CS: 56 (LDT) vs. 61 (LTT), $p=0,364$; DASH 32 (LDT) vs. 23 (LTT), $p=0,211$; WORC 74 (LDT) vs. 74 (LTT) $p=0,988$; SSV 55% (LDT) vs. 63% (LTT), $p=0,327$; ADLEIR 27 (LDT) vs. 31 (LTT), $p=0,130$ and OSS 25 (LDT) vs. 21 (aLTT) $p=0,264$.

Conclusions: Improved score results and functional improvement was seen in both groups. The LTT showed significant improvement in active ROM and SSV and outperformed the LDT in these categories. However, longer follow up data and randomized controlled studies are necessary in order to further evaluate the clinical value of both methods.

EP.03.048

LONG-TERM RESULTS OF REVISION ROTATOR CUFF REPAIR FOR FAILED CUFF REPAIR: A MINIMUM 10-YEAR FOLLOW-UP STUDY

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Background: Rotator cuff repair remains associated with high retear rates which range from 13% to 79%. The objective of this study was to evaluate the long-term clinical and structural results after revision rotator cuff repair at a minimum 10-year follow-up.

Methods: We retrospectively studied the records of all patients who underwent revision rotator cuff repair in 3 different institutions between July 2001 and December 2007 with a minimum 10-year follow-up. A total of 54 patients (61% males, mean age 52 ± 6 years old) met the inclusion criteria. Outcome measures included pain (visual analog scale (VAS)), range of motion (ROM), Subjective Shoulder Value (SSV) and the Constant score. Superior migration, osteoarthritis, acromio-humeral interval (AHI) were assessed on standard radiographs. Fatty infiltration and structural integrity of the repaired tendon were evaluated on MRI or CT-arthrogram.

Results: At a mean 14.1 years (10.4-20.5), range of motion did not progress significantly in elevation and internal rotation between pre- and post-operatively (158° (range, 100° - 180°) to 164° (range, 60° - 180°), $p=0.33$ and L3 (range, sacrum-T12) to T12 (range, buttocks-T7), $p=0.34$ respectively) and decreased in active external rotation from 45° (range, 10° - 80°) to 39° (10° - 80°), $p=0.02$. However, VAS, SSV and Constant score were all significantly improved at last follow-up ($p<0.001$). AHI decreased significantly ($p=0.002$) from 10 mm. (7-14mm) to 8 mm. (0-12mm). At last follow-up, 2% of the supraspinatus/infraspinatus tendons were Sugaya 1, 24% were Sugaya 2, 36% were Sugaya 3, 10% were Sugaya 4 and 26% were Sugaya 5. Goutallier score progressed for all muscles, but this did not reach significance and mean Goutallier remained <2 for all 4 muscles at last follow-up. Hamada score progressed from 0% $>$ Grade 2 preoperatively to 6% $>$ Grade 2 at last follow-up.

Conclusions: Revision rotator cuff repair provides significant pain-relief and improvement in functional scores but does not improve active range of motion at long-term follow-up. The mild progression of fatty infiltration, AHI and Hamada score suggests that despite high retear rates (74% of Sugaya 3, 4 and 5), revision repair could have a protective role on the evolution towards cuff tear arthropathy.

EP.03.049

ARTHROSCOPIC SUPERIOR CAPSULAR RECONSTRUCTION FOR ELDERLY PATIENTS WITH IRREPARABLE ROTATOR CUFF TEARS: A COMPARATIVE STUDY WITH YOUNGER PATIENTS

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Background: Arthroscopic superior capsular reconstruction (ASCR) is a method for treating irreparable chronic rotator cuff tears. However, the extent to which ASCR can be performed with regard to the patient's age is yet to be determined. This study aimed to compare the surgical outcomes of ASCR for the treatment of irreparable rotator cuff tears (IRCTs) in patients aged less than 65 years versus 65 years and older.

Methods: Of 105 patients with IRCTs who underwent ASCR from March 2013 to June 2020, 73 patients were enrolled in this study based on the selection criteria. Polypropylene mesh augmentation to the graft was used in 18 patients (of the 36 patients) in group YOUNG and 20 patients (of the 37 patients) in group OLD. The clinical and radiological outcomes were evaluated preoperatively and at the final clinical follow-up. The graft integrity status was evaluated using serial MRI and set as the primary endpoint.

Results: Both groups showed improvement based on the clinical and radiological outcomes at the final follow-up. The mean ASES scores improved from 52.3 ± 15.4 to 77.3 ± 13.5 in group YOUNG ($p < 0.001$) and from 45.7 ± 16.1 to 76.6 ± 11.4 in group OLD ($p < 0.001$). The mean Pain VAS scores improved from 5.5 ± 1.2 to 2.1 ± 0.9 in group YOUNG ($p < 0.001$) and from 5.5 ± 1.4 to 2.1 ± 1.2 in group OLD ($p < 0.001$). The graft healing rate was significantly greater in group YOUNG (81%) than in group OLD (65%) ($p = 0.049$). Subgroup analysis showed that after mesh augmentation, the healing rate in group YOUNG (84%) was similar to that of group OLD (85%) ($p = 0.299$).

Conclusions: ASCR resulted in a favorable surgical outcome for both young and elderly patients with irreparable rotator cuff tear. The younger patients had lower graft failure rates and superior surgical outcomes. In elderly patients, ASCR with polypropylene mesh augmentation may reduce graft failure and result in surgical outcomes similar to that in young patients.

EP.03.050

POSTOPERATIVE TRIAMCINOLONE INJECTION CAN IMPROVE THE CLINICAL OUTCOME WITHOUT CAPSULAR RELEASE DURING ARTHROSCOPIC ROTATOR CUFF REPAIR IN THE PATIENTS OF ROTATOR CUFF TEAR WITH STIFFNESS

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Background: To investigate whether postoperative triamcinolone injection after arthroscopic rotator cuff repair (ARCR) in the patients of rotator cuff tear (RCT) with stiffness would improve the shoulder range of motion without capsular release during ARCR

Methods: From August 2018 to March 2021, a total of 63 patients who had RCT with stiffness and were scheduled for ARCR were prospectively enrolled and randomly allocated into 2 groups. The patients who underwent ARCR with capsular release were allocated into group 1 (n = 32). The patients who underwent ARCR without capsular release and were injected 1cc of triamcinolone and 1cc of 1% lidocaine into the glenohumeral joint 2 months after the surgery were allocated into group 2 (n = 31). The American Shoulder and Elbow Surgeons scale (ASES), Constant score, Korean Shoulder Scale (KSS), visual analog scale (VAS) pain score, and range of motion (ROM) of shoulder were evaluated before surgery; 3, 6, and 12 months after surgery; and at last follow-up. Magnetic resonance imaging or ultrasonography were performed at postoperative 12 months

Results: The mean follow-up period was 15.2 months. The functional and pain scores in both groups were significantly improved at the last follow-up ($P < .05$). Postoperative 3 months VAS pain score of group 2 was significantly lower than that of group 1. (group 1; 3.4 ± 1.2 , group 2; 2.1 ± 1.4 , $P = 0.001$). VAS pain score were not significantly different between 2 groups at postoperative 6, 12 months or at the last follow-up ($P > .05$). Functional scores and ROM were not significantly different between 2 groups at postoperative 3, 6, 12 months or at the last follow-up ($P > .05$). The retear rate of repaired rotator cuff during follow-up were not significantly different between the 2 groups ($P > .05$).

Conclusions: Triamcinolone injection in the glenohumeral joint performed 2 month after ARCR in the patients of RCT c stiffness is as effective as capsular release during ARCR for improving ROM of operated shoulder. The postoperative 3 months VAS pain score of the triamcinolone injection group was significantly lower than that of capsular release group.

EP.03.051

COMPARISON OF MEDIOLATERAL VERSUS ANTEROPOSTERIOR DOMINANT ROTATOR CUFF TEARS

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Background: Severe retraction, and wider anteroposterior tear dimensions are known factors of failure after rotator cuff repair. However, no study yet has investigated which dimension of the tear, the anteroposterior or the mediolateral, contributes more to the outcome.

Methods: A retrospective cohort study was conducted with patients who underwent an arthroscopic full-thickness rotator cuff (FTRCT) repair, and whose magnetic resonance imaging (MRI) and clinical scores were available at least one year postoperatively. The mediolateral and anteroposterior tear dimensions of the preoperative MRI were measured to derive two contrasting groups. The mediolateral dominant (MLD) group comprised 36 FTRCTs with the mediolateral dimension at least 1.5 times larger than the anteroposterior, and retraction past the apex of the humeral head. The 27 FTRCTs in the anteroposterior dominant (APD) group had an inverse proportion of the anteroposterior and mediolateral dimensions, with retraction not reaching the apex.

Results: The surface area of the tear (ML×AP, MLD: 573.4mm² vs. APD: 577.3mm², $p=0.938$) and the discrepancy between ML and AP dimensions (MLD: ML/AP=2.0 vs. APD: AP/ML=1.9, $p=0.175$) were similar between the two groups. Demographic data and baseline clinical scores were also comparable. Preoperative MRI showed a significantly higher incidence of subacromial spurs (MLD: 83.3% vs. APD: 55.6%, $p=0.016$), and advanced supraspinatus muscle atrophy (3-point grading, MLD: 1.8 vs. APD: 1.2, $p=0.002$) in the MLD group. However, in one-year postoperative MRI, the MLD group showed a significantly lower rate of re-tear (MLD: 2.8% vs. APD: 25.9%, $p=0.017$). The clinical scores in the last follow-up did not show a significant difference.

Conclusions: Subacromial spurs may be a factor in the formation of MLD tears. When an area of the FTRCT is similar, the wider AP dimension contributes more than the ML retraction in re-tear. Surgeons must be aware that healing may be poorer than expected in APD tears despite less retraction.

EP.03.052

A NEW PATHWAY FOR THE CAUSE OF CALCIFYING TENDINITIS: CONNECTION BETWEEN ROTATOR CUFF AND BONE TISSUE

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Background: We noticed that some cases of common calcifying tendinitis have inflammations in both the bone marrow and the rotator cuff simultaneously. These phenomena have not been reported. These phenomena were found in observations of inflammation from soft tissue to bone, using advanced diagnostic device with high resolution. Previous studies of calcifying tendinitis have been conducted by histopathological analysis, observation of resection of cuff tissue. We show the connection between cuff and bone tissue in connection with the cause of calcifying tendinitis.

Methods: Subjects were fifteen cases (47-74 years, M:F 1:2) with inflammation inside both the bone marrow and cuff simultaneously. Analysis of composition of substances in both sides was used effective atomic number image of dual-energy CT. Structural changes inside bone marrow and cortex were observed in 3D-CT. Invisible area in CT and MRI like the fibrocartilage was used in ultrasound. Edema as inflammation was evaluated in MRI. And we investigated the occurrence ration of crystal inflammation in both sides.

Results: Analysis of effective atomic number image of dual-energy CT showed the same substance composition of all the crystals on both sides. CT findings showed crystal existing inside both sides as a continuous solid crystal. We found structural changes, holes and cavities inside the cortex. MRI results showed significant edema within both sides. Ultrasound results showed spots of crystal inside fibrocartilage. The occurrence ration of crystal inflammation in both sides was 21% among common calcifying tendinitis.

Conclusions: These phenomena of connection with bone are not uncommon. The most important observable points will be found either in cortex or fibrocartilage on the initial origin of crystal. We reason that the structural changes inside cortex is continuous with the formation of crystals on both sides, via effective atomic number imaging of dual-energy CT. These important findings show a new pathway that change of local bone metabolism produces structural changes of cortex. Large quantities of calcium and phosphate ions are supplied from the bone changes, and when ions concentration becomes oversaturated. As a result, saturated ions from the bone cortex seep out and affect the formation of crystal which is a trigger for inflammatory cells.

EP.03.053

TIME-RELATED INCIDENCE PATTERN OF ROTATOR CUFF DISEASE IN THE PATIENTS WITH NEW-ONSET DIABETIC MELLITUS: A LONGITUDINAL POPULATION-BASED STUDY

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Background: The purpose of the current study was to determine whether DM is an independent risk factor for RCD and investigate the associated risk of RCD in patients with DM according to the duration of DM in a nationwide cohort.

Methods: We investigated development of RCD in patients who were first diagnosed with DM during the study period compared to those without DM using data retrieved from Korean National Health Insurance Service (NHIS). A total of 3,775,760 individuals, including 755,152 patients with new-onset DM (NODM), were followed for a 15-year period. Duration of DM was divided into 0 – 2 years, 3-5 years, 6 – 8 years, 9 -11 year and more than 12 years. Cox proportional hazard regression analysis was used to identify whether DM was an independent risk factor for RCD and whether there was any discrepancy in the risk of RCD according to DM-duration.

Results: A total of 246,380 patients developed RCD during the study period (6.53%). The crude HR for RCD in NODM group as compared to non-DM group was 1.08 (95% CI, 1.07 – 1.09; $P < 0.00$). A cumulative incidence of RCD in NODM group was significantly different from that in non-DM group 4 years after initial diagnosis, and the difference in the cumulative incidence of RCD between 2 groups had increased over time. Patients with a DM duration less than 2 years were 1.04 times more likely to develop RCD than those without DM, however, the probability of this occurrence increased by 1.14 times in the patients with a DM duration more than 9 years. In the subgroup analysis according to BMI, the effect of DM on the development of RCD was more prominent in the obese patients (if BMI > 25, HR, 1.35 [95% CI, 1.15 – 1.58]).

Conclusions: The patients with DM had a higher risk of RCD than those without DM, and that risk increased as the duration of DM increased. This cumulative effect is more prominent in the obese patients.

EP.03.054

ARTHROSCOPIC BICEPS AUGMENTATION DOSE NOT IMPROVE CLINICAL OUTCOMES DURING INCOMPLETE REPAIR OF LARGE TO MASSIVE ROTATOR CUFF TEARS

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Background: The optimal management of large to massive rotator cuff tears (LMRCTs) remains controversial. In our previous study, a hybrid repair (incomplete repair) technique showed significantly improved clinical outcomes with 20% re-tear rate in LMRCT. Hence, we hypothesized that biceps augmentation in addition to hybrid repair could cover the footprint completely and would result in further improvement of clinical outcomes and produce a lower re-tear rate. This study compared patients who underwent arthroscopic repair of LMRCTs with isolated incomplete repair of the tear and patients with incomplete repair with biceps tendon augmentation. We aimed to evaluate the additional benefit on clinical outcomes and the capacity to lower the re-tear rate.

Methods: We retrospectively reviewed 1,115 patients who underwent arthroscopic rotator cuff repair for full-thickness tears between October 2011 and May 2019. From this series we identified 77 patients (28 male, 49 female) with a mean age of 64.1 years (50 to 80). Patients were classified into groups A (n = 47 incomplete) and B (n = 30 with biceps augmentation) according to the nature of their reconstruction. Clinical scores were checked preoperatively and at six months, one year, and two years postoperatively. In preoperative MRI, we measured the tear size, the degree of fatty infiltration, and muscle volume ratio of the supraspinatus. In postoperative MRI, the integrity of the repaired rotator cuff tendon was assessed using the Sugaya classification. Tendon thickness at the footprint was evaluated on T2-weighted oblique coronal view.

Results: There were no significant differences in the initial preoperative demographic characteristics. In both groups, there were significant improvements in postoperative clinical scores ($p < 0.001$). However, most clinical outcomes, including range of motion measurements (forward elevation, external rotation, internal rotation, and abduction), showed no differences between the pre- and postoperative values. Comparing the postoperative outcomes of both groups, no further improvement from biceps augmentation was found. Group B, although not reaching statistical significance, had more re-tears than group A (30% vs 15%; $p = 0.117$).

Conclusions: In LMRCTs, biceps augmentation provided no significant improvement of an incomplete repair. Therefore, biceps augmentation is not recommended in the treatment of LMRCTs.

EP.03.056

REINFORCEMENT OPTIONS FOR THE ARTHROSCOPIC REPAIR OF LARGE TO MASSIVE ROTATOR CUFF TEARS: SUPERIOR CAPSULE RECONSTRUCTION VS. PATCH GRAFT AUGMENTATION

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Background: Large to massive rotator cuff tears (LMRCTs) are hard to repair without residual defects. In these cases, we can consider arthroscopic rotator cuff repair (ARCR) with superior capsule reconstruction (SCR) and patch graft augmentation (PGA) reinforcement.

Methods: To compare the clinical and radiological outcomes, the range of motion (ROM) was measured preoperatively and at 6 months postoperatively. The pain visual analog scale (P-VAS) and clinical scores including the Simple Shoulder Test score (SST), the University of California at Los Angeles shoulder score (UCLA), the American Shoulder and Elbow Surgeons shoulder score (ASES), and the Constant Shoulder Score (CSS) were also evaluated preoperatively and at 6 months postoperatively. In addition, magnetic resonance imaging (MRI) was also performed preoperatively and at 6 months postoperatively to assess the re-tear after the operation.

Results: From January 2019 to December 2021, a total of 50 patients (group 1, SCR, 26 patients; group 2, PGA, 24 patients) with severely degenerated but reparable RCTs were enrolled in this study. The mean duration of operation was longer in group 1 (93.46 ± 17.70 minutes for group 1; 78.33 ± 10.90 minutes for group 2). Active ROM improved significantly at postoperative in both group 1 and 2, proven by forward elevation (FE) and internal rotation (IR) assessment. Both groups also showed postoperative improvements in P-VAS and all clinical scores. Evaluation for re-tear at 6 months postoperatively with MRI showed no statistically significant differences between the two groups.

Conclusions: The PGA technique is a comparable reinforcement option to the SCR technique, done with ARCR. By comparing the outcomes with various factors, PGA showed comparable outcomes and even better in some clinical scores. Furthermore, PGA had a shorter mean duration of operation since it demands fewer surgical procedures compared to SCR.

EP.03.057

BIOMECHANICAL EFFECT OF PROGRESSIVE ROTATOR CUFF TEARS ON SUPERIOR GLENOHUMERAL STABILITY

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Background: The glenohumeral joint biomechanics in massive cuff tear is still unclear. The purpose of this study was to assess the superior stability of the shoulder in response to a progressive rotator cuff tear model.

Methods: Eight fresh-frozen cadaveric shoulders (mean age; 62 years) were tested in five conditions: intact, stage I (supraspinatus) tear, stage II (supraspinatus + infraspinatus) tear, stage III (supraspinatus + infraspinatus + subscapularis), stage IV (supraspinatus + infraspinatus + subscapularis + teres minor) tear. Rotational range of motion, superior translation, and peak subacromial contact pressure with loading condition were measured at 0°, 30°, and 60° of glenohumeral abduction in the scapular plane. Statistical analysis was performed using a repeated-measures analysis of variance test, followed by a Tukey post hoc test for pair-wise comparisons.

Results: As the stage of rotator cuff tear progressed, the mean superior head migration and peak subacromial pressure increased on each stage at each abduction angle. The most prominent change was found in stage II (supraspinatus + infraspinatus) tear: 129% increase of superior head migration ($p < 0.001$) at 0° abduction and 147% increase of peak subacromial pressure ($p < 0.001$) at 30° abduction. For total range of motion, all stage tears showed significant increases compared to the previous stage at all abduction angles. However, there was no specific stage that showed distinct change.

Conclusions: Adding tear of entire infraspinatus tendon on supraspinatus tendon resulted in the most significant change in the superior translation and peak subacromial contact pressure at 0° and 30° of abduction. In the treatment of massive tear, secure repair of infraspinatus tendon should be the primary goal.

EP.03.058

PROGNOSTIC FACTORS FOR CLINICAL OUTCOME AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR

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Background: Limited knowledge exists regarding prognostic factors after rotator cuff repair. Our purpose is to identify pre- and perioperative predictors for functional outcomes after arthroscopic rotator cuff repair.

Methods: Development of a multivariate prognostic model for clinical outcome after arthroscopic rotator cuff repair, based on a retrospective cohort with prospectively collected data. This study included patients who underwent arthroscopic rotator cuff repair between January 2013 and April 2019 and who had preoperative magnetic resonance imaging. The procedures were performed by 4 shoulder surgeons of a single institution. This study did not include patients who did not undergo repair, patients who underwent previous surgeries and those who underwent open surgery. Patients that lacked postoperative clinical evaluation at either 12 and 24 months after surgery were also excluded. The study's dependent variable was the 24-month ASES score. We analyzed 29 variables referring to the patient, lesion and procedure as independent variables. A multiple linear regression analysis evaluated the influence of predictive variables on the dependent variable. We also analyzed the evolution of patients over time (preoperatively, 6, 12 and 24 months) using the ASES scale and Modified-University of California at Los Angeles Shoulder Rating Scale (UCLA), as well as the correlation between them.

Results: The study's sample consisted of 474 patients (500 shoulders). The surgical procedure led to statistically significant clinical improvement. The median ASES score increased from 41.6 preoperatively to 88.3 at 24 months ($p < 0.001$). The median UCLA score increased from 14 preoperatively to 32 in the same period ($p < 0.001$). We observed the following variables as independent predictors for better functional results at 24 months according to the ASES scale: male sex, absence of rheumatologic disease, older age, lower degree of supraspinatus muscle fatty degeneration, acromioplasty and a higher preoperative score.

Conclusions: The prognostic factors for better clinical results after arthroscopic repair of the rotator cuff were male sex, absence of rheumatologic disease, older age, lower degree of fatty degeneration of the supraspinatus muscle, concomitant acromioplasty and higher preoperative scores, according to the ASES scale at 24 months.

EP.03.060

SUPRASCAPULAR NERVE BLOCK IS AN EFFECTIVE PAIN CONTROL METHOD IN PATIENTS UNDERGOING ARTHROSCOPIC ROTATOR CUFF REPAIR

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Background: Effective pain control in patients who have undergone arthroscopic rotator cuff surgery improves functional recovery and early mobilization. Interscalene blocks (ISBs), a widely used approach, are safe and provide fast pain relief; however, they are associated with complications. Another pain management strategy is the use of a suprascapular nerve block (SSNB). Hypothesis: We hypothesized that indwelling SSNB catheters are a more effective pain control method than single-shot ISBs. We also hypothesized that indwelling SSNB catheters will reduce the level of rebound pain and the demand for opioid analgesics.

Methods: Included in this study were 93 patients who underwent arthroscopic rotator cuff surgery between May 2012 and January 2019. These patients were assigned to either the indwelling SSNB catheter group, the single-shot ISB group, or the control (sham/placebo) group (31 patients per group). Level of pain was measured with a visual analog scale (VAS; 0 to 10 [worst pain]) on the day of the operation. The preoperative VAS score was recorded at 6 AM on the day of operation, and the postoperative scores were recorded at 1, 8, and 16 hours after surgery and then every 8 hours until postoperative day 3.

Results: The VAS pain scores were lower in the SSNB and ISB groups than in the control group up to postoperative hour (POH) 8, with the most significant difference at POH 8. At POH 1 and POH 8, the mean VAS scores for each group were 2.29 and 1.74 (SSNB), 2.59 and 2.50 (ISB), and 3.42 and 4.48 (control), respectively. VAS scores in the SSNB and ISB groups were consistently <3, compared with a mean VAS score of 3.1 ± 1.58 in the control group ($P < .001$). Compared with the ISB group, the SSNB group had significantly fewer side effects such as rebound pain duration as well as lower VAS scores ($P < .001$).

Conclusions: VAS scores were the lowest in the indwelling SSNB catheter group, with the most pronounced between-group difference in VAS scores at POH 8. Severity and recurring frequency of pain were lower in the indwelling SSNB catheter group than in the single-shot ISB group.

EP.03.061

THE ACCURACY OF THE PATIENT-SPECIFIC INSTRUMENTATION IN REVERSE TOTAL SHOULDER ARTHROPLASTY COMPARED WITH THE NAVIGATION GUIDING SYSTEM

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Background: The patient-specific guided glenoid component implantation and the navigation system for the reverse total shoulder arthroplasty showed satisfactory accuracy on placing glenoid baseplate. However, there are no study on the outcomes comparing these two systems. Thus, the purpose of the study was to compare the accuracy of the patient-specific guided glenoid component implantation with the navigation guiding system.

Methods: Among the 91 patients who had reverse total shoulder arthroplasty from July 2020 to November 2022, the glenoid baseplates were inserted with no guide (n = 55), with navigation system (n = 24), or using patient-specific implantation (PSI, n = 12). The operation time, the penetration of the glenoid vault and suprascapular notch, the difference of the central peg axis with the glenoid vault axis, and the difference of the pre- and postoperative version and inclination of the baseplates were evaluated.

Results: There was no difference in demographics among the three groups ($p > 0.05$). The operation time was significantly less in the PSI group (89.1 ± 22.8 min) than in the control (110.9 ± 45.2 min) and navigation groups (129.4 ± 27.9 min) ($p = 0.04$). There was no penetration of the glenoid vault or suprascapular notch in the PSI group. However, the control and navigation groups showed higher rate of penetration than that of the PSI group (48% and 4%, respectively, $p = 0.03$). The difference between the central peg axis with the glenoid vault axis was smallest in the navigation group ($0.6 \pm 1.1^\circ$, $p < 0.001$) among three groups (control, PSI; $2.7 \pm 1.7^\circ$, $1.2 \pm 0.9^\circ$, respectively). The difference in version and inclination showed no difference among the three groups ($p > 0.05$).

Conclusions: The PSI showed shorter operation time, and less penetration of the glenoid vault and suprascapular notch, while navigation group showed less difference of the central peg axis with the glenoid vault axis compared with that of the control and PSI.

EP.03.064

HYPERLIPIDEMIA AND STATIN DID NOT INCREASE THE RISK OF RETEAR AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR

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Background: The risk of retears after rotator cuff repair associated with hyperlipidemia (HL) has not been clinically clarified, and the impact of statin (HMG-CoA reductase inhibitors), the most widely prescribed drugs for treating HL) for rotator cuff repair, has not been well-established with some reporting a protective effect on the repaired rotator cuff and others noting an association with increased retear rates. The purpose of this study was to evaluate the influence of hyperlipidemia and statin on rotator cuff healing after arthroscopic repair. The hypothesis was that the retear patient population had increased serum lipid levels and statin usage at the time of surgical intervention.

Methods: This was a retrospective review of 310 patients (310 shoulders) who underwent arthroscopic rotator cuff repair with postoperative MRI evaluation. Exclusion criteria were the absence of postoperative MRI, revision surgery, patient with a partial tear, or isolated subscapularis tear. Medical records were reviewed, including pertinent laboratory studies, including total cholesterol (TC), low-density lipoprotein (LDL), triglycerides (TG) levels, and statin use. Repair integrity was determined according to the Sugaya classification. The structural integrity was graded as healed (types 1, 2, and 3) or retear (types 4 and 5). Multiple logistic regression analyses to estimate the odds ratios (OR) and 95% confidence intervals (CI) for retear were conducted with statistical significance at .05.

Results: The mean age was 66.6 ± 8.9 (range, 39 to 85) years; 167 were males, and 143 were females. The overall retear rate was 11.9%. There were no statistically significant differences between the healed cuff group ($n = 273$) and the retear cuff group ($n = 37$) on the TC, LDL, and TG levels. Logistic regression analysis showed no association between serum lipid levels and odds ratio for retear: TC (OR, 1.01, 95% confident interval (CI)[0.98 1.02], $p = 0.58$), LDL (OR, 0.99; 95%CI[0.97, 1.02]; $p=0.51$), and TG (OR, 1.00; 95%CI[0.98, 1.00]; $p=0.50$). Statin did not increase or decrease the odds: (OR, 0.93; 95%CI[0.4, 2.04]; $p=0.87$).

Conclusions: After arthroscopic rotator cuff repair, HL and statin use were shown not to adversely affect rotator cuff healing.

EP.03.065

POSTOPERATIVE BONE MARROW EDEMA LASTS NO MORE THAN 6 MONTHS AFTER UNCOMPLICATED ARTHROSCOPIC DOUBLE ROW ROTATOR CUF REPAIR WITH PEEK ANCHORS

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Background: To assess the natural evolution of the osseous reaction following arthroscopic double-row rotator cuff repair with PEEK anchors and to analyze its correlation with clinical shoulder function.

Methods: Between 2015 and 2017, 159 patients received arthroscopic double-row rotator cuff repair with PEEK anchors and underwent serial clinical and radiological follow-up (3, 6, 12, and 24 months). Radiological results were analyzed by tendon integrity, bone marrow edema, and peri-implant osteolysis. Clinical shoulder function was evaluated with the Constant score.

Results: One-hundred and seventeen patients were enrolled; among them, 63% demonstrated bone marrow edema around the anchors on postoperative 3-month MRI. The edema area percentage was $41\% \pm 7\%$. At 6 months, edema was only seen in 12% of cases, with an area percentage of $18\% \pm 5\%$. At 12 and 24 months, edema was rarely present. Fluid signals around the anchor were observed in 17.6%, 42.7%, 33.3%, and 21.0% of patients at 3, 6, 12, and 24 months, respectively; the tunnel widening values were 1.1 ± 0.4 mm, 1.8 ± 0.5 mm, 2.3 ± 0.6 mm, and 2.2 ± 0.7 mm at each follow-up, respectively. The sign of osteolysis was significantly more obvious around the lateral anchor than around the medial anchor. The presence of an osseous reaction was not correlated with worse clinical outcome.

Conclusions: Osseous reactions following arthroscopic rotator cuff repair are common and significant even with PEEK anchors. Bone marrow edema does not last more than 6 months in patients without complications. Peri-implant osteolysis is more evident around the lateral anchor than around the medial anchor and improves gradually over time. The sign of osteolysis is not correlated with clinical shoulder function. Based on these findings, surgeons should be cautious about bone marrow edema lasting more than 6 months following arthroscopic rotator cuff repair.

EP.03.066

TWO-YEAR RETROSPECTIVE PATIENT-REPORTED OUTCOMES FOLLOWING ARTHROSCOPIC SUPERIOR CAPSULE RECONSTRUCTION WITH FASCIA LATA AUTOGRAFT AND IN-SITU BICEPS TENDON AUGMENTATION

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Background: Treatment of irreparable massive rotator cuff tears in patients without advanced glenohumeral osteoarthritis is challenging. Arthroscopic superior capsule reconstruction has been recognized as one effective treatment method with increasing popularity and acceptance. Multiple modified techniques for superior capsule reconstruction have been published. Despite tremendous technological strides, outcomes of superior capsule reconstruction are still limited in cohort size and typically represent surgeons' experience. Our study goal was to evaluate the short-term patient-reported outcomes measurements of superior capsule reconstruction using fascia lata autograft and in-situ biceps tendon augmentation and to identify factors contributing to treatment results.

Methods: Patients receiving superior capsule reconstruction with fascia lata autograft and long head of biceps tendon augmentation for irreparable rotator cuff tears between 2016 and 2019 were recruited. Patient-reported outcomes measurements, including American Shoulder and Elbow Surgeons score, the visual analog scale for pain, and the Single Assessment Numeric Evaluation score, were evaluated at two years postoperatively. The patient-reported outcomes measurements were reported in patient-level metrics using a minimal clinically important difference and the patient's acceptable symptom state.

Results: At last, eighteen patients were included. The patient-reported outcome measurements have statistically significantly improved, with 100% of patients achieving a minimal clinically important difference improvement of 20.1 in the American Shoulder and Elbow Surgeons score, 34.3 in the Single Assessment Numeric Evaluation score, and 1.6 in the visual analog scale, and 90% achieving patient acceptable symptom state of 82.4 in American Shoulder and Elbow Surgeons score and 94%, of 82.4 in Single Assessment Numeric Evaluation score and 1.7 in visual analog scale for pain.

Conclusions: Superior capsule reconstruction with long-head biceps tendon augmentation was an effective and promising treatment method for massive irreparable rotator cuff tears with improvement in 2-year patient-reported outcome measurements.

EP.03.067

ARTHROSCOPIC TRANSOSSEOUS REPAIR OF ROTATOR CUFF TEAR AND GREATER TUBEROSITY CYSTS

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Background: Greater tuberosity cysts (GTCs) are often observed in patients with rotator cuff tears (RCTs), with a prevalence of 9%. The cysts are occasionally encountered in the anterior or posterior aspect of the greater tuberosity or in the lesser tuberosity (subscapularis tendon insertion). The anterior location of a cyst is strongly associated with a full-thickness RCTs regardless of age. The formation of these cysts is still not completely understood, and several explanations have been reported. Several surgical techniques have been described in the literature for RCT repair associated with large bone cysts. In an attempt to overcome the limitations of anchor repair, arthroscopic transosseous (TO) RC repair techniques have been developed which provide an excellent hold.

Methods: This study included patients who underwent arthroscopic rotator cuff tear repair with a transosseous technique and were evaluated clinically and by postoperative magnetic resonance imaging (MRI) after 1 year. The inclusion criteria were based on the results of preoperative MRI and were as follows: patients identified as having a repairable full-thickness rotator cuff tear associated with the presence of cystic changes at the tendon insertion site of the greater tuberosity, defined as a GTC involving the footprint area of the torn tendon (supraspinatus and/or infraspinatus tendons).

Results: We evaluated 25 patients. The mean preoperative and postoperative American Shoulder and Elbow Surgeons scores were 39.48 ($P < .530$) and 84.64 ($P < .035$), respectively; Constant shoulder scores, 38.96 ($P < .005$) and 80.28 ($P < .425$), respectively; and University of California and Los Angeles shoulder rating scale scores, 10.6 ($P < .045$) and 29.04 ($P < .315$), respectively. The GTC mapping system was easily adopted in all the MRI examinations independently from the quality of the images. The GTCs were mostly located in the superficial anterolateral section of the humeral head and in both the posterolateral sections (superficial and deep).

Conclusions: Arthroscopic transosseous rotator cuff repair led to significant mid-term improvement and satisfactory subjective outcomes with low complication and failure rates in this study. The GTC mapping system could be useful to evaluate GTCs and to aid surgeons in the choice of the best surgical technique.

EP.03.068

FULL THICKNESS ROTATOR CUFF REPAIR OUTCOMES BASED ON GEOCODING AND SOCIOECONOMIC FACTORS

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Background: Disparities among populations of low socioeconomic status have been an issue in orthopedics. No studies have investigated functional outcomes following full-thickness rotator cuff tear repair based on socioeconomic status. This study aims to investigate how geocoding impacts postoperative outcomes following full-thickness rotator cuff tear repair.

Methods: 322 patients who underwent full-thickness rotator cuff tear repair at a single institution from 2014-2021 were retrospectively reviewed. Patients were stratified based on their zip code's median household income and Social Deprivation Index. Patients were grouped according to Federal definitions of income limits as well as Social Deprivation Index quartile. Primary outcomes included ASES scores, SANE scores, and patient satisfaction scores at 12 months. Secondary outcomes included preoperative ASES scores, SANE scores, age, race, BMI, smoking status, Charlson Comorbidity Index, number of tendons, and tear size. One-way ANOVA and Chi-Squared tests were performed to detect differences in outcomes. Univariate and multivariate linear regressions were performed to examine which variables significantly correlated with ASES and SANE scores.

Results: The extremely/very low income and high Social Deprivation Index area patients reported significantly decreased ASES, SANE, and satisfaction scores. These groups also had a lower rate of return to work. Univariate linear regressions revealed a statistically significant positive correlation between ASES and SANE scores with median household income and negative correlation between ASES and SANE scores with Social Deprivation Index. This effect was not observed with multivariate analysis, as multivariate analysis revealed significant correlations with female gender and smoking status.

Conclusion: Our results support the hypothesis that individuals from areas of low socioeconomic status. Individuals from areas of low socioeconomic status reported worse functional outcomes following full-thickness rotator cuff tear repair. Explanations for our results include a lack of access to orthopedic care and physical therapy for populations of low socioeconomic status. Therefore, we urge healthcare systems and orthopedic institutions to increase the availability of care in underserved areas. As healthcare trends towards patient satisfaction-driven financial models, we stress the importance of risk-adjusted compensation models for full-thickness rotator cuff tear repair, as well as the importance of equitable preoperative patient expectation counseling to ensure disparities are not exacerbated.

EP.03.070

ROTATOR CUFF TEAR AND ABO BLOOD TYPE SYSTEM

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Background: The ABO blood group system is based on the presence on the erythrocytes cells membrane of one of four oligosaccharide antigens (A, B, O, and AB). Various human pathologies have shown an association with blood group. Recent studies have demonstrated the existence of a relationship between tendon pathologies and blood groups. However, the different have analyzed several tendons at the same time with various pathologies, in small groups of patients.

Methods: Data were obtained from patients who had undergone rotator cuff repair surgery. Patients were also subdivided according to the RCTs size. These data were compared to the distribution of blood groups in our country. The chi-square test was used for statistical analysis, and Cramer's V test was used as a measure of effect size.

Results: We enrolled 1079 subjects [467 Female (43.3%); 612 Male (56.7%); mean age 60.82; SD, 8.55; range 27-83]. The distribution of blood types in our study was significantly differed from that of the general population in our country ($p < 0.001$). The RCT size and ABO system were significantly associated ($p < 0.001$), with Cramer's $V = .231$ for $k = 3$. Patients with type O blood showed a significantly higher frequency of RCTs and especially of large RCTs ($p < 0.001$).

Conclusions: Other studies have advanced the hypothesis of possible chromosomal interference between the ABO genes, and the collagen genes placed on chromosome 9. However, these different loci have been found to be too far apart or even positioned on different chromosomes, refuting this thesis. Our data suggest a different hypothesis: the lack of enzymes such as glycosyltransferases, which expression depends on that of the ABO genes, could cause mechanical instability of the tendon matrix. Glycosyltransferases, which are absent in type O subjects, play a key role in tendon stability as they participate to the synthesis of glycosaminoglycans, an essential constituent of this structure. This hypothesis supports the role of intrinsic factors as key elements of the progression of RCTs. This is sustained by the presence of larger tears in patients with blood type O.

EP.03.071

CLINICAL AND RADIOLOGICAL OUTCOMES OF ARTHROSCOPIC MUSCLE ADVANCEMENT FOR MASSIVE RETRACTED / IRREPARABLE POSTEROSUPERIOR ROTATOR CUFF TEARS

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Background: Re-tear rates remain high following repair of massive rotator cuff tears. Retraction and delamination result in poor tendon quality and increased tension on the repair. These tears are often deemed irreparable due to a high failure rate. Younger patients are often managed with tendon transfers or superior capsular reconstruction, whereas elderly patients are recommended reverse shoulder arthroplasty. An all-arthroscopic rotator cuff repair technique that involves muscle advancement (MA) and double layer lasso loop repair is described for treating massive posterosuperior cuff tears retracted to the glenoid rim. The purpose of this study is to evaluate the clinical and radiologic outcomes of MA technique.

Methods: Our prospective study includes patients with massive, retracted posterosuperior cuff tears with adequate tendon stump length, dynamic or no superior humeral head migration, and none-to-mild Hamada grade arthropathy treated with MA. Preoperative and postoperative clinical scores, range of motion, and strength were compared. Preoperative and postoperative structural radiological characteristics were also analysed.

Results: 53 patients (58 shoulders) were evaluated with minimum follow-up of 13.5 months. The healing rate was 89.7% with a retear rate of 10.3% as identified on sequential MRI. In patients with a successful healed repair (52 shoulders), improvement in scores for VAS [4.3 ± 2.5 to 0.9 ± 1.6 ($p < 0.001$)], UCLA score [15.2 ± 4.8 to 31.2 ± 3.9 ($p < 0.001$)], Constant-Murley score [52.2 ± 19.5 to 83.3 ± 10.7 ($p < 0.001$)], and ASES score [51.2 ± 17.8 to 89.8 ± 12.4 ($p < 0.001$)] was noted. Forward elevation increased from $132^\circ \pm 48^\circ$ to $170^\circ \pm 12^\circ$ ($p < 0.001$), lateral elevation from $117^\circ \pm 43^\circ$ to $154^\circ \pm 18^\circ$ ($p < 0.001$), and ER1 from $46^\circ \pm 20^\circ$ to $59^\circ \pm 11^\circ$ ($p < 0.001$). Supraspinatus strength improved from 3.2 ± 1.6 kg to 4.7 ± 1.6 kg ($p < 0.001$), and infraspinatus strength improved from 3.7 ± 1.8 kg to 5.3 ± 1.5 kg ($p < 0.001$). Recovery of pseudoparalysis ($n=13$) was 100%. The presence of preoperative pseudoparalysis and advanced fatty infiltration did not significantly affect postoperative outcomes.

Conclusions: All-arthroscopic muscle advancement coupled with double layer lasso loop repair leads to high healing rate with excellent clinical outcomes, even in patients with pseudoparalysis and advanced fatty infiltration.

EP.03.072

PULL-OUT STRENGTH OF SUTURE ANCHOR AND TORQUE OF BUDDY ANCHOR FOR AN OSTEOPOROTIC HUMERAL HEAD IN ROTATOR CUFF REPAIR : PARALLEL VERSUS DIVERGENT INSERTION

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Background: The buddy anchor technique is useful to reinforce loose anchors in the osteoporotic humeral head during arthroscopic rotator cuff repair. However, theoretical parallel insertion of the buddy anchor to index a loose anchor is challenging in arthroscopy and can widen the entry site and decrease structural integrity.

Methods: A total of 24 paired fresh-frozen cadaveric shoulders were used, and each pair was randomly assigned to either the parallel insertion group or the divergent insertion group. In the parallel insertion group, the buddy anchor was inserted parallel to the index loose anchor. In the divergent insertion group, the buddy anchor was inserted at a 20° angle in the medial direction to the index loose anchor. The insertion torque of the buddy anchor and ultimate pull-out strength of the index anchor were measured and compared between the 2 groups.

Results: The mean maximum insertion torque was significantly higher in the parallel insertion group (16.1 ± 1.8 cN·m) compared with the divergent insertion group (12.0 ± 1.5 cN·m) ($P < .001$). The mean ultimate pull-out strength was significantly higher with divergent insertion (192.2 ± 28.6 N) than with parallel insertion (147.7 ± 23.6 N) ($P < .001$).

Conclusions: For application of the buddy anchor system in the cadaveric osteoporotic humeral bone model, divergent insertion showed better ultimate pull-out strength than conventional parallel insertion, despite inferior maximum insertion torque.

EP.03.073

DIFFERENCE OF CLINICAL OUTCOMES BETWEEN TYPE 2 AND 3 SUGAYA AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR WITH MINIMUM 2-YEAR FOLLOW UP

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Background: Recently, a study showed more favorable 10-year outcome of type 3 Sugaya compared to type 4, 5 Sugaya. However, it is still unclear if type 3 Sugaya shows comparable outcomes with type 2 Sugaya. Primary aim of this study was to compare of clinical outcomes of type 2 and type 3 Sugaya after rotator cuff repair.

Methods: Retrospective data analysis of all patients with full-thickness rotator cuff tears who had undergone rotator cuff repair between 2016 and 2020 was conducted. A total of 74 patients (32 males and 42 females), with a mean age of 62.3 years (SD 6.3) showed type 3 Sugaya. Another 74 patients who showed type 2 Sugaya were matched for sex, age, tear size, atrophy and fatty infiltration of supraspinatus and infraspinatus, and American Shoulder and Elbow Surgeons (ASES) score. All patients had completed minimal 2-year follow-up, and range of motion (ROM), visual analog scale (PVAS), functional analog scale (FVAS), ASES score, Constant score were evaluated at preoperative, postoperative 2, 6, 12, 24 months and final follow-up.

Results: Mean follow-up of each group were 40.9 ± 17.7 months in type 2 Sugaya group and 45.9 ± 19.1 months in type 3 Sugaya group ($p=0.103$). There was no significant difference in the range of motion and clinical scores at preoperative, postoperative 2, 6, 12 months between two groups. However, type 2 Sugaya group showed significantly better external rotation at postoperative 24 month ($p=0.011$), and higher ASES score at final follow-up ($p=0.024$).

Conclusions: According to this study, patients with type 3 Sugaya after rotator cuff repair may show different clinical course with patients with type 2 Sugaya in long-term follow-up. This study suggests that type 3 Sugaya should be carefully followed up than type 2 Sugaya.

EP.03.074

EFFECT OF CUMULATIVE SMOKING EXPOSURE ON THE INCIDENCE OF ROTATOR CUFF TEAR

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Background: Cigarette smoking is thought to be related to tendon degeneration and have an adverse effect on the prevalence of rotator cuff tear. We investigated the association of cumulative smoking exposure and duration of smoking cessation with rotator cuff tear.

Methods: The study population consisted of 1083 patients who complained shoulder pain. Information on smoking characteristics such as smoking status, pack-years of smoking, and years since quitting smoking was collected using standardized questionnaire. Rotator cuff tear was examined using magnetic resonance imaging (MRI).

Results: A total of 1021 patients were included in the analysis except for those with previous history of shoulder girdle fracture and surgeries on the same shoulder. Of these, 277 patients had rotator cuff tears (27.1%). The current or past smoking status was not significantly correlated with the prevalence of rotator cuff tears ($p = 0.925, 0.631$). The years since quitting smoking also was not related with the prevalence of rotator cuff tears ($p = 0.173$). However, there was a significant dose-response relationship between pack-years of smoking and rotator cuff tears ($p = 0.045$). The average pack-years of smoking was 13.9 in rotator cuff tear group, and 12.2 in rotator cuff intact group. Compared who had never smoked, smoker of > 20 pack-years were 1.4 times more likely to have rotator cuff tears (OR = 1.4, 95% CI 1.1 - 2.0).

Conclusions: Cumulative smoking exposure was significantly associated with the incidence of rotator cuff tears. However, there was no correlation between smoking status and the incidence of rotator cuff tears.

EP.03.075

CHARACTERISTICS AND OUTCOMES OF L-SHAPED AND REVERSE L-SHAPED ROTATOR CUFF TEARS

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Background: The prevalence of reverse L-shaped rotator cuff tear (RCT) has not been clearly established, and the characteristics and clinical outcomes of patients with a reverse L-shaped tear or an L-shaped tear are unknown.

Methods: Eighty-two shoulders after arthroscopic rotator cuff repair were retrospectively enrolled. Thirty-six shoulders had an L-shaped tear (group L) and 46 had a reverse L-shaped tear (group RL). Both groups were compared regarding characteristics, pre- and postoperative pain and functional outcomes. Muscle statuses were assessed by preoperative magnetic resonance imaging (MRI), and retear rates by postoperative ultrasonography or MRI.

Results: Patients in Group RL were significantly older than in group L ($p=0.008$), and group RL was significantly associated with female gender ($OR=2.5$, $p=0.041$). Mean postoperative pain visual analog scale (VAS) score was significantly greater and mean postoperative American Shoulder and Elbow Surgeons (ASES) score was significantly lower in group RL than group L ($p=0.033$ and $p=0.028$, respectively). However, postoperative pain VAS and ASES score were not lower than the patient acceptable symptom state scores. Retracted tear length was significantly larger in group L ($p=0.003$). Overall retear rate for 82 tears was 12.1%, and retear rates in group L and RL were similar at 13.8% and 10.8%, respectively ($p=0.742$). No significant intergroup difference was found for fatty degeneration (FD) or muscle atrophy. In group L, FD grades of supraspinatus and subscapularis worsened significantly postoperatively ($p=0.034$ and $p=0.008$, respectively). Mean postoperative pain VAS and ASES scores were similar in male and female patients ($p=0.700$ and $p=0.475$, respectively). Regression analysis showed age was not a prognostic factor of postoperative pain VAS or ASES scores ($p=0.188$ and $p=0.150$, respectively).

Conclusions: Older age and female gender were associated with reverse L-shaped tears, and postoperative functional outcomes were poorer for patients with a reverse L-shaped tear. Surgeons should be aware of clinical outcome differences between L-shaped and reverse L-shaped rotator cuff tears.

EP.03.077

INFLUENCE OF PSYCHO-SOCIAL DISORDERS ON RETURN TO SPORT AFTER ROTATOR CUFF REPAIR

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Background: Few data are available regarding the influence of psycho-social disorders (PSD) on return to sport after rotator cuff repair (RCR). The aim of this study was to evaluate the influence of PSD on return to sport after RCR. Working hypothesis was that return to sport delays would be extended in case of a medical history of PSD.

Methods: Retrospective monocentric study including 118 patients (mean age 55.2 ± 8.3 years), operated on for an arthroscopic RCR (distal supraspinatus tear). Among them, 17.8% had a history of PSD (depression, anxiety, bipolar disorder and non specific mood disorder) and 82.2% did not. All patients practiced a sport activity preoperatively on a regular basis. Primary endpoint was the postoperative delay to return to sport. Secondary endpoints were: return to sport rates at 3, 6, 12 months, the return to same level rate at last follow-up, the change of sport or final interruption of sport activity at last follow-up. Influence of PSD on these different endpoints has been realized with Bayesian statistical methods, in univariate and multivariate analysis.

Results: Patients with PSD returned to sport 17 ± 8.2 weeks later than patients without PSD. In multivariate analysis, we found a 98% probability of delaying return to sport by at least 4 weeks in patients with PSD and a 75% probability of delaying return to sport by at least 12 weeks. The relative risk to definitively stop all sport activity - regardless the cause or due to the shoulder - were respectively 2.8 times higher (OR = 2.8 [1 ; 7.8]) and 2.2 times higher (OR = 2.2 [0.4 ; 12.4]), in patients with PSD. PSD did not appear to have an influence on the other endpoints: return to sport rates at 3 months (OR=1.6 [0.5 ; 4.5]), 6 months (OR=0.7 [0.2 ; 2.1]), 12 months (OR=0.7 [0.2 ; 2.4]), the return to same level rate at last follow-up (OR=0.5 [0.2 ; 1.6]), or the change of sport at last follow-up (OR=0.8 [0.1 ; 4.1]).

Conclusions: We found a negative influence of PSD on resuming sport activities after RCR, with a 98% probability of delaying return to sport.

EP.03.078

METABOLIC SYNDROME IS ASSOCIATED WITH SYMPTOMATIC ROTATOR CUFF TEAR

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Background: Symptom development in rotator cuff tear (RCT) remains incompletely determined. Metabolic syndrome, a suggested RCT risk factor, is of undetermined association with symptomatic RCT. This study's purposes were to determine any association between metabolic syndrome and symptomatic RCT and any strength increases in such association as metabolic syndrome's present constituents increase.

Methods: This study involved single shoulders of 736 rural residents. As determined by MRI, 405 had intact rotator cuffs; 331 had RCTs without isolated subscapularis tear, of which 136 were full thickness and 195 were partial thickness tears. 165 RCT subjects were asymptomatic; 166 were symptomatic, not meeting all the following Moosmayer asymptomatic criteria: (1) absence of any current or earlier pain and of subjective dysfunction, in the studied shoulder, (2) result >90 points in the self-report section of the ASES form, and (3) pain-free range of at least 160° for active shoulder abduction and flexion and of at least 50° for external rotation. Demographic, physical, social, and radiological factors, and comorbidities, RCT severity, and serological parameters were studied. Multivariable logistic regression analyses were performed on subsets created to avoid any possible multicollinearity. Using the DeLong test, the studied subsets' areas under the receiver operating characteristic curves (AUCs) were compared to determine the subset most predictive of symptomatic RCT.

Results: Dominant-side involvement, manual labor, partial and full thickness tear, global fatty degeneration index, biceps tendon injury, hs-CRP, and metabolic syndrome were significantly associated factors for symptomatic RCT ($p < 0.001$). Increases in metabolic syndrome's present constituents were significantly associated with symptomatic RCT ($p < 0.001$). Constituent threesomes, metabolic syndrome's diagnostic minimum, were significantly associated with symptomatic RCT ($p < 0.001$); one or two further constituents significantly increased those combinations' strengths of association with symptomatic RCT ($p < 0.001$).

Conclusions: Metabolic syndrome and increases above the minimum number of its present constituents are significantly associated with symptomatic RCT, suggesting metabolic syndrome's possible involvement in RCT's symptom development.

EP.03.079

EFFECT OF PATCH-TYPE ATELOCOLLAGEN IN SUBJECTS WITH ARTHROSCOPIC ROTATOR CUFF REPAIR – A PROSPECTIVE RANDOMIZED CONTROLLED TRIAL

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Background: The effect of atelocollagen in treating rotator cuff tears is still controversial. Although positive results with injectable gel-type atelocollagen were reported, a limitation is the containment of the collagen material in the rotator cuff tendon. This study aimed to evaluate the effect of patch-type atelocollagen for the treatment of rotator cuff tears.

Methods: From December 2020 to December 2021, 54 patients who underwent arthroscopic rotator cuff repair were enrolled. These patients were randomly allocated to rotator cuff repair with atelocollagen group (group A, n=30) and without atelocollagen group (group B, n=24). All patients underwent time zero MRI on the second day postoperatively to confirm the atelocollagen containment. Patients were evaluated using the visual analog scale (VAS) for pain, range of motion (ROM), and shoulder function was evaluated by using American Shoulder and Elbow Surgeons score (ASES), Constant score, University of California at Los Angeles (UCLA) shoulder score and Korean Shoulder Score (KSS) preoperatively and at 2, 3, 6 months and at 1 year follow-up visit. Repaired rotator cuff tendon integrity was assessed by using an ultrasonogram on postoperative 2 and 3 months. MRI was assessed at postoperative 6 months and 1 year follow-up visit.

Results: There was no significant difference between groups in the preoperative demographic data. A total of 11 retear cases were observed representing 20.3% of retear rate. A significantly low retear rate was found in group 1. Three cases were observed in group 1 (10%) and 8 cases were observed in group 2 (33.3%) ($p=0.046$). No significant differences between groups were found in VAS score, functional scores, and ROM.

Conclusions: The tendon healing rate was significantly higher in the group receiving patch-type atelocollagen than in the control group.

EP.03.081

IN VIVO REVASCULARIZATION OF AUTOLOGOUS FASCIA LATA GRAFT AFTER SUPERIOR CAPSULE RECONSTRUCTION EVALUATED USING POWER DOPPLER ULTRASOUND

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Background: We aimed to investigate the serial changes in vascularity in autologous fascia lata grafts and surrounding tissues, and the relationship between vascularity and shoulder pain after superior capsule reconstruction (SCR).

Methods: This prospective study included 19 patients with irreparable rotator cuff tears who underwent SCR with autologous fascia lata grafts. The presence or absence of vascularity and subjective blood flow score (0: none, 1: mild, 2: moderate, 3: prominent) in the peribursal, perigraft, and graft tissues were evaluated using Power Doppler ultrasound at 6 weeks, 3, 6, and 12 months postoperatively. Visual analog scale (VAS) for shoulder pain was obtained simultaneously.

Results: In the peribursal tissue, the vascularity and blood flow scores were 95%, 100%, 84%, and 74% and 1.7, 1.9, 1.1, and 0.6 at 6 weeks, 3, 6, and 12 months postoperatively, respectively. The vascularity was observed from 6 weeks in most cases, and blood flow score at 6 and 12 months was significantly decreased compared with 3 months ($P=.031$, $P<.001$, respectively). In the perigraft tissue, the vascularity and blood flow scores were 89%, 84%, 89%, and 47% and 1.8, 1.6, 1.5, and 0.6 at 6 weeks, 3, 6, and 12 months postoperatively, respectively. The vascularity was observed from 6 weeks in most cases, and blood flow score decreased significantly between 3 and 12 months ($P=.034$). In the graft tissue, the vascularity and blood flow scores were 58%, 95%, 84%, and 89% and 0.8, 1.4, 2.0, and 1.0 at 6 weeks, 3, 6, and 12 months postoperatively, respectively. The vascularity increased significantly between 6 weeks and 3 months ($P<.001$), whereas the blood flow score increased significantly between 6 weeks and 6 months then, decreased significantly between 6 and 12 months ($P=.029$, $P=.037$, respectively). The blood flow score and VAS were not correlated at any time point or in any region.

Conclusions: The study results suggest that the vascularity and blood flow evaluated using Power Doppler ultrasound reflect the tissue healing status but not pain-related inflammation. Moreover, the blood flow in the graft tissues peaked at 6 months postoperatively, suggesting that the graft revascularization after SCR requires 6 months.

EP.03.082

CLINICAL OUTCOMES OF ARTHROSCOPIC PECTORALIS MINOR TRANSFER FOR IRREPARABLE ANTEROSUPERIOR MASSIVE ROTATOR CUFF TEARS

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Background: Surgical treatment options for irreparable anterosuperior massive rotator cuff tears are limited and highly challenging. The purpose of this study was to evaluate the results of an arthroscopic pectoralis minor tendon transfer for irreparable anterosuperior rotator cuff tears.

Methods: Sixty-four patients (58 male and six female) with a mean age of 68.9 (range, 56 to 82) years underwent arthroscopic pectoralis minor tendon transfer and were available for a minimum 24-month follow-up evaluation (30, Lafosse type 3; 34, type 4), including eight revision cases. The pectoralis minor tendon was harvested via a mini-open incision with a flake bone and fixed at the lesser tuberosity arthroscopically. Supraspinatus and/or infraspinatus were attempted to be repaired, and if not possible, a partial repair was performed. All patients were evaluated preoperatively and postoperatively using the University of California Los Angeles (UCLA) score, active range of motion (elevation and external rotation), and the visual analog pain scale (VAS). Multiple regression analysis was conducted to analyze prognostic factors for UCLA score and elevation angle using demographic factors or intraoperative factors (whether or not the supraspinatus was repaired). The level of significance was set at 0.05.

Results: At a mean of 35.2 months (range, 24 to 99 months), the mean UCLA score increased from 14.8 preoperatively to 30.5 postoperatively ($P < 0.001$). The mean active forward elevation increased from 105 preoperatively to 147 postoperatively ($P < 0.001$). The mean active external rotation did not change significantly from 43 preoperatively to 55 postoperatively ($P < 0.001$). The VAS improved from 60 mm to 10 mm ($P < 0.001$). One shoulder was revised with the reverse shoulder arthroplasty. The positive predictor of the UCLA score was preoperative external rotation angle, and the negative predictors were revision surgery and workers' compensation. The positive predictor of elevation was preoperative elevation angle, and the negative predictors were age and revision surgery. Lafosse classification was not a significant predictor for both.

Conclusions: Arthroscopic pectoralis minor tendon transfer was effective for anterosuperior massive rotator cuff tears, including Lafosse types 3 and 4 irreparable subscapularis tears.

EP.03.084

TERES MAJOR TRANSFER USED FOR IRREPARABLE POSTERO-SUPERIOR ROTATOR CUFF TEARS IN PATIENTS UNDER THE AGE OF 65 : LONG TERM FOLLOW UP

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Background: Massive rotator cuff tears are defined as irreparable whenever it is not possible to recover tendon-to-bone or tendon-to-tendon continuity with an adducted arm. Tendon transfers are palliative procedures that are used to improve shoulder functionality and relieve the pain. The aim of our study was to review patients under the age of 65 who presented irreparable postero-superior rotator cuff tears treated using teres major tendon transfer. We evaluated this group over two different follow-ups to obtain a long-term study and to observe changes over time.

Methods: The patients' histories along with the results of preoperative and postoperative clinical and radiographic evaluations were analyzed. Constant score, Disabilities of the Arm, Shoulder and Hand (Dash) score and Visual Analogue Scale for pain (VAS) were performed before muscle tendon transfer and at the time of the two follow-ups.

Results: 24 consecutive patients under the age of 65 (mean age 59) who presented massive irreparable cuff tears and no previous surgical treatments were identified. All patients were evaluated over two follow-ups (at five and ten years). Mean Constant scores were 26 preoperative, 68 points on the first follow-up and 66 on the final follow-up. Mean Dash scores were 62.2 preoperative, 7.8 on the first follow-up and 9.3 on the final follow-up. Vas scores at rest were 6.1 preoperative, 0.3 on first follow-up and 0.5 on the final follow-up. According to Hamada classification, on the first follow up 3 patients developed a stage 2 degenerative change of the gleno-humeral joint while one patient developed a stage 3 change. On the last follow up, 7 patients recorded stage 2 changes and one patient recorded a stage 3 change.

Conclusions: Whenever massive rotator cuff tears cannot successfully be repaired due to atrophy with irreversible fatty degeneration and retraction of the torn muscles, muscle transfers are treatment options used to restore functional deficits and reduce pain in relatively young patients. In our experience, twenty-three patients were able to improve their daily activity functions and relief from pain over the two follow-ups (at 5 and 10 years)

EP.03.085

ARTHROSCOPIC REPAIR OF LARGE AND MASSIVE ROTATOR CUFF TEARS : COMPLETE REPAIR WITH AGGRESSIVE RELEASE COMPARED WITH PARTIAL REPAIR ALONE AT A MINIMUM FOLLOW-UP OF 5 YEARS

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Background: The purpose of this retrospective study was to assess the clinical and radiographic outcomes of large and massive rotator tears treated with arthroscopic complete repair with a posterior interval slide compared with partial repair without a posterior interval slide at a minimum follow-up of 5 years.

Methods: This study included 58 patients with large and massive rotator cuff tears that were unable to be treated with arthroscopic complete repair with an anterior interval slide and margin convergence alone. Each patient underwent either arthroscopic complete repair with an additional posterior interval slide and a subsequent side-to-side repair of the interval slide edge (complete-repair group) or arthroscopic partial repair with margin convergence and without the additional posterior interval slide (partial-repair group). Patient assignment to treatment group was not randomized. Clinical assessments included the visual analog scale pain score, the Subjective Shoulder Value, the American Shoulder and Elbow Surgeons score, the University of California Los Angeles shoulder score, and active range of motion. Preoperative and 6-month follow-up magnetic resonance arthrography (MRA) images were compared within and between groups.

Results: At the time of the latest follow-up evaluation, both groups had significant improvements in clinical outcomes ($p < 0.001$). There were no significant differences in the clinical outcomes between groups. A retear was identified in 22 (88%) of the 25 patients in the complete-repair group and 28 (85%) of the 33 patients in the partial-repair group. Patients in the complete-repair group had larger retear sizes ($p = 0.001$) and reduced acromiohumeral intervals ($p = 0.007$) compared with those in the partial-repair group.

Conclusions: Although larger retear size on early postoperative MRA led to significantly reduced acromiohumeral intervals in the complete-repair group, there were no significant differences in clinical outcomes between groups during the minimum 5-year follow-up period. Therefore, it may be preferable to perform partial rotator cuff repair rather than aggressive release in large and massive rotator cuff tears to achieve complete repair.

EP.03.087

THE EFFECTIVENESS OF EXTRACORPOREAL SHOCK-WAVE THERAPY IN SUPRASPINATUS CALCIFIC TENDINOPATHY

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Background: Calcific tendinitis is a painful shoulder disorder characterised by either single or multiple deposits in the rotator cuff tendon and is often associated with chronic pain and impairment of function. Extracorporeal shockwave therapy (ESWT) is considered to be a treatment option but clinical results are controversial. We analyzed the effectiveness of ESWT based on the morphology and type of calcific tendinopathy.

Methods: 168 patients with symptomatic supraspinatus calcific tendonitis for more than three months were included. The patients were divided into two groups based on the extent of calcification: 103 (61,5%) patients with < 10mm (Group 1) and 65 (38,5%) patients > 10mm (Group 2). All calcific tendonitis were evaluated with X-Ray (Type A, B, C French Classification) and Ultrasound (US) to define the morphological characteristics. All patients were treated with application of 5 x 3000 impulses of 0.20 mJ/mm² at an interval of two weeks without pretreatment analgesia. Shoulder function (Constant score, CS) and pain (Numeric rating scale, NRS) were assessed before treatment and at two months, six months and one year after treatment. US were performed at the 6 month follow-up visits.

Results: Improvement in CS was significantly higher in group 1 at all follow-up visits ($p < 0.05$). Six months post-treatment, calcifications dissolved completely in 72% of the group 1 and 26% of group 2. Regarding reduction of pain, there was a strong relationship between subsidence of symptoms and remission of calcification, so there was significant improvement in the group 1 compared with the group 2 at all follow-up visits ($p < 0.05$). In 67% shoulders with incomplete resorption, US examination showed deposits hyperechoic and arc shaped and X-Ray examination showed Type A calcification.

Conclusions: ESWT is effective for improving pain and shoulder function in chronic calcific shoulder tendinitis but it's important to select calcific tendinopathy correctly. Poor prognosis was significantly related to type A arc shaped calcification and calcification extent > 10 mm. Patients with this type of calcification should undergo a different procedure.

EP.03.089

SUPERIORE CAPSULAR RECONSTRUCTION WITH LONG HEAD OF BICEPS: CLINICAL AND RADIOGRAPHICAL OUTCOME

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Background: Superior capsular reconstruction (SCR) is an established procedure in the treatment of irreparable rotator cuff (RC) tears. There is still controversy regarding the best transplant for this operation. Aim of this study is to demonstrate structural and clinical results one year after SCR using autologous long head of the biceps (LHB) graft. (LHB-SCR). The hypothesis is that there is a significant improvement in clinical score results one year after the intervention with a radiographically intact graft.

Methods: Between 2019-2020 23 patients have been treated with arthroscopic LBS-SCR due to irreparable postero-superior RC tears. The origin of the LHB was preserved and the tendon was armed with to suture loops and fixed at the footprint between the supra and infraspinatus insertion side using two knotless anchors. The posterior part of the RC was also fixed to the foot print and side to side to the LHB. Preoperatively and at follow up ROM, subjective shoulder value (SSV) and power were analyzed and the Constant-Score (CS), DASH, WORC, ADLEIR, Oxford-Shoulder-Score (OSS) were evaluated. Integrity of the reconstructin was evaluated by MRI one year postoperatively.

Results: Mean follow-up was $14,9 \pm 3,9$ months. The mean age was $62,8 \pm 8,1$ years (47-78 years). Active Flexion improved from $110,0^\circ \pm 53,9$ to $153,9^\circ \pm 26,0$ ($p=0,002$) and active Abduction from $106,1^\circ \pm 54,3$ to $146,1^\circ \pm 35,0$ ($p=0,008$) at follow up. External rotation improved from $36,9^\circ \pm 16,8$ to $42,5^\circ \pm 11,5$ ($p=n.s.$). The score results at final follow up were: absolut CS: $66,0 \pm 11,7$; DASH: $22,6 \pm 18,8$; WORC: $70,8\% \pm 22,5$; ADLEIR: $32,7 \pm 3,8$ and OSS: $22,5 \pm 8,5$. The SSV significantly improved from $42,4\% \pm 18,1$ to $73,9\% \pm 14,0$ ($p<0.0001$). Postoperative MRI showed an intact LHB graft in 85,7% of all cases.

Conclusions: LBS-SCR shows promising clinical and structural results at 1 year follow up. Longer Follow-Up data and the comparison to alternative transplants would be necessary to further evaluate the value of this treatment option.

EP.03.090

HEALING RATE IN ROTATOR CUFF TEARS. DO TRAUMATIC REALLY DO BETTER THAN DEGENERATIVE?

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Background: Acute traumatic (tear) and chronic degenerative (wear) rotator cuff (RC) lesions are etiologically different pathologies. It is paramount to identify the type of rupture to decide the therapeutic management. Previous articles have suggested that the healing rate of traumatic tears is better than degenerative ones. The purpose of this study is to determine the difference in outcomes after RC repair based on tear etiology as well as tendon integrity.

Methods: This was a retrospective comparative study from prospectively collected data. A total of 873 consecutive shoulders with an operated RC rupture (414 traumatic and 423 degenerative) were followed up at a minimum of 6 months.

Results: There was a higher distribution of male (72 vs. 52.5%) and younger patients (53 vs. 57 years) in addition to an early onset of symptoms (3 vs. 15 months), reduced ROM in preoperative assessment for forward elevation (150° vs 160°) and higher preoperative ASES and Constant score in traumatic ruptures. Degenerative lesions presented fewer proportion of grade 3 tendon coronal retraction (13.2 vs. 20%). Postoperative RC tendon integrity was similar for both groups being Sugaya type 1 and 2 the most prevalent (93.1% traumatic; 90.5% degenerative). Both groups exhibited good outcomes in ROM and postoperative functional scores. Most traumatic ruptures (72.4%) returned to work, meanwhile, an increased number of degenerative ruptures retired from work (18.7%).

Conclusions: Traumatic RC tears occurred in younger male patients however the clinical outcomes and tendon integrity were similar in both groups. No functional or ROM difference was found in the postoperative assessment between degenerative and traumatic tears.

EP.03.091

THE DIAGNOSTIC VALUE OF THE POSTEROSUPERIOR TETRALOGY SCORING SYSTEM FOR PREDICTING SHOULDER FUNCTION AFTER LARGE TO MASSIVE ROTATOR CUFF REPAIRS

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Background: Fatty infiltration (FI) or atrophy alone was found to be inaccurate for predicting shoulder function following repair of large-to-massive rotator cuff tears (L/MRCTs), especially for those with less severe FI. The Posterosuperior Tetralogy Scoring System (PS-Tetra-Score) has been proposed to predict shoulder function after surgery. The PS-Tetra-Score assessed four aspects: supraspinatus atrophy, supraspinatus FI, infraspinatus atrophy, and infraspinatus FI.

Methods: A total of 152 arthroscopic repairs of L/MRCTs were performed. Radiographic evaluations were performed. Shoulder function was assessed using the American Shoulder and Elbow Surgeons (ASES) scores. Univariate and multivariate analyses were performed to determine the risk factors for poor shoulder function. Crude agreement, sensitivity, specificity, positive predictive value, negative predictive value, and area under the curve (AUC) of the receiver operating characteristic (ROC) curve were used to determine the diagnostic values of different indicators.

Results: Univariate analysis showed that sex, Goutallier grading of the supraspinatus and infraspinatus, supraspinatus tangent sign, and PS-Tetra-score correlated with poor postoperative shoulder function. In the binary logistic regression analysis, a PS-Tetra-score >2 was the only risk factor. A PS-Tetra-score >2 showed higher crude agreement, specificity, positive predictive value, and AUC of the ROC curve than the other three indicators, with a relatively high negative predictive value and moderate sensitivity.

Conclusions: PS-Tetra-Score >2 was a risk factor for poor shoulder function following repair of L/MRCTs and possessed greater diagnostic value than FI or atrophy alone for predicting postoperative shoulder function.

EP.03.092

OUTCOME COMPARISON BETWEEN ARTHROSCOPIC REPAIR OF FULL-THICKNESS ROTATOR CUFF TEARS AND PARTIAL-THICKNESS ROTATOR CUFF TEARS

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Background: The purpose of this study was to compare the functional outcome and retear rate of arthroscopic repair of partial-thickness rotator cuff tears (PTRCT) compared with full-thickness rotator cuff tears (FTRCT).

Methods: A total of 304 patients with FTRCT (242) and PTRCT (62) that required a repair between 2012 and 2020 with completed serial ultrasound examinations at weeks 6, 12 and 26 postoperatively were included. Functional clinical scores were assessed by Constant score, Western Ontario Rotator Cuff Index (WORC) and Oxford score. Surgical procedures were performed by the same senior surgeon (MH). All patients had undergone a suture bridge repair technique.

Results: Statistically, a significant difference was observed between the mean age of patients ($63 \text{ years} \pm 8.29$ for the FTRCT group and $57 \text{ years} \pm 10.01$ for the PTRCT $p=.001$). Clinical outcomes were significantly improved in both groups. Oxford usual pain was statistically significant higher in the PTRCT group (2.82 ± 0.8 vs 2.64 ± 0.9 $p<0.05$). Oxford worst pain at week 26 was statistically significantly higher in the PTRCT group (1.38 ± 0.79 vs 1.05 ± 0.82 $p<0.05$). No differences between preoperatively Constant scores were observed between both groups. The Constant score at week 26 reflected statistically significant differences with the higher score for FTRCT group (66.58 ± 16.34 vs 64.45 ± 17.55 $p<0.05$). Preoperatively WORC score vs week 12 improved in the FTRCT group from 1118 (range 20-2030) to 972 (range 0-1980) however there were no significant differences in the PTRCT group ($P=>0.05$). Retear rates at weeks 12 and 26 were statistically significantly higher in FTRCT group than in the PTRCT group. (10.33% vs 3.23% $p<0.05$ at final follow-up)

Conclusions: Patients with PTRCT repairs are usually younger, have similar preoperatively functional scores but paradoxically, tend to have more pain and stiffness following surgery but a lower risk of re-tear. They have similar outcomes in Oxford and WORC scores at 6 months follow-up. Therefore, these two different groups should be rehabilitated very differently as the PTRCT have higher grade of stiffness and worse pain but a lower re-tear rate than FTRCT. We suggest PTRCT should commence earlier physiotherapy however can return to activity earlier.

EP.03.093

RETURN TO SPORTS AND PHYSICAL LABOR AFTER ARTHROSCOPIC SUPERIOR CAPSULE RECONSTRUCTION FOR IRREPARABLE ROTATOR CUFF TEARS

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Background: Patients with irreparable rotator cuff tears often give up returning to their sports participation and physical labor, because these high-demand activities require good functional recovery. For irreparable rotator cuff tears, arthroscopic superior capsule reconstruction (ASCR) is a joint-preserving option that yields good functional outcomes. The objective of this retrospective study was to evaluate the rate of return to sports and manual labor among patients treated with ASCR.

Methods: We retrospectively studied 18 patients with irreparable rotator cuff tears who underwent ASCR using at least 6-mm thick fascia lata autografts from 2018 to 2021. Fourteen patients (mean age, 64.1 years, range, 32 - 78 years) who had participated in recreational sports and/or physical labor were enrolled in this study. Three patients participated in over-head sports (2 players; badminton, 1 player; tennis). Rates of return to sports and physical labor, active shoulder range of motion, Japanese Orthopedic Association (JOA) score, and American and Elbow Shoulder Surgeons (ASES) score were evaluated. Postoperative graft integrity was also evaluated by magnetic resonance imaging. The presence of a full-thickness defect within the graft was diagnosed as a graft tear. The mean time to final follow-up was 24.7 months (range, 12 - 48 months). Wilcoxon rank sum test was used for statistical analyses.

Results: All patients returned to sports participation and/or physical labor. All patients who had participated in over-head sports required 1 year postoperatively to return to the game. Active elevation, external rotation, and internal rotation significantly improved after ASCR (elevation; $124 \pm 45^\circ$ to $169 \pm 10^\circ$, $p=0.002$, external rotation; $30 \pm 13^\circ$ to $54 \pm 12^\circ$, $p=0.0005$, internal rotation; L1 to Th11, $p=0.02$, respectively). JOA and ASES scores also significantly improved after ASCR (47.9 ± 25.4 to 94.2 ± 2.6 , $p=0.0001$, 28.8 ± 18.3 to 93.2 ± 3.9 , $p=0.004$, respectively). The graft tear rate was 7.1% in this study.

Conclusions: ASCR using at least 6-mm thick fascia lata autografts showed high rates of return to recreational sports including over-head sports and physical labor. These results suggest that ASCR is a good surgical option for high-demand patients with irreparable rotator cuff tears.

EP.03.095

COMPARISON OF CLINICAL RESULTS BETWEEN SUPERIOR SINGLE ROW REPAIR WITH POSTERIOR DOUBLE ROW AND PARTIAL AUTOLOGOUS PATCH GRAFT AUGMENTATION FOR LARGE AND MASSIVE ROTATOR CUFF TEARS

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Background: The purpose of this study was to compare clinical results of superior single row repair with posterior double row (SSR) and partial autologous patch graft augmentation (PPG) for large and massive rotator cuff tears.

Methods: We studied 21 shoulders of 21 patients who underwent arthroscopic SSR (7 cases) or mini open PPG (14 cases) for large and massive tears. The patients were 13 males and 8 females, and the mean age was 63.5 years old. Based on the morphology of SSP and ISP tears, the SSR was performed when SSP tendon tear could be repaired with single row at medial side of the footprint and ISP tendon could be repaired with double row method. On the other hand, the PPG was selected when torn tendon had a delamination and bursal side or joint side tendon could not be repaired to the greater tuberosity. Pre- and 1-year postoperative JOA score, UCLA score, ASES score, ROM and MMT of active elevation and external rotation were examined. Post-operative cuff integrity with MRI (Sugaya's classification) was also evaluated.

Results: Mean JOA score, UCLA score and ASES score of the SSR cases (60.7 to 91.2 points, 13.9 to 32.7 points and 34.7 to 88.0 points) and the PPG cases (64.7 to 93.8 points, 15.0 to 32.7 points and 35.3 to 90.2 points) were improved significantly and there were no statistical differences between two groups. Mean active elevation of the SSR (92.9 to 146.1 degrees) and the PPG (112.9 to 141.4 degrees) cases also improved postoperatively but passive external rotation did not change (40.4 to 44.3, 52.8 to 55.7 degrees, respectively). On the other hand, MMT of active elevation and external rotation of both groups significantly improved to MMT 4 and over level. Re-tear rates of the SSR and PPG groups were 14.3% and 0% respectively but there was no statistical difference.

Conclusions: The PPG for large and massive rotator cuff tears had the same clinical results as the SSR. The PPG might reduce the re-tear rate in patients with large and massive rotator cuff tears.

EP.03.096

RELATIONSHIP BETWEEN HEMATOMA-LIKE TISSUE ON THE FOOTPRINT AND STRUCTURAL OUTCOME OF ARTHROSCOPIC ROTATOR CUFF REPAIR WITH A TRANSOSSEOUS TECHNIQUE

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Background: We have tried to create hematoma over the footprint site at the end of arthroscopic rotator cuff repair (ARCR) surgery, expecting to apply biochemical effects of the platelet-related factors to promote faster tendon-bone healing. The purpose of this study was to investigate the presence of hematoma-like tissue (HLT) over the footprint site for ARCR, and to evaluate the relationship between the HLT and the structural outcomes of repaired rotator cuff.

Methods: This prospective cohort study included patients who underwent ARCR surgery for rotator cuff tear including the supraspinatus (SSP) using a modified transosseous method from December 2020 to April 2022. Twenty-five patients (18 men, 7 women) were able to be reviewed, with a mean age at surgery of 69.8 years (range, 52–85 years). Postoperative MRI was performed in all patients at 1 week, 6–8 weeks, and >6 months after surgery. Structural outcomes for the repaired cuff were evaluated using Sugaya's classification on coronal T2-weighted images at >6 months postoperatively. Thickness of the HLT was also evaluated on coronal T2-weighted images, and classified into three grades. Signal intensity of HLT was evaluated on coronal T2-weighted fat-suppressed images as the ratio compared to SSP intensity (HLT/SSP ratio). Univariate analyses of the thickness of HLT were performed among Sugaya's classification types. HLT/SSP ratios were compared among the timings of postoperative MRI, among Sugaya's classification types, and between thickness grades.

Results: Structural outcomes for repaired cuffs showed Sugaya type 1 in 12 shoulders, type 2 in 4, and type 3 in 9. HLT thickness was significantly thicker at 1 week and at 6–8 weeks postoperatively in Sugaya type 1 patients than in type 3 patients (1 week ; $p=.013$, 6-8 weeks ; $p<.001$). HLT/SSP ratio gradually decreased (at 1 week postoperatively: 1.9 ± 0.7 ; at 6–8 weeks postoperatively: 1.6 ± 0.6 ; at >6 months postoperatively: 1.2 ± 0.5), and differed significantly between >6 months and both 1 week and 6–8 weeks ($p<.001$ each).

Conclusions: Signal intensity of the HLT on the outside of the footprint became close to that of the supraspinatus tendon over time. Cases with thick HLT at 6 weeks postoperatively can expect good structural outcomes at >6 months postoperatively.

EP.03.097

MASSIVE ROTATOR CUFF TEARS DEMONSTRATE SIGNIFICANTLY ALTERED SCAPULOHUMERAL RHYTHM WHEN COMPARED TO SMALL TEARS USING DYNAMIC RADIOGRAPHY: A MATCHED, CONTROLLED STUDY

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Background: Rotator cuff tears (RCTs) alter force couples and glenohumeral kinematics and are known to alter the scapulohumeral rhythm - the ratio of glenohumeral (GH) to scapulothoracic (ST) motion. Quantifying SHR with Dynamic Digital Radiography (DDR), by taking a series of pulsed low radiation radiographs during active range of motion, may enable clinicians to understand the pattern, extent of motion impairment and clinical relevance of RCTs. This could overcome the limitation of conventional magnetic resonance imaging (MRI) only evaluating static soft tissue and morphologic changes. The purpose of this study was to evaluate patients with massive and small rotator cuff tears using DDR, assessing for differences in SHR and range of motion between the two groups.

Methods: Using a standardized acquisition protocol, DDR (15 frames/second) was prospectively performed on shoulders, that had MRI-confirmed massive and small RCTs. Glenohumeral and scapulothoracic joint angles were measured at 0-30°, 30-60°, 60-90°, and maximal coronal plane humeral abduction. SHR was defined as the ratio of the change in humeral abduction over the change in scapula upward rotation during humeral abduction and was calculated within the above angle intervals. Descriptive statistics and pairwise t-tests were performed to compare differences between groups.

Results: Forty-two patients, 29 with massive RCTs (MRCTs) and 13 small RCTs (SRCTs) were included and matched for age and BMI and underwent DDR. SRCTs had a significantly higher average overall SHR (3.04 ± 1.16) compared to the MRCT (1.91 ± 0.51) ($p=0.003$). Scapular range of motion during humeral abduction was lower in SRCT (29.71 ± 12.91) compared to MRCT (41.57 ± 10.41).

Conclusions: Our study uses novel dynamic radiography to demonstrate consistently lower SHR in patients with MRCTs compared to SRCTs when matched for BMI and age. MRCTs had an increased reliance on scapular contributions to overall humeral elevation. While RCTs continue to be diagnosed on static MRI, dynamic SHR quantification can also inform the extent of motion impairment, clinical relevance and compensatory kinematic changes in a safe and cost-effective manner. Efficient integration of DDR and SHR measurement into a clinical workflow could improve diagnostics and clinical decision making.

EP.03.098

ARTHROSCOPIC VS MINI-OPEN REPAIR IN ISOLATED SUBSCAPULARIS TEARS: A SYSTEMATIC REVIEW

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Background: This study aimed to compare the long-term outcomes of arthroscopic versus mini-open repair in patients with isolated subscapularis tendon tears.

Methods: Google scholar, PubMed, and Embase databases were examined for studies evaluating isolated subscapularis tears subsequently treated by arthroscopic or mini-open reconstruction. Inclusion criteria were clinical studies reporting isolated subscapularis lesions treated by arthroscopic or mini-open repair. All the included articles also bring back functional outcomes following each treatment at a minimum follow-up of 12 months. Articles not reporting the functional outcomes or studies that reported results for anterosuperior rotator cuff tears without a separate analysis of subscapularis tendon tear were excluded. Were also removed from the research case reports, studies older than 20 years, and studies with a minimum follow-up of less than 1 year.

Results: A total of 12 studies met the inclusion criteria: 8 papers were included in the arthroscopic repair group, and 6 were included in the mini-open repair one (2 studies reported results for both techniques). The mean age reported was 49.37 years, with males involved in 85.1% of cases. The dominant limb was involved in 77.67% of the cases, and a traumatic onset of symptoms was verified in 76.31%. The mean time to surgery was 9.68 months. Constant-Murley Score showed positive results for both the arthroscopic and the mini-open groups, with a mean postoperative value of 84.63 and 82.18, respectively. Pain showed promising results, too, with a mean of 13.27 (out of 15) points for the arthroscopic group and 11.74 for the mini-open one. The long head of the biceps was involved in 78% of the patients, and LHB tenodesis or tenotomy were the most common concomitant procedures applied.

Conclusions: Subscapularis injury is most frequently associated with a traumatic event, resulting in a loss of function and subsequent pain during the patient's shoulder movements. Surgical treatment has been shown to have excellent healing rates. There is no significant difference in clinical and functional outcomes between open and arthroscopic repair. Moreover, the same complication rates were reported in both treatments, but arthroscopic repair leads to less post-operative pain.

EP.03.099

LOCAL INTRAOPERATIVE MARROW-DERIVED AUGMENTATION FOR PRIMARY ROTATOR CUFF REPAIR: AN UPDATED SYSTEMATIC REVIEW AND META-ANALYSIS OF STUDIES FROM 2010-2022

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Background: Recurrent tears of the rotator cuff pose a substantial problem despite advances in repair technique. Biologic augmentation via marrow stimulation or vented anchors may strengthen the suture-tendon junction and improve healing rates of native tissue, thereby enhancing outcomes of primary surgical repair.

Methods: A systematic review of PubMed, Embase, and Cochrane was conducted following PRISMA guidelines. 2,131 studies from 2010-2022, focused on either marrow stimulation or vented anchors, were isolated and classified as either preclinical or clinical. Meta-analyses were performed for comparative marrow stimulation and vented anchor studies. Heterogeneity was tested through calculation of I².

Results: Thirteen clinical studies were included in the review. All nine comparative studies included in the meta-analyses demonstrated high methodologic quality or a low risk of bias. The pooled retear rate across all 9 clinical studies for patients undergoing marrow stimulation was 11%. For the 5 studies in the meta-analysis, the pooled retear rates were 15% for marrow stimulation and 30% for controls. Meta-analysis demonstrated a significant difference in the overall retear rate that favored marrow stimulation (OR 0.40; 95% CI, 0.25-0.66; P=0.0003, I²=0%). Similarly, meta-analysis of the Constant Score at final follow-up demonstrated a statistically significant difference between the two groups that favored a higher Constant Score in the marrow stimulation group (Mean diff. 2.84; 95% CI, 1.02-4.66; P=0.002, I²=29%). Vented anchors demonstrated improved ossification and bone density at the anchor site, but no difference in outcomes or retear. Pooled retear rates were 22.5% for vented anchors and 27.8% for controls.

Conclusions: Current evidence demonstrates that marrow stimulation techniques may have a positive impact on healing and retear rate, while vented anchors have muted impact relative to non-vented anchors. Though available evidence is limited and more research is needed, findings to date suggest marrow stimulation techniques may be an inexpensive, straightforward technique to consider in qualifying patients to prevent rotator cuff retears.

EP.03.101

EFFECT OF INTRAVENOUS STEROID INJECTION TO PROLONG INTERSCALENE NERVE BLOCK EFFECT ON ROTATOR CUFF HEALING

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Background: Intravenous steroid injection is used to prolong the duration of the effect of interscalene nerve block. However, the effect of intravenous steroid injection just before rotator cuff repair surgery is unknown. The aim of this study was to evaluate the effect of intravenous steroid injection on rotator cuff healing.

Methods: Seventy-one patients who underwent interscalene nerve block before primary arthroscopic rotator cuff repair surgery were prospectively enrolled. These patients were randomly assigned to two groups (group 1: 37, group 2: 34). In group 1, 25 patients had full-thickness rotator cuff tear (RCT), and 12 patients had partial-thickness RCT. In group 2, 25 patients had full-thickness RCT, and 9 patients had partial-thickness RCT. Group 1 received intravenous injection of 0.15mg/kg steroid after interscalene nerve block. For group 2, the same dose of normal saline was injected intravenously after interscalene nerve block. The rotator cuff integrity of these two groups was compared by ultrasonography at 6months and MRI at 1year postoperatively.

Results: On ultrasonography at 6 months, retear was observed in 5 patients. Two patients were group 1 and 3 patients were group 2. Overall retear rate was 7.0% and retear rates in group 1 and group 2 were 5.4% and 8.8%, respectively. No significant intergroup difference was observed between retear rates ($p=0.665$). One year after surgery, 53 patients underwent MRI. There were 28 patients from group 1, 25 patients from group 2. Retear was observed in 3 patients, 1 patient was from group 1 and 2 patients were from group 2. Overall retear rate of those patients was 5.7%, and retear rates of patients from group 1 and from group 2 were 3.6% and 8.0%, respectively. There was no significant difference between the two patient groups ($p=0.597$)

Conclusions: A single intravenous steroid injection to prolong the effect of interscalene nerve block perioperatively did not affect rotator cuff healing rates. However, additional steroid usage or different dosage needs further evaluation.

EP.03.103

CLINICAL AND IMAGE OUTCOMES OF NEW SUTURE ANCHOR WITH INTERPOSITIONAL BIORESORBABLE SCAFFOLD IN ARTHROSCOPIC ROTATOR CUFF REPAIR

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Background: Recently, interpositional scaffold-anchor implant designed to address both the biological and mechanical issues of arthroscopic rotator cuff repair (ARCR) have been developed, and reported to increase the rate of tendon bone healing and type III collagen only in animal studies. We performed ARCR using the new suture anchor and compared the repair condition on MRI at 1 year postoperatively and clinical outcomes with those of conventional suture anchors.

Methods: Fifty-one patients with rotator cuff tears were enrolled, with an average age of 66.5 years old (range, 58 ~ 75 years old). Twenty-one patients were undertaken ARCR using interpositional scaffold-anchor (BioWick® SureLock® suture anchors) (S group), and 30 patients underwent ARCR using conventional suture anchors (C group). Clinical outcomes were evaluated by JOA and UCLA scores 1 year after surgery, and postoperative MRI 1 year after surgery were assessed using the Sugaya's classification (Type I to V) and signal intensity ratio of the repaired rotator cuff (R) and deltoid muscle (D).

Results: In the clinical outcomes, there were no significant difference between 2 groups. The results of MRI showed that the S group included Sugaya Type I: 4 cases, Type II: 6 cases, and that the C group did Sugaya Type I: 3 cases, Type II: 8 cases, Type III: 3 cases. Signal intensity ratio (R/D) were better in the S group than C group in the 1 year postoperatively ($p < 0.05$).

Conclusions: Our results would support that a bioresorbable scaffold between the repaired rotator cuff tendon and bone in the new anchors have accelerated rotator cuff repair. This new anchor makes it possible for us to put collagen scaffold without any additional procedures. In conclusion, ARCR using interpositional scaffold-anchor was superior to conventional suture anchors at 1 year postoperative MRI evaluation.

EP.03.104

LONG-TERM OUTCOMES OF ROTATOR CUFF REPAIR AND RECONSTRUCTION BY SURFACE HOLDING REPAIR TECHNIQUE. -MORE THAN 10 YEARS-

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Background: Though Suture Bridge technique was worldwide performed for rotator cuff tear and reported good clinical outcomes, we have performed Surface holding repair technique (SH method) with medial suture and transosseous fixation since 2008. The purpose of this study is to evaluate long-term outcomes with clinical, Xray and MRI evaluation of rotator cuff repair and reconstruction using SH method.

Methods: 67 shoulders were treated rotator cuff repair or reconstruction using SH between 2008 and March 2012. At 10 years of follow-up, 2 shoulder was dead, 5 shoulders were re-operated (1 anatomical TSA for osteoarthritis, 1 irrigation for infections and 3 re-repairs for rotator cuff re-tear) and 17 (25.4%) were lost to follow-up. 43 shoulders had been evaluated at a minimum follow-up 10 years after repair or reconstruction for rotator cuff tear. Mean age was 63.0 years old and mean follow-up period was 138.6 months. The tear size of 17 shoulders were small or middle and 26 shoulders were large or massive. 4 shoulders were added rotator cuff reconstruction using muscle transfers (1 partial subscapularis transfer and 3 Pectoralis Major transfer) for irreparable rotator cuff tear. 43 shoulders were evaluated ROM (flexion / ER), JOA score. Tendon healing and fatty infiltration were evaluated using MRI for 40/36 shoulders (short-term / long-term (more than 120 months after surgery)). Furthermore, osteoarthritis for 26 shoulders that had large and massive tear were also evaluated by X ray.

Results: ROM (Flexion / ER) improved from 131.6/42.4 to 158.8/43.1 postoperatively, and JOA score improved from 67.4 to 94.3 postoperatively. Clinical outcomes (Flexion/ER/JOA score) of small and middle tear group (162.4/50.9/96.3) were better outcomes than large and massive tear group (156.5/38.1/92.9). 3/5 shoulders were observed re-tear at short/long term, and even if 1 shoulder of massive tear preoperatively was healed at short-term, occurred re-tear at long-term. Fatty infiltration progressed in 6 shoulders from short to long-term. Severe osteoarthritis appeared 8 Grade2 and 2 Grade3 in Samilson-Prieto classification.

Conclusions: Good clinical outcomes of SH method for rotator cuff tear were maintained at long term. Rotator cuff re-tear was observed in 8 shoulders (include the shoulders of reoperation) after surgery.

EP.03.105

WORSE POSTOPERATIVE OUTCOMES AND HIGHER REOPERATION IN SMOKERS COMPARED TO NONSMOKERS FOR ARTHROSCOPIC ROTATOR CUFF REPAIR

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Background: Smoking significantly impairs healing potential and is a significant risk factor for complications after various orthopaedic surgeries. The purpose of this study was to determine if a cohort of former or current smokers at time of surgery met the minimally clinical important difference (MCID) for Patient-Reported Outcomes Measurement Information System Upper Extremity (PROMIS-UE), Depression (PROMIS-D), and Pain Interference (PROMIS-PI) scores in comparison to nonsmoking patients.

Methods: A retrospective review of a prospectively collected database of patients undergoing arthroscopic rotator cuff was performed. Patients who completed preoperative and 6-month postoperative PROMIS scores were included. The MCID was calculated using a distribution technique with a threshold of 0.5 standard deviations above the mean. A cohort of nonsmokers was compared to a cohort of patients currently or former smokers at time of surgery in terms of their clinical outcomes and PROMIS scores. A sub-analysis was also performed where a cohort of nonsmokers were propensity matched 1:1 to a cohort of current/former smokers via age, mass index (BMI), and tear size.

Results: A total of 182 patients, 80 current or former smokers and 102 nonsmokers, who underwent rotator cuff repair were included in the study. Smokers had statistically more massive tears and had more revision surgery (16.3% vs 5.9%, $P=0.02$). No differences were found in preoperative PROMIS scores, change in PROMIS scores or proportion meeting MCID for PROMIS scores. In the sub-analysis, 74 current or former smokers were matched to 74 nonsmokers. Smokers had a lower change in PROMIS-UE (8.6 ± 9.8 vs 12.3 ± 10.0 , $P=0.007$) and PROMIS-PI (-9.1 ± 8.5 vs -12.8 ± 10.1 , $P=0.03$) postoperatively. Fewer smokers met MCID for PROMIS UE postoperatively (60.3% vs 82.4%, $P=0.003$) and more had revision surgery (16.2% vs 4.1%, $P=0.02$).

Conclusions: Patients who smoke currently or had a history of smoking preoperatively demonstrated smaller improvements in function, pain scores, and were less likely to meet MCID for PROMIS-UE when compared to nonsmokers after arthroscopic rotator cuff repair. Smokers were more likely to have higher failure rates requiring revision surgery within 6 months.

EP.03.106

SUPRASCAPULAR NEUROPATHY CAUSED BY ROTATOR CUFF TEAR WAS HARDY RECOVERED AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR

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Background: There were many studies that suprascapular neuropathy concomitant with RCT. However it was not fully clarified recovery of suprascapular neuropathy after ARCR. The purpose of this study was to evaluate the recovery of pre-operative suprascapular neuropathy due to RCT after ARCR two years post operatively using needle electromyography(EMG).

Methods: 32 shoulders with a mean age of 67.4 ± 5.3 years who had symptomatic 14 cases of large and 18 cases of massive RCT patients with suprascapular neuropathy diagnosed by pre-operative EMG were enrolled in this study. All cases were underwent needle EMG and MRI before surgery and two years post operatively. Needle EMG before surgery was to exclude other neuropathy. Suprascapular neuropathy was diagnosed if abnormal waves were detected only on supraspinatus and infraspinatus. Post-operative cuff repair integrity was evaluated using Sugaya's classification on MRI two years post-operatively.

Results: Among 32 cases, 26 cases were repaired primarily using suture bridge technique. Four cases were repaired arthroscopic tensor-fascia-lata patch repair and partial repair was performed in one case and LD transfer was performed in one case. All cases were diagnosed suprascapular neuropathy only on infraspinatus. Recovery of suprascapular neuropathy after ARCR was found only on 2 cases (6.3%) and the rest 30 cases (93.7%) were not recovered. Repair integrity after ARCR was evaluated except for the partial repair and LD transfer. Among 30 cases, 22 cases (66.7%) showed re-tear. Furthermore, 2 cases of recovery of suprascapular neuropathy were sugaya type 1. To the contrary, the repair integrity of non- recovery of suprascapular neuropathy cases showed 74.1% re-tear rate.

Conclusions: Our data showed that suprascapular neuropathy was detected only on infraspinatus, so that the cause of suprascapular neuropathy was thought to be compression of suprascapular nerve into spinoglenoid notch with retraction of infraspinatus. Rotator cuff repair led suprascapular nerve into normal position and thought to be recovered theoretically. However, our results showed that suprascapular neuropathy was thought to be hardly recovered. Furthermore, re-tear rate of ARCR for concomitant suprascapular neuropathy was high. From our results, rotator cuff repair was recommended before occurring suprascapular neuropathy in large to massive RCT to achieve good clinical outcome.

EP.03.107

USE OF POLYETHYLENE TEREPHTHALATE GRAFT (LARS) FOR MASSIVE IRREPARABLE ROTATOR CUFF TEAR. 11 YEARS EXPERIENCE WITH THIS NOVEL TECHNIQUE

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Background: Rotator cuff injuries are characterized by pain and functional impair, represent approximately 20-40% of all shoulder pathologies and surgical treatment has shown good outcomes in terms of functional scales and improvement of symptomatology, however, on massive irreparable ruptures, there are few reliable options different to joint replacement with good results, allowing patients to recover their function, reestablish native biomechanics, improves motion and relief pain. Superior capsular reconstruction is an option for massive irreparable rotator cuff tears, multiple techniques have been described for this procedure ranging from autografts to synthetic grafts. Polyethylene terephthalate graft (LARS) has been used for a long time in multiple joints with good results, but in the shoulder no long-term results have been published in the literature and the original technique described by the designer is propense to fracture on greater tuberosity, so a novel technique was designed in our department for the use of LARS, reducing its technical complications.

Methods: This is a descriptive and longitudinal study from January 2011 to May 2022 inclusive with a minimum follow up of 6 months in order to be included. 40 adult patients were the sample and all of them diagnosed with massive irreparable rotator cuff tear and underwent to superior capsular reconstruction with LARS with a novel technique using anchor fixation and central medial pulley knot.

Results: No intraoperative complications in any case. No case of re-rupture. 1 patient (2.5%) was undergone to second look of the reconstruction of superior capsule due to traumatic event which LARS was intact and an acute subscapularis tendon tear was found. No major complications were seen. 18 patients (45%) presented postoperative stiffness of the shoulder that improved with physical therapy and analgesic blockages, without surgical intervention. The constant scale improved from a mean of 58.98 to a mean of 92.83 ($p < 0.001$), 96,3% of satisfaction after 6 months postoperatively.

Conclusions: Superior capsular reconstruction with LARS is an effective, safe and a reliable technique in patients with massive irreparable rotator cuff tear, with a good to excellent outcome in the medium and long term associated to low rate of critical complications.

EP.03.108

SERUM HS-CRP AS A PREDICTOR OF GRADE II LONG HEAD OF THE BICEPS TENDON TEAR

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Background: The long head of the biceps tendon (LHB) is frequently used as an augmented material or a graft material for rotator cuff repair surgery, especially for large to massive tears. However, there are no readily accessible relevant studies evaluating factors that are associated with LHB tear severity or predictive of grade II LHB tear. This study aimed to determine any factors associated with LHB tear severity and any factors predictive of the presence of grade II LHB tear before rotator cuff surgery.

Methods: This study retrospectively reviewed the data of consecutive patients who underwent arthroscopic surgery by a single surgeon from January 2010 to February 2021. Patients with a history of infection, greater tuberosity fracture, revision arthroscopic surgery, arthroscopy after arthroplasty or fracture fixation, complete biceps tendon rupture, or acute traumatic rotator cuff tear (RCT) were excluded. The study enrolled 728 patients who met the inclusion and exclusion criteria. This study evaluated demographic, physical, social, and serologic parameters, medical comorbidities, intrinsic shoulder lesions, factors related to RCT, and pain severity. LHB tears were diagnosed based on the Lafosse classification. Multivariable ordinal logistic regression analyses were performed to determine associated factors for LHB tear severity. Multivariable binary logistic regression analyses were performed to determine associated factors for grade II LHB tear. Those analyses were performed for both the overall cohort and the large-to-massive RCT cohort. The predictive accuracy for grade II LHB tear was determined using the area under the receiver operating characteristic curve (AUC). The statistical significance was set at $P < .05$.

Results: In the overall studied cohort, Aged 50 years or older, hs-CRP > 1 mg/L, and subscapularis (SSC) tear were significantly associated with LHB tear severity ($P < .05$). In the large-to-massive RCT cohort, serum hs-CRP > 1 mg/L was only significantly associated with grade II LHB tear ($P < .05$), for which they had a satisfactory predictive accuracy, with AUCs of 0.69.

Conclusions: Serum hs-CRP > 1 mg/L is associated with LHB tear severity and has satisfactory predictive accuracy for the presence of grade II LHB tear prior to arthroscopic surgery for large to massive tears.

EP.03.109

RADIOLOGIC AND CLINIC EVALUATION OF ROTATOR CUFF REPAIR WITH BIOINDUCTIVE COLLAGEN IMPLANT

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Background: Although current biomechanically validated techniques can restore the native footprint of the tendon, failure to heal and recurrence of tears remain ongoing challenges. One of the approach for rotator cuff repair augmentation is to use a highly porous, collagen bioinductive implant.

Methods: The study population included 30 patients (mean age 56 years) affected by atraumatic rotator cuff tear who underwent arthroscopic repair. 15 patients (group A) were treated with mini anchors repair, in the other 15 patients (group B) rotator cuff repair has been augmented by collagen bioinductive implant. The inclusion criteria was: isolated tear of supraspinatus, small lesion extension <2cm according to DeOrio and Cofield classification, absence of chondromalacia of grade 3 or greater. Clinical evaluation was assessed submitting Constant score at 3, 6 and 12 months. Magnetic resonance imaging were obtained after 12 months postop. Tendon quality and footprint integration were evaluated using the Sugaya classification. The mean follow-up was 20 months.

Results: The Constant score improved in both groups with advantage of group B in the first 6 months. At 12 months the difference was not significative. The MRI showed 80% of Sugaya 1 and 20% of Sugaya 2 in group A and 100% of Sugaya 1 repairs in group B demonstrating excellent results of tendon healing.

Conclusions: Clinical outcome data showed comparable results for both techniques. The tendon healing results at 12 months were satisfying for both groups. Longer term follow-up are ongoing.

EP.03.110

ARTHROSCOPIC ROTATOR CUFF REPAIR AUGMENTATION WITH AUTOLOGOUS MICRO-FRAGMENTED LIPOASPIRATE TISSUE IS SAFE AND EFFECTIVELY IMPROVES SHORT-TERM CLINICAL AND FUNCTIONAL RESULTS

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Background: Autologous micro-fragmented lipoaspirate tissue has been recently introduced in orthopaedics as an easily available source of non-expanded adipose-derived mesenchymal stem cells. Autologous micro-fragmented lipoaspirate tissue is expected to create a suitable microenvironment for tendon repair and regeneration. Rotator cuff tears show a high incidence of re-rupture and represent an ideal target for non-expanded mesenchymal stem cells. The aim of study was to evaluate safety and efficacy of autologous lipoaspirate tissue in arthroscopic rotator cuff repair.

Methods: Consecutive patients referring to the investigation center for surgical treatment of MRI-confirmed degenerative posterolateral rotator cuff tears were assessed for eligibility and randomized to receive a single-row arthroscopic rotator cuff repair either followed by intra-operative injection of autologous micro-fragmented adipose tissue processed with an enzyme-free technology (treatment group) or not (control group). Clinical follow-up was conducted at 3, 6, 12, 18, and 24 months; 18 months after surgery, MRI of the operated shoulder was obtained to assess tendon integrity and re-rupture rate.

Results: One hundred and seventy-seven patients were screened and 44 (22 per group) completed the 24-month follow-up period. A statistically significant difference in favour of the treatment group in terms of Constant-Murley score emerged at the primary endpoint at 6-month follow-up (control group: 76.66 ± 10.77 points; treatment group: 82.78 ± 7.00 points; $p=0.0050$). No significant differences in clinical outcome measures were encountered at any of the other follow-up points. No significant differences in terms of re-rupture rate, complication rate, and number of adverse events emerged between the two groups.

Conclusions: This prospective, randomized, controlled trial demonstrated that the intra-operative injection of autologous micro-fragmented adipose tissue is safe and effective in improving short-term clinical and functional results after single-row arthroscopic rotator cuff repair. These results open new perspectives in the enhancement of rotator cuff repair, paving the way to a possibly accelerated return to pre-injury level of performance in the patients treated with autologous micro-fragmented adipose tissue, which could have a particularly relevant role in sports medicine.

EP.03.111

THE COVID-19 PANDEMIC SHUT DOWN DID NOT ADVERSELY AFFECT OUTCOMES OF ARTHROSCOPIC ROTATOR CUFF REPAIR

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Background: We investigated whether patients who received an arthroscopic rotator cuff repair (RCR) in January-March 2020 had a difference in outcomes compared to patients who received it the previous year. We hypothesized that patients in 2020 will have decreased access to physical therapy (PT) due to the COVID-19 shutdowns and differences in postoperative outcomes compared to 2019 patients.

Methods: Patients who underwent RCR between 1/1/2020 and 3/17/2020 were selected to be included and patients who underwent RCR between 1/1/2019 and 3/17/2019 were used as a control group. Retrospective chart review was performed, and patient reported outcomes were recorded at an average of 2.68 ± 0.05 years and a minimum of 1 year postoperatively. Patient data was collected and analyzed statistically using the 2-sample t-test and Chi-square test.

Results: This study identified 50 and 51 patients in 2020 and 2019. Rotator cuff repairs done in 2019 had improvements in forward elevation (FE) (135° to 161° ; $p < 0.01$) and internal rotation (IR) (L4 to L1; $p\text{-value} < 0.01$) whereas those done in 2020 did not improve their FE (146° to 151° ; $p = 0.42$) or IR (L3 to L2; $p = 0.29$). There was no difference in external rotation (ER). Both cohorts had improvements in rotator cuff strength testing following surgery (2019: FE/ER/IR: 5/5; 2020: FE/ER/IR 5/5; $p\text{-value} = 0.21, 0.21, 0.09$ for FE, ER, IR, respectively). Patients in 2019 completed more PT sessions (2019: 25.0; 2020: 16.7; $p < 0.01$). Patients in 2020 also experienced a significant delay from date of surgery to date of first PT session (2019: 28.5 ± 11.9 days; 2020: 35.0 ± 16.5 days; $p\text{-value} = 0.03$). Of the 2020 patients, 8% did not initiate PT after RCR, 16% reported a delay in PT while 44% reported that the COVID-19 pandemic affected their recovery following RCR. At final follow up, patients reported a SANE score of 78.2 ± 12.1 on the affected shoulder and a mean VAS pain score of 2.3 ± 1.8 .

Conclusions: Patients who underwent arthroscopic RCR in early 2020 had a longer delay to starting PT, did less PT overall, but still had comparable range of motion and strength at final follow-up.

EP.03.112

OUTCOME COMPARISON BETWEEN ARTHROSCOPIC REPAIR OF FULL-THICKNESS ROTATOR CUFF TEAR IN WORKERS' COMPENSATION AND NON-WORKERS' COMPENSATION PATIENTS: SPECIAL COUNSELLING IS REQUIRED

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Background: Rotator cuff tears (RCTs) are significantly more common in manual workers referred to as workers' compensation patients (WC), compared to the general population. The purpose of this study was to compare the functional outcome and retear rate of arthroscopic repair of full-thickness rotator cuff tear (FTRCT) in WC compared to non-WC patients.

Methods: A total of 301 patients with FTRCT were included. 243 non-WC patients and 58 WC patients that required an arthroscopic rotator cuff repair between 2012 and 2020 with completed serial ultrasound examinations at weeks 6, 12, and 26 postoperatively were included. Functional clinical scores were assessed by Constant score, Western Ontario Rotator Cuff Index (WORC), and Oxford score. Surgical procedures were performed by the same experienced senior surgeon (MH). All patients had undergone an arthroscopic suture bridge repair technique.

Results: Statistically, a significant difference was observed between the mean age of patients. 63 years \pm 8.28 for the non-WC group and 55 years \pm 7.52 for the WC group ($p=.001$). Clinical outcomes were significantly improved at week 26 of all three scores ($p<0.05$) compared to preoperative scores in both groups. WC patients have statistically significantly inferior Total Oxford Scores and WORC Total scores preoperatively, at week 12 and week 26 compared with non-WC patients ($p<0.05$). The Constant score at week 26 reflected statistically significant differences with lower scores for the WC group (61.9 ± 18.5 vs 66.5 ± 16.3 $p=0.01$). However, the WC group has a significantly less complete retear rate at week 12 (1.7% vs 5.8%) and at week 26 (1.7% vs 7.8% $p<0.05$).

Conclusions: These results demonstrate that WC patients are on average 8 years younger than non-WC patients, suggesting that manual labour is a substantial contributing factor to RCTs. WC patients have lower outcomes, at week 12 and at week 26. However, paradoxically, our study showed that WC patients have better healing with low retear rates due to their younger age and non-compliance with physiotherapy. Short-term clinical outcomes of WC patients have worse results than those who don't have a WC claim. This result is helpful in the counselling of these patients and the formation of rehabilitation plans.

EP.03.113

DIAGNOSTIC ACCURACY OF MAGNETIC RESONANCE IMAGING FOR PARTIAL TEARS OF THE LONG HEAD OF THE BICEPS TENDON IN PATIENTS WITH ROTATOR CUFF TEARS

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Background: Magnetic resonance imaging (MRI) is useful for diagnosing shoulder diseases preoperatively. However, detection of partial tears of the long head of the biceps tendon (LHBT) using current clinical tests and imaging modalities is difficult. Recently, there are a few reports that radial-slice MRI is useful for diagnosis of rotator cuff tears. Radial-slice MRI that provides cross slice perpendicular to rotator cuff insertions may acquire high ability of capturing rotator cuff tear. We aimed to evaluate the accuracy of radial-slice MRI for diagnosing partial tears of the LHBT. We hypothesized that radial-slice MRI may be a valuable diagnostic tool for assessing diagnosing tears of the LHBT.

Methods: We retrospectively investigated 118 patients who underwent shoulder arthroscopy for rotator cuff tears. Intraoperative LHBT findings were compared with the identification of partial tears of the LHBT on conventional-slice MRI and radial-slice MRI, using a 3.0 Tesla system. We calculated sensitivity, specificity, accuracy, and positive and negative predictive values for detection of LHBT tears. Inter- and intra-observer reliability for radial-slice MRI was calculated using kappa statistics.

Results: We diagnosed 69 patients (58%) without any LHBT tears and 49 with partial tears (42%), arthroscopically. Sensitivity, specificity, accuracy, and positive and negative predictive values of conventional-slice MRI for detection of partial tears of the LHBT were 52%, 94%, 78%, 92%, and 58%, respectively. Radial-slice MRI had 84% sensitivity, 90% specificity, 86% accuracy, and 92% positive and 80% negative predictive values for partial tears of the LHBT. Inter- and intra-observer reliability for radial-slice MRI was 0.69 and 0.74, respectively, corresponding to high reproducibility, and defined as good.

Conclusions: Radial-slice MRI demonstrated significantly higher sensitivity than conventional-slice MRI. These results indicate that radial-slice MRI is useful for diagnosing LHBT partial tears.

EP.03.114

RISK FACTORS FOR SHOULDER OSTEOARTHRITIS WITH ROTATOR CUFF TEAR IN THE ELDERLY GENERAL POPULATION

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Background: The relationship between shoulder osteoarthritis (OA) and rotator cuff tear (RCT) is unclear. We hypothesized that there is a difference between the pathogenesis of OA complicating RCT and that of RCT complicating OA. In this study, our primary objective was to determine the prevalence of shoulder OA without RCT, RCT without OA, and OA with RCT in the general older population. Our secondary objective was to identify risk factors for the association with OA+RCT in shoulder OA alone or RCT alone, respectively.

Methods: We enrolled patients from the public health checkup conducted in Gunma prefecture (Japan) in 2014. Subjects' shoulder pain at rest, during motion, and at night was evaluated using a questionnaire. Moreover, active and passive range of motions (ROMs) in flexion, abduction, and external rotation were measured. For RCT parameters, we evaluated as no tear, partial-thickness supraspinatus (SSP) tear, full-thickness SSP tear, and SSP-infraspinatus tears. For further analysis, the shoulders were divided into three groups according to the presence of RCT and/or OA: OA, RCT, and OA + RCT groups. Risk factors for OA + RCT were identified in a logistic regression analysis.

Results: Overall, 944 of 1148 shoulders were eligible for inclusion. The prevalence rates of shoulder OA, RCT, and OA + RCT were 5.8%, 21.1%, and 4.2%, respectively. Furthermore, 650 shoulders were excluded, and 55, 199, and 40 shoulders had OA, RCT, and OA + RCT, respectively. There were significant differences for age, ROM of active external rotation, strength of abduction, external rotation, and morphology of the rotator tears. However, there were no significant differences for pain visual analog scale score, passive ROM, Simple Shoulder Test, and grades of OA. Older age decreased active ROM in external rotation, and the presence of both subscapularis and SSP-infraspinatus tears was a risk factor for the association of OA with an RCT shoulder. Older age, weaker power in external rotation, and affected dominant side were risk factors for the association of RCT with an OA shoulder.

Conclusions: This study is the first to report risk factors by considering both shoulder OA and RCT in the general population.

EP.03.115

WILL ADDRESSING SOCIAL DETERMINANTS OF HEALTH HELP REDUCE RACIAL DISPARITIES IN MEDICARE BENEFICIARIES UNDERGOING ROTATOR CUFF SURGERY?

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Background: Prior studies have shown that racial disparities exist among patients undergoing rotator cuff surgery, with some attributing negative social determinants of health's (SDOH) as potential confounders to this relationship. However, there is a paucity of literature observing whether negative SDOH's influence the racial disparities among patients undergoing rotator cuff surgeries. Therefore, the purpose of this study was to determine whether race and SDOH are predictors for Medicare beneficiaries undergoing rotator cuff surgery, and explore whether a diagnosis of at least one negative SDOH is an effect modifier for racial disparities in this population

Methods: A retrospective analysis was conducting using the Medicare Standard Analytic Files (SAF) dataset of the PearlDiver database, observing 211,340 patients with rotator cuff pathology. A univariate and multivariable regression analysis was conducted to observe whether race and SDOH's were predictor variables for those undergoing rotator cuff surgery (21,835 [10.33%] patients). Subsequently, stratified multivariable regression analysis was conducted of those with at least on negative SDOH (5,223 patients) and those without any (16,612 patients) to observe whether there was any difference in racial disparities among these two cohorts. Significant differences in racial disparities were observed if the odds ratios in the stratified analyses were non-overlapping.

Results: Those who underwent rotator cuff surgery had lower odds of being non-Caucasian (OR: 0.622; 95% CI: 0.599-0.668; $p < 0.001$) or having at least on negative SDOH (OR: 0.715; 95% CI: 0.501-0.814; $p < 0.001$). There was no significant difference in racial disparities among those with one or more SDOH when compared to the racial disparities in those without any negative SDOH (overlapping 95% confidence intervals).

Conclusions: Medicare beneficiaries who were non-Caucasian and had at least one negative SDOH were 38% and 27%, respectively, less likely to undergo surgery for a rotator cuff tear within 1 year from initial injury. SDOH was shown to not be an effect modifier on the observed racial disparities, emphasizing the importance of the continuation and expansion of initiatives targeting racial disparities in musculoskeletal health

EP.03.118

WHAT IS THE MOST PREDICTIVE MRI FINDING OF ROTATOR CUFF TEAR CONCOMITANT WITH SHOULDER STIFFNESS?

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Background: To determine the most predictive MRI finding of rotator cuff tear with shoulder stiffness to differentiate from that without stiffness.

Methods: Patients who underwent arthroscopic rotator cuff repair between January 2014 and October 2019 were retrospectively reviewed. Stiffness was defined as forward flexion < 120°, external rotation at side < 30°, and internal rotation at back < L3. Propensity score matching (1-to-1) was performed between Stiff and Control groups by sex, age, and tear size, and 76 patients per group were matched. Anterior capsular thickness, maximal humeral/glenoid capsular thickness in the axillary recess, coracohumeral ligament thickness, the presence of hyperintensity in the anterior capsule and humeral/glenoid capsule in the axillary recess, and hyperintensity and obliteration of the subcoracoid fat triangle were evaluated.

Results: Anterior capsular thickness, glenoid capsular thickness in the axillary recess, and anterior and axillary capsular hyperintensity were significantly more dominant in the Stiff group (all $p < .05$) than in the Control group. Anterior capsular thickness and anterior capsular abnormal hyperintensity could be used to differentiate between the Stiff and the Control groups ($p < .05$). Anterior capsular thickness showed a high diagnostic performance with an area under the receiver operating characteristic curve of 0.993. The cut-off value for stiffness was 3.07 mm (sensitivity, 96.1%; specificity, 100%).

Conclusions: Anterior capsular thickening and anterior capsular abnormal hyperintensity were the most predictive MRI findings for stiffness in patients with rotator cuff tear and stiffness to differentiate from patients with rotator cuff tear without stiffness.

EP.03.119

CORRELATION BETWEEN THE INCIDENCE OF ROTATOR CUFF LESION IN TRAUMATIC UNILATERAL ANTERIOR GLENOHUMERAL DISLOCATION AND THE CONTRALATERAL SHOULDER

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Background: Anterior glenohumeral dislocation in patients older than 60 years is related to rotator cuff lesions because of its pre-existing degenerative condition. However, in this age group, the scientific evidence fails to elucidate whether rotator cuff lesions are the cause or consequence of recurrent shoulder instability. The objective of this paper is to describe the prevalence of rotator cuff injuries in a series of consecutive shoulders in patients older than 60 years who suffered a first episode of traumatic glenohumeral dislocation and its correlation with rotator cuff injuries in both shoulders.

Methods: Retrospectively, 35 patients over 60 years of age who had the first episode of unilateral traumatic anterior glenohumeral dislocation and who had MRI of both shoulders were studied, evaluating both shoulders with MRI to determine the structural damage correlation of the rotator cuff and long head of the Biceps between them.

Results: When assessing the existence of partial or complete injury to the supraspinatus and infraspinatus tendons, the concordance on the affected and healthy sides, we have shown concordant results on both sides in 88.6% and 85.7%, respectively. The Kappa concordance coefficient was 0.72 for supraspinatus and infraspinatus tendons tear. Of the total of 35 cases evaluated, 8 (22.8%) presented at least some alteration in the tendon of the long head of the biceps on the affected side and only 1 (2.9%) on the healthy side, where the Kappa coefficient of concordance was 0.18. Of the 35 cases evaluated, 9 (25.7%) presented at least some retraction in the tendon of the subscapularis muscle on the affected side, while no participant showed signs of retraction in the tendon of this muscle on the healthy side.

Conclusions: Our study has found a high correlation between the presence of a posterosuperior rotator cuff injury after presenting a glenohumeral dislocation regarding the shoulder that has suffered the event and the presumably healthy contralateral shoulder. Nevertheless, we have not found this exact correlation in relation to the subscapularis tendon injury and medial biceps dislocation.

EP.03.120

AUTOMATED CLASSIFICATION OF SHOULDER RADIOLOGY FOCUSING ON CUFF TEAR ARTHROPATHY AND GLENOID EROSION USING ARTIFICIAL INTELLIGENCE

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Background: Recent advances in artificial intelligence for image recognition using convolutional neural network (CNN) architecture have led to its successful application in medical imaging. Thus far, application on plain radiographs has been limited, particularly in identification of degenerative musculoskeletal disorders. Our aim was to train and evaluate the performance of an artificial neural network in classification of cuff tear arthropathy (CTA) and glenoid erosion (GE) on plain shoulder radiographs, performed according to Hamada and Favard classifications.

Methods: We utilized a publicly available CNN pre-trained for image recognition. The network was trained using images consisting of shoulder and clavicle radiographs (n=6733). The training set was quite unselected containing many clinical conditions. Network performance was evaluated against a validation set (n=560), resulting in measurements of sensitivity, specificity, Youden's index and Area Under Curve (AUC) in the receiver operating characteristics Curve analysis for each grade, with AUC being the primary accuracy measure.

Results: The network performed best on Hamada grades 3 and 4 for CTA, achieved AUC of 0.95, 95% CI [0.91-0.98] in both groups. Performance in Hamada grades 0-2 and on Favard classification for GE was slightly poorer, though still adequate, with AUC ranging from 0.81 to 0.91.

Conclusions: The network successfully identified CTA on plain radiographs at a rate comparable to earlier studies on osteoarthritis. It performed particularly well on later degenerative stages with more pronounced pathology. Achieving this performance with a heterogenous data set is promising for implementation of AI in a real-world setting. Use of the validation set in place of a test set may influence our results.

EP.03.121

BIOMECHANICAL COMPARISON OF COMBINED LATISSIMUS DORSI AND TERES MAJOR TENDON TRANSFER VERSUS LATISSIMUS DORSI TENDON TRANSFER IN SHOULDERS WITH IRREPARABLE ANTEROSUPERIOR ROTATOR CUFF TEARS

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Background: Irreparable anterosuperior rotator cuff tears (IASRCTs) can result in a loss of active elevation and internal rotation, superior and anterior migration of the humeral head, and cuff tear arthropathy over time. Recently, isolated latissimus dorsi (LD) and combined LD and teres major (TM) tendon transfer have gained attention as reliable treatment options. No attempt for biomechanical comparison study of these tendon transfers have been made. Therefore, the purpose of this study was to evaluate the biomechanical efficacy of the LDTM transfer and compare to LD transfer for IASRCTs.

Methods: Eight cadaveric shoulders (mean age: 68.3 ± 5.2) were tested using a custom shoulder testing system for four conditions: (1) Intact, (2) IASRCT, (3) LDTM transfer, and (4) LD transfer. Subacromial contact pressure, rotational range of motion, glenohumeral translation and kinematics were measured at 0°, 30°, and 60° of glenohumeral abduction in the scapular plane. Muscle loading was applied according to the physiological cross-sectional area ratios. To simulate increased muscle tension from the advanced insertion site of the transferred tendons, three different LD and LDTM muscle loading conditions were applied. For statistical analysis, A linear mixed effects model was used, followed by Tukey's test which adjusted p-values for multiple comparisons.

Results: IASRCT significantly increased glenohumeral translation and subacromial peak contact pressure. The LDTM transfer significantly decreased translation and subacromial peak contact pressure at every abduction angle ($P < .046$), while LD transfer could only at 30° abduction ($P < .048$). Both the LDTM and LD transfer restored glenohumeral kinematics to Intact, but LDTM transfer was more effective than the LD transfer, especially at 60° abduction and 30° ER. Both LDTM and LD transfer significantly increased resting humeral internal rotation and maximum internal rotation compared to the IASRCT and Intact at 30° and 60° abduction (LDTM: $P < .003$, LD: $P < .006$). At 0° abduction, LDTM condition significantly increased maximum IR compared to the IASRCT and Intact ($P < 0.021$).

Conclusions: Combined LDTM transfer may be reliable treatment option than isolated LD transfer in patients with an IASRCT.

EP.03.122

LOWER TRAPEZIUS TRANSFER WITH SEMITENDINOSUS , USING ARTHROSCOPIC ASSISTANCE TO TREAT AN IRREPARABLE POSTEROSUPERIOR TEAR OF ROTATOR CUFF WITHOUT GLENOHUMERAL ARTHROSIS: ONE - YEAR OUTCOMES

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Background: To analyze the functional outcomes and postsurgical pain of patients who underwent a lower trapezius transfer with semitendinosus and gracilis tendon graft, using arthroscopic assistance to treat irreparable posterosuperior tear of rotator cuff without glenohumeral arthrosis; at 3, 6 and 12 months postoperative.

Methods: A single surgeon retrospective chart review of prospectively collected data was completed of ten patients with an irreparable posterosuperior rotator cuff tear without glenohumeral arthrosis who underwent a lower trapezius transfer with semitendinosus and gracilis autologous tendon graft fixed to humerus with knotless suture anchors, using arthroscopic assistance. ASES (American Shoulder and Elbow Surgeons) score, Constant score, pain (Analogue scale of pain) and ranges of motion was evaluated pre and post-operatively at 3, 6 and 12 months postoperative.

Results: A total of 10 patients (7 males, 12 females) with a mean age of 57,6 (54,2 - 61,0) years for males and 64,3 (56,0 - 72,7) years for females were included, 60% were right-handed. No intraoperative complications, neurovascular injuries, adverse events, bleeding, or infections were reported. At 3, 6 and 12 months follow-up, there was statistically significant improvement of the ASES score (preoperative=27,2 at 3 months= 43,9 at 6 months=76,3 at 12 months=92,8 Constant score (preoperative=32,3 at 3 months=41,6; at 6 months=70,7 at 12 months=87,0; and pain (preoperative=7 at 3 months=5; at 6 months=2,2; at 12 months=0,8 The ranges of motion had a statistically significant improvement at 6 and 12 months: Flexion (preoperative=82,5 at 3 months=58,5; at 6 months=125,5; at 12 months=143,5 Abduction (preoperative=76 at 3 months=46,0 ; at 6 months=154, at 12 months=160,0 External rotation (preoperative=10,5 at 3 months=9,0 at 6 months=52,0; at 12 months=65,0) and internal rotation (preoperative=2,3 at 3 months=3,2; at 6 months=3,6; at 12 months=3,8).

Conclusions: Lower trapezius transfer with semitendinosus and gracilis autologous tendon graft fixed to humerus with knotless suture anchors, using arthroscopic assistance to treat irreparable posterosuperior tear of rotator cuff without glenohumeral arthrosis has an improve of functionality and pain relieve at 3, 6 and 12 months follow-up, with an excellent outcome at year of surgery. Ranges of motion decrease at 3 months postoperative but improve at 6 and 12 months.

EP.03.123

SUBACROMIAL DECOMPRESSION IS ASSOCIATED WITH A NUMBER NEEDED TO TREAT OF 4 FOR REDUCED REVISION ROTATOR CUFF REPAIR: A LARGE MATCHED COHORT INSURANCE DATABASE ANALYSIS

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Background: Subacromial decompression (SAD) during arthroscopic rotator cuff repair (ARCR) has traditionally been performed to relieve impingement of the rotator cuff tendons as they pass through the subacromial space. The purpose of this study is to quantify the reduced risk of revision rotator cuff surgery conferred by performing SAD with ARCR.

Methods: The PearlDiver administrative claims database was queried for patients who underwent ARCR between 2015-2020 with a minimum follow up of 2 years. The study population was stratified by whether concurrent SAD was performed at the time of the index ARCR. Groups were matched on age, gender, Charlson Comorbidity Index (CCI), complete versus partial tear, and comorbidities previously correlated with RCR healing. The primary outcome was requiring a revision rotator cuff repair.

Results: The final analysis included 30,407 patients per group, with a mean age of 60 years (SD=7) and 45.3% women. Baseline demographics were similar between groups after matching. 551 (1.8%) patients without SAD vs. 437 patients with SAD (1.4%) underwent a revision rotator cuff repair, corresponding to a number needed to treat (NNT) of 3.8 (unadj-OR=0.79, 95% CI 0.70-0.90, P<0.001). In a multivariable model, factors associated with revision rotator cuff repair included subacromial decompression (adj-OR=0.79, 95%CI 0.70-0.90, P<0.001), male gender (adj-OR 0.97, 95% CI 0.97-0.98, P=0.017), older age (adj-OR=0.97, 95% CI 0.97-0.98, P<0.001), complete tear (adj-OR=3.62, 95% CI 2.87-4.57, P<0.001), tobacco use (adj-OR 1.33, 95% CI 1.12-1.52, P<0.001), and CCI (adj-OR 1.05, 95% CI 1.01-1.09, P=0.027).

Conclusions: In a large cohort of over 60,000 patients with partial or complete rotator cuff tears, performing concurrent SAD conferred a 26% relative risk reduction (NNT»4 patients) for revision rotator cuff repair when compared to ARCR alone. These findings suggest that SAD may reduce the risk of revision rotator cuff surgery.

EP.03.126

ARTHROSCOPIC REPAIR OF MASSIVE ROTATOR CUFF TEARS LEADS TO FUNCTIONAL IMPROVEMENT IN THE MAJORITY OF CASES AT MID-TERM FOLLOW-UP

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Background: There is a paucity of mid-term outcomes following arthroscopic repair of massive rotator cuff tears (MRCTs). The purpose of this study is to report mid-term outcomes after arthroscopic rotator cuff repair of MRCTs.

Methods: A retrospective study was conducted on patients who underwent ARCR of a MRCT by 2 surgeons at different institutions. At a minimum of 4 years postoperative, Patient-reported outcomes collected included visual analog scale for pain (VAS), American Shoulder and Elbow Surgeons (ASES), Veterans RAND 12 (VR-12), and Subjective Shoulder Value (SSV) scores. Repair technique and concomitant procedures were also gathered. Tendon healing was evaluated via ultrasound at final follow-up.

Results: Functional outcomes were available for 101 patients at mean 63.6 ± 8.8 months (range 48-82 months) postoperative. Mean ASES scores improved from 40.1 to 78 ($p < 0.001$), VR-12 from 37.1 to 47.7 ($p < 0.001$), and the SSV from 36.7 to 84.6 ($p < 0.001$). Forward flexion improved 126° to 144° ($p = 0.001$), external rotation remained unchanged (47° to 44° ; $p = 0.268$), and internal rotation improved 2 spinal levels (L4 to L2; $p = 0.001$). Eighty eight percent (89 of 101) of patients were satisfied with the procedure and only 5% went on to reverse shoulder arthroplasty within the study period. Among 39 patients who had a postoperative ultrasound to assess healing, complete tendon healing was observed in 56% of cases. There was no difference in healing or outcomes according to tear pattern. Additionally, tendon healing did not affect outcomes.

Conclusions: Arthroscopic repair of massive rotator cuff tears lead to functional improvements and patient satisfaction in most cases at mid-term follow-up. Complete tendon healing is difficult to achieve, but does not appear to limit functional improvements. Despite a modest complete healing rate, few patients went on to require reverse shoulder arthroplasty.

EP.03.127

A NARROW CORACOHUMERAL INTERVAL CANNOT DISTINGUISH BETWEEN PARTIAL AND COMPLETE SUBSCAPULARIS TEARS

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Background: Subscapularis (SSc) tendon tears are difficult to diagnose and classify with magnetic resonance imaging (MRI). SSc tears have been associated with a decreased coracohumeral interval (CHI). The study objective was to assess the measurement of CHI on axial MRI scans as a tool for predicting and differentiating partial and complete SSc tears.

Methods: Patients with preoperative shoulder MRIs and intraoperatively confirmed subscapularis tears were retrospectively identified from our institutional registry. Two reviewers reviewed all MRI scans and measured the CHI on axial images. MRI measurements were compared to arthroscopic assessments performed by a single surgeon. A narrow CHI was defined as <7 mm. Mean CHIs on axial MRI scans were compared between partial and complete tears of the SSc tendon.

Results: A total of 145 patients were included with an average age of 61.2 years. A narrow CHI was found on 71.7% of MRIs and in 74.4% of intraoperative reports. The average CHI on MRI was 5.9 ± 1.5 mm. There was no statistically significant difference between the mean CHI on axial MRI scans between partial and complete subscapularis tears (6.4 ± 1.6 mm vs 5.6 ± 1.5 mm, respectively; $p > 0.05$).

Conclusions: A narrow CHI is present in the majority of subscapularis tears. However, it cannot be used to differentiate between partial and complete tears. These findings support measuring the CHI on axial MRI scans when suspecting subscapularis tears and additionally highlight the importance of careful arthroscopic examination of such tears when surgery is indicated.

EP.03.128

SECONDARY ARTHROSCOPIC DISTAL CLAVICLE RESECTION CAN RELIEVE PAIN IN RARE CASES WITH SYMPTOMATIC ACROMIOCLAVICULAR JOINT ARTHROPATHY FOLLOWING ISOLATED ROTATOR CUFF WITH COMPLETE TENDON HEALING

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Background: Recent meta-analyses advised against distal clavicle resection (DCR) as an adjuvant procedure during rotator cuff repair (RCR), whether performed systematically or in shoulders diagnosed with acromioclavicular joint (ACJ) arthropathy. However, the efficacy of DCR as a secondary procedure in patients with persistent pain attributed to symptomatic ACJ arthropathy remains unknown. The purpose was to evaluate outcomes of secondary DCR in patients that had failed conservative treatment of symptomatic ACJ arthropathy following isolated rotator cuff repair (RCR) with complete tendon healing.

Methods: Between 2008 and 2018, the senior surgeon performed isolated RCR in 1935 patients, of which 23 (1.2%) presented with ACJ pain and discomfort at 6 months following index RCR, despite complete healing of repaired tendons. Those 23 patients underwent secondary DCR as ACJ arthropathy was confirmed clinically and radiographically. Clinical assessment before DCR included Subjective Shoulder Value (SSV) and pain at rest. Clinical assessment at >12 months after DCR included SSV, pain at rest, Constant-Murley score and range of motion.

Results: Of the initial cohort of 23 patients, 5 were lost to follow-up, leaving 18 patients aged 53.3 ± 7.6 years (range, 39-68) for outcome assessment. None of the patients had complications or ACJ instability following DCR. At a mean follow-up of 7.0 ± 3.1 years after DCR, the SSV improved to 76.1 ± 20.2 , the pain at rest decreased to 2.8 ± 1.9 . At final follow-up, the Constant-Murley score was 64.7 ± 20.5 . Of 18 patients, 15 had none or mild residual pain (0-2; 83%), while 3 had substantial residual pain (5-6; 17%). Only 1 of the 3 patients with substantial residual pain had poor SSV (20 points) and responded that they would not opt for DCR in retrospect.

Conclusions: Secondary DCR for symptomatic ACJ arthropathy following isolated RCR with complete tendon healing reduced pain in 83% of patients, though 94% were satisfied and would undergo secondary DCR again. A minority of patients could experience substantial residual pain that seldom impacts functional outcomes.

EP.03.129

POSTOPERATIVE GRAFT INTEGRITY AFFECTS CLINICAL OUTCOMES AFTER SUPERIOR CAPSULE RECONSTRUCTION USING FASCIA LATA AUTOGRAFT IN POSTERIOR-SUPERIOR ROTATOR CUFF TEARS: A MULTICENTER STUDY

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Background: The relationship between postoperative graft integrity and clinical outcomes after superior capsule reconstruction (SCR) remains unclear. We aimed to assess the relationship between postoperative graft integrity, including graft thickness and size of graft tear, and clinical outcomes after SCR in patients with irreparable rotator cuff tears (RCTs).

Methods: This retrospective multicenter study included 188 patients (86 women, 102 men; mean age, 69.2 years; range, 49–87 years) with irreparable RCTs who underwent arthroscopic SCR using fascia lata autografts. Using magnetic resonance imaging (MRI), the graft integrity was evaluated postoperatively at or after 1 year and was classified, according to Hasegawa's classification, into four categories: type I–II, intact graft of sufficient thickness; type III, thinned graft without discontinuity; type IV, presence of a minor discontinuity; and type V, presence of a major discontinuity. We compared visual analog scale (VAS) for pain, American Shoulder and Elbow Surgeons (ASES) score, active shoulder range of motion (ROM), and acromiohumeral distance (AHD) among four groups based on postoperative graft integrity.

Results: MRI scans revealed 152 shoulders (80.9%) with type I–II graft, 13 (6.9%) with type III graft, 13 (6.9%) with type IV graft, and 10 (5.3%) with type V graft. VAS and ASES scores significantly improved after SCR in all graft types ($P < 0.0001$ to $P = 0.02$). However, shoulders with type V grafts had significantly inferior postoperative VAS and ASES scores (2.3 and 69.7) compared to those with type I–II grafts (0.3 and 93.0; $P = 0.001$ and $P < 0.0001$, respectively). Shoulders without graft tears (types I–II and III) showed significant improvements in shoulder elevation and internal rotation after SCR ($P < 0.0001$ to $P = 0.02$). In contrast, shoulders with large graft tears (type V) showed no significant improvement in shoulder ROM. Postoperative AHD significantly increased only in shoulders with type I–II grafts ($P < 0.0001$).

Conclusions: Postoperative graft thickness and size of graft tear affected clinical and radiographic outcomes after SCR using a fascia lata autograft. Patients with large graft tears had significantly inferior postoperative clinical scores compared to those with intact grafts of sufficient thickness. Shoulders with intact grafts of sufficient thickness restored glenohumeral stability and showed better clinical outcomes than those with graft thinning or tears.

EP.03.131

DECREASED BLOOD FLOW TO REMNANT TENDON STUMP IS ASSOCIATED WITH INTENSITY OF NOCTURNAL SHOULDER PAIN IN PATIENTS WITH ROTATOR CUFF TEAR

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Background: Nocturnal shoulder pain is a common clinical symptom in patients with rotator cuff tear (RCT), however, underlying mechanisms remain controversial. Recently relationship between hemodynamics of glenohumeral capsule and pain has received much attention in frozen shoulder. The purpose of this study was to investigate association of hemodynamics in remnant tendon stump and surrounding bursa with nocturnal shoulder pain in patients with RCT.

Methods: Forty-three RCT patients (Mean age: 65[42-83]) who had full thickness supraspinatus tendon tear and underwent arthroscopic repair were included. Intensity of nocturnal shoulder pain was evaluated using a 100mm visual analog scale (VAS). Dynamic MRI was performed for 3 minutes, and time-intensity-curve analysis was conducted for evaluating hemodynamics of the remnant tendon stump, surrounding bursa, and deltoid muscle (control) within a 20mm² ROI. Peak enhancement ratio (PER; reflecting blood flow volume) and enhancement slope (ESL; reflecting blood flow velocity) were calculated. Correlations of PER / ESL in the tendon stump and bursa (divided by the data of deltoid muscle for normalization) with the pain VAS were evaluated. Additionally, contribution of demographic data (age, sex, duration of pain, size of RCT, range of motion) and chronic-pain-associated questionnaires (pain catastrophizing scale, hospital anxiety and depression scale, central sensitization inventory) to the nocturnal shoulder pain was analyzed.

Results: Nocturnal shoulder pain VAS was 68 [30-80] mm. PER / ESL in the bursa (1.27 [0.79-1.76] / 7.92[5.62-11.6]) was significantly higher than tendon stump (0.04 [0.03-0.10] / 0.31 [0.15-0.58]) and deltoid muscle (0.26 [0.21-0.36] / 1.31 [1.00-1.95]). The pain VAS was negatively correlated with PER ($r=-0.448$, $P<0.01$) and ESL ($r=-0.352$, $P<0.05$) in the tendon stump, while it was positively correlated with PER ($r=0.395$, $P<0.01$) in the bursa. Neither demographic data nor chronic-pain-associated questionnaires were associated with the pain VAS.

Conclusions: Lower PER and ESL in the remnant tendon stump reflected ischemic changes probably due to tear and repetitive mechanical stimuli, and higher PER in the surrounding bursa possibly suggested secondary bursitis. Impressively, the severity of nocturnal shoulder pain was partly explained by these different mechanisms worked in adjacent tissues, which showed greater impact than demographic data and chronic-pain-associated questionnaires.

EP.03.132

OUTCOMES OF SUPERIOR CAPSULAR RECONSTRUCTION WITH ACHILLES TENDON-BONE ALLOGRAFT USING KEY HOLE FOR FITTING BONE TO BONE: NOVEL TECHNIQUE FOR IRREPARABLE ROTATOR CUFF TEAR

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Background: Superior capsular reconstruction (SCR) has become a popular treatment for massive irreparable rotator cuff tears. However, despite the improved outcomes, failures or non-healing of graft materials have been recently reported after SCR. The purpose of this study is to evaluate the clinical and radiological outcomes of SCR using Achilles tendon-bone allograft as a novel technique.

Methods: We performed a retrospective review of patients who underwent SCR using Achilles tendon-bone allograft with the keyhole technique, and were followed-up for a minimum of 2 years. The visual analog pain rating, American Shoulder and Elbow Surgeons (ASES) score, and Constant score were evaluated as subjective outcomes, while the range of motion of shoulder joint and isokinetic strength were evaluated as objective outcomes. The acromiohumeral interval (AHI), bone-to-bone healing of the allograft and humeral head on computed tomography (CT), and tendon integrity on magnetic resonance imaging (MRI) were obtained as radiological outcomes.

Results: This study included 32 patients with a mean age of 56.8 ± 4.2 years and a mean follow-up of 28.4 ± 6.2 months. All subjective and objective clinical outcomes improved significantly, except for degrees of external rotation in range of motion. The radiologically measured AHIs also increased significantly. Medial to lateral tendon integrities were intact in all cases, and non-union at the fitting zone of the keyhole on the greater tuberosity was diagnosed in one case (3.1%). Failure of engraftment between the allograft and remnant tendon at the posterior marginal convergence was observed in four cases (12.5%).

Conclusions: The overall outcomes of SCR using Achilles tendon-bone allograft using the keyhole technique improved, with an increased AHI and excellent integrity of medial and lateral direction compared to preoperative measurements. Hence, SCR using Achilles tendon-bone allografts is a reasonable option for the surgical treatment of irreparable rotator cuff tears.

EP.03.133

MORPHOLOGY OF THE CORACOID PROCESS AS A PREDICTOR OF THE SUBSCAPULARIS TEAR

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Background: Articular side tear at the upper border of the subscapularis (SSC-AST) is often detected during shoulder arthroscopic surgeries, although its exact pathology remains unknown. The purpose of this study was to investigate the correlation between various characteristics of the coracoid process, including classification of the morphology of the coracoid process tip, and the presence of SSC-AST.

Methods: This retrospective, case-controlled study included patients who underwent arthroscopic sub-acromial decompression with or without rotator cuff repair between January 2018 and September 2021. One-hundred thirty shoulders of 124 patients, including 77 male shoulders and 53 female shoulders (mean age at surgery: 64 years (range, 39-88 years), were included in this study. Three-dimensional (3D) computed tomography examination was performed preoperatively, and each indices were measured including offset of the tip of the coracoid process and glenoid (as anterior, lateral and superior offsets). The morphology of the tip of the coracoid process was classified into three types: flat, round and beak types. The presence of SSC-AST was intraoperatively evaluated during arthroscopy via a posterior glenohumeral portal. The correlation between the incidence of SSC-AST and classification of the tip of the coracoid process were analyzed.

Results: Fifty-three shoulders (40.8%) had SSC-AST. Group T subjects were significantly older than Group N (68.4 ± 10.0 years vs. 61.5 ± 11.8 years $p < .001$). No sex difference was detected between the two groups (Group T: 28 males, 25 females, Group N: 49 males, 28 females, $p = .28$). Multivariate analysis of morphological parameters between the two groups detected a smaller superior offset as a risk factor for SSC-AST (odds ratio 0.91, 95% confidence interval 0.84-0.98 $p = .01$). No significant differences were found in the other parameters. Regarding classification of the tip of the coracoid process, round and beak type coracoid tips had a significantly higher rate of SSC-AST than flat type tips (flat type, 21.8%; round type, 64.7%; beak type, 46.3%, $p < .001$).

Conclusions: Evaluation of the correlation between morphology of the coracoid process on 3D-CT and presence of SSC-AST visualized during arthroscopy indicated a significant association between SSC-AST and morphology of a coracoid process.

EP.03.135

PRELIMINARY OUTCOMES OF ARTHROSCOPIC BICEPS REROUTING FOR THE TREATMENT OF LARGE TO MASSIVE ROTATOR CUFF TEARS

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Background: To evaluate the short-term outcomes of arthroscopic biceps rerouting (ABR) for the treatment of large to massive rotator cuff tears (LMRCTs).

Methods: A prospective evaluation of patients treated with ABR for the repair of LMRCTs was performed, with a minimum follow-up period of 18 months. Range of motion (ROM) and functional outcomes were assessed preoperatively and at final follow-up. Radiographs were used to evaluate the acromiohumeral interval (AHI). Magnetic resonance imaging was performed at 2 and 12 months postoperatively to examine the integrity of the repaired tendons.

Results: Sixty one patients who underwent ABR from March 2017 to January could be evaluated more than 18 months after surgery. The average age of the enrolled patients was 64.5 years. The visual analog scale pain score decreased from 3.7 preoperatively to 1.6 at final follow-up, the American Shoulder and Elbow Surgeons score improved from 60.0 to 85.2, and the Korean Shoulder Scale score improved from 64.3 to 85.3. Assessment of ROM showed significant improvement in forward flexion, external rotation, and internal rotation from preoperatively to last follow-up. The AHI was 7.1 mm at baseline and improved significantly to 9.7 mm at 3 months postoperatively. Of the patients, 16 (26%) exhibited a retear of the repaired rotator cuff on magnetic resonance imaging at 12 months postoperatively. Male sex was the only significant risk factor for retear.

Conclusions: ABR improved the functional and radiologic outcomes of patients with LMRCTs. The ABR technique can be a useful treatment option for LMRCTs.

EP.03.138

WHEN ROTATOR CUFF REPAIR MAY NOT BE INDICATED: MACHINE LEARNING CAN PREDICT NON-ACHIEVEMENT OF CLINICALLY SIGNIFICANT OUTCOMES AFTER ROTATOR CUFF SURGICAL REPAIR

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Background: Although rotator cuff surgical repair has considerable clinical benefits in symptomatic individuals with rotator cuff tears, the functional results and the re-tear rate after surgery are still far from ideal. This raises the question of who would likely benefit from surgical treatment. Few studies in the literature developed prediction models to address this issue by identifying prognostic factors for treatment outcomes using classical statistical methods. Nevertheless, the performance of those algorithms are usually very low. The main goal of this study was to determine whether machine learning algorithms using preoperative data can predict the non-achievement of clinically significant disability improvement at 2 years after rotator cuff surgical repair.

Methods: We followed a total of 474 patients (500 shoulders) with rotator cuff tears who underwent arthroscopic rotator cuff repair between January 2013 and April 2019. We used routinely collected imaging, clinical and demographic data to train eight machine learning algorithms (random forest classifier, LightGBM, decision tree classifier, extra trees classifier, logistic regression, XGBoost, KNN classifier and CatBoost classifier). We used a random sample of 70% of patients to train the algorithms and 30% were left for performance assessment, simulating new unseen data.

Results: The random forest classifier and LightGBM presented the highest AUC measures (0.68 and 0.67, respectively). An interface with the trained random forest classifier algorithm deployed was developed for clinical application (<https://bit.ly/rotatorcuffsurgeryAI>).

Conclusions: We found that machine learning algorithms using preoperative data can predict with substantial performance acceptable the non-achievement of clinically significant outcomes for disability improvement at 2 years after rotator cuff surgical repair.

EP.03.139

INFLUENCE OF PSYCHO-SOCIAL DISORDERS ON RETURN TO PROFESSIONAL OCCUPATION AFTER ROTATOR CUFF REPAIR

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Background: There are few data available regarding the influence of psycho-social disorders (PSD) on return to professional occupation after rotator cuff repair (RCR). The aim of this study was to evaluate the influence of PSD on return to professional occupation after RCR. Working hypothesis was that return to professional occupation delays would be extended in case of a medical history of PSD.

Methods: This retrospective monocentric study included 158 patients (mean age 53.4 ± 8.0 years), operated on for an arthroscopic RCR (distal supraspinatus tear). Among them, 16.5% had a history of PSD (depression, anxiety, bipolar disorder and non specific mood disorder) and 83.5% did not. All patients had a professional occupation, preoperatively. Primary endpoint was the postoperative delay to return to professional occupation. Secondary endpoints were: return to professional occupation rates at 3, 6, 12 months, the return to same professional occupation rate at last follow-up, the modification in their professional occupation (change of occupation or cessation of all activity). Influence of PSD on these different endpoints has been realized with Bayesian statistical methods, in univariate and multivariate analysis.

Results: Patients with PSD returned to professional occupation 21 ± 11 weeks later than patients without PSD. In multivariate analysis, we found a 98% probability of delaying return to professional occupation by at least 4 weeks in patients with PSD and a 75% probability of delaying it by at least 14 weeks. Patients with a heavy physical work had a 99% probability of delaying return to professional occupation. The relative risk to return to professional occupation within the 3 first postoperative months was 2 time lower (OR=0.5 [0.1 ; 2.3]) and to change occupation at last follow-up was 1.8 times higher (OR=1.8 [0.7 ; 4.3]), in patients with PSD. A history of PSD did not appear to have an influence on the other endpoints: return to professional occupation rates at 6 months (OR=0.8 [0.3 ; 2.2]) and 12 months (OR=0.7 [0.3 ; 2.3]), or cessation of all professional activity at last follow-up (OR=1.1 [0.4 ; 3.5]).

Conclusions: We found a negative influence of PSD on resuming professional occupation after RCR.

EP.03.140

THE TRIPPLE TENDON TRANSFER (T3) FOR TRAPEZIUS MUSCLE PAULSY. A CASE REPORT AND LITERATURE REVIEW

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Background: Background: This case report details the outcome of a triple-tendon (T3) transfer, an Eden-Lange variant, to the scapula to stabilize the scapulothoracic joint in the treatment of symptomatic trapezius paralysis in a one patient.

Methods: Technique: The tripple transfer was performed in a 63 year old male with a history of persistent trapezius paralysis secondary to spinal accessory nerve injury sustained during base of tongue cancer resection. Surgery was indicated following 18mths of pain and weakness and limited range of motion of the shoulder despite non surgical management. The tripple transfer included transfer of the levator scapulae to the lateral aspect of the spine of the scapula, the rhomboid minor to the spine of the scapula just medial to the levator scapulae insertion and the rhomboid major to the medial spine of the scapula. Post-operatively the patient was managed in an abduction brace for 8 weeks prior to commencing active shoulder range of motion.

Results: At 6 months follow up winging was partially corrected. Visual analogue score (VAS) for pain improved from 3/10 preoperative to 0/10 post operatively. Single assessment numeric evaluation (SANE) for shoulder function improved from 30% function preoperatively to 100% post operatively. Western Ontario Rotator Cuff Index (WORCI) improved from 1384/2100 = 65.9% disability to 146/2100 representing 7% disability about the shoulder. Oxford shoulder score improved 30/48 to 46/48 at six months post surgery. Active shoulder flexion improved from 100 degrees preoperatively to 150 degrees post operatively. The outcome in this case is in keeping with previous reported literature including the largest case series published by Bassem el Hassan who reported on 22 cases with mean follow of 36 months.

Conclusions: This is a single case report that demonstrates the technique of the tripple tendon transfer. It was effective in compensating for a deficient trapezius to stabilise the scapulothoracic articulation. This subsequently resulted in an improvement in pain, range of motion and overall shoulder function for this patient.

EP.03.141

HUMAN DERMAL ALLOGRAFT AUGMENTATION IN PRIMARY AND REVISION ARTHROSCOPIC ROTATOR CUFF REPAIR: A RETROSPECTIVE COMPARATIVE STUDY INCLUDING PATIENT OUTCOMES AND ULTRASOUND EVALUATION OF TENDON HEALING

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Background: Failure of tendon healing after rotator cuff (RC) repair has been associated with poorer functional outcomes and patient complaints. We hypothesized that human dermal allograft augmentation would result in significant improvement of shoulder function and low retear rates in primary and revision arthroscopic RC repair.

Methods: Thirty-nine patients (39 shoulders) underwent arthroscopic RC repair with dermal allograft augmentation were included. Primary RC repair was performed in 19 patients (49%) (Primary group) and revision repair in 20 (51%) (Revision group). Clinical outcome measures included active range of motion (anterior and lateral elevation [AAE and ALE], external and internal rotation [ER and IR]), subjective shoulder value (SSV) and the Constant- Murley score (CS). Jobe test for the supraspinatus, infraspinatus strength test and belly-press test for the subscapularis were performed by three raters. Results of diagnostic tests were discussed and finally reported when the raters reached a perfect agreement. Postoperative RC repair integrity was assessed using US-based criteria of Barth in accordance with the MRI-based classification of Sugaya (grade I-V). The decision for allograft augmentation was the involvement of two tendons (supraspinatus and infraspinatus) and the poor tissue quality as assessed on preoperative MRI and intraoperatively.

Results: The mean follow-up duration was 30.5 months in the Revision group and 33.7 months in the Primary group ($p=0.922$). The preoperative and postoperative delta scores of active shoulder mobility and CS were significantly different in both groups ($p<0.01$). Clinical test evaluations and SSV were also similar in the two groups. A low retear rate (Sugaya IV and V) was recorded in both groups ($p=0.259$). Patients with Sugaya IV and V retear showed lower ALE values ($p=0.038$), lower SSV ($p=0.012$) and positive supraspinatus and subscapularis tests ($p=0.006$ and $p=0.016$, respectively).

Conclusions: Dermal allograft augmentation is reliable surgical option to improve clinical outcomes and decrease the retear rate after primary and revision arthroscopic RC repair. Minor and major full-thickness discontinuity are associated with worse shoulder mobility and higher patient dissatisfaction.

EP.03.142

RISK FACTORS OF TEAR PROGRESSION IN SYMPTOMATIC SMALL TO MEDIUM SIZE FULL-THICKNESS ROTATOR CUFF TEAR: RELATIONSHIP BETWEEN OCCUPATION RATIO OF SUPRASPINATUS AND WORK LEVEL

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Background: It is important for clinicians to decide whether to implement nonoperative or operative treatment in patients with small to medium FTRCT. There is no clear consensus on the risk factors of tear progression in FTRCT. Different results have been reported for the rate of tear progression in FTRCT and it has not been reported in small to medium sized cases. Therefore, this study aimed to analyze the tear progression rate and identify the demographic and radiologic risk factors of tear progression in small to medium FTRCT

Methods: We retrospectively reviewed 81 shoulders of patients diagnosed with small or medium FTRCTs using magnetic resonance imaging (MRI) who underwent conservative treatment from January 2017 to November 2021. Various demographic factors, including patient work level and radiological factors such as atrophy of rotator cuff muscles were analyzed to evaluate their association with tear progression. Work level was divided into high (heavy manual labor), medium (manual labor with less activity), and low (sedentary work activity). The atrophy of rotator cuff muscles was calculated by occupation ratio.

Results: Tear progression was observed in 48% (39/81) of patients (criterion for tear progression was medial-lateral or anterior-posterior tear length > 5 mm). In patients with tear progression, the lengths of medial-lateral and anterior-posterior tears progressed by 6 mm and 3 mm, respectively. Among the rotator cuff muscles, fatty degeneration and occupation ratio of the supraspinatus were only worsened ($P = 0.014$, $P = 0.013$, respectively). The mean MRI follow-up duration was 14.8 months. The significant risk factors of tear progression were high work level (odds ratio, 7.728 $P = 0.031$), and occupation ratio of the supraspinatus muscle (OR, 0.308 $P = 0.001$). The optimal cutoff value for the occupation ratio of the supraspinatus was 0.55 (sensitivity 74%, specificity 62%).

Conclusions: Tear progression was observed in approximately 50% of patients with symptomatic small to medium FTRCTs. High physical work level and atrophy of the supraspinatus muscle were independent risk factors of tear progression. The risk of tear progression increases with occupation ratio of the supraspinatus muscle < 0.55 and heavy manual labor.

EP.03.143

SUPERIOR CAPSULAR RECONSTRUCTION: FASCIA LATA AUTOGRAFT VS ACELLULAR DERMAL ALLOGRAFT

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Background: Background: Superior capsule reconstruction (SCR) is the preferred option for irreparable massive rotator cuff tear in younger population. It's still the point of contention that whether to use autograft or allograft.

Methods: Forty-two patients, including 18 of those who underwent the SCR using FL and 24 using ADA were enrolled, after excluding 11 patients in FL and 1 in ADA group with pseudoparalysis to reduce the selection bias. The average age was 57.22 years (range, 48–69) with 36 males and 6 females.

Results: The visual analog scale (VAS) score, range of motion (ROM), and muscle power (MP) showed significant improvement in both groups at the final follow-up. There was no significant difference in the post-operative mean VAS score (FL vs. ADA, 1.56 vs. 1.22, $p=0.579$), ROM (in degrees) of forward flexion (159.78 vs. 160.61, $p=0.858$), abduction (85.56 vs. 83.18, $p=0.078$), external rotation (47.78 vs. 47.78, $p=0.652$), or MP (in Kilogram-Force) tested for forward flexion (9.89 vs. 8.54, $p=0.419$), abduction (8.91 vs. 8.71, $p=0.114$), external rotation (12.72 vs. 10.10, $p=0.087$), between the groups. The mean acromiohumeral distance (AHD) was significantly increased in FL group from 6.22 to 7.84 mm ($p=0.0099$) and from 6.24 to 8.47 mm ($p<0.0001$) in ADA group. However, there was no statistically significant difference between the groups (7.84 vs. 8.47 mm, $p=0.595$). There was no difference in outcome between the patients with primary and secondary SCR. There was reversal of pseudoparalysis with good functional outcome in 8/12 patients (66.6%), but comparison was not meaningful due to the small sample size in ALA group with pseudoparalysis (1 patient). Re-tear was identified in 3 cases in FL and 1 case in ADA, and there were 3 patients with effusion at the donor site in FL group.

Conclusions: Both FL and ADA showed good functional improvement with no significant difference between them, however the increase in AHD was notably more in ADA group. The thickness of the graft did not alter the clinical outcomes. Thus, the SCR with ADA is a compelling alternative, which will eliminate donor site morbidity associated with FL and yet have the similar outcomes.

EP.03.145

ELECTROSURGERY AND ELECTROCAUTERY- IT IS ALL ABOUT DELIVERING HEAT TO THE RIGHT PLACE

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Background: Arthroscopic electro-surgical tools for ablative, desiccating or coagulative effect are delivered as monopolar or bipolar probes. Monopolar electro-surgery delivers various profiles of heat energy directly to the tissue within a non-conductive irrigant (such as water or glycine) whereas bipolar electro-surgery creates an energy source by producing an electrical arc between the bipolar electrodes on the instrument head within an electro-conductive irrigation solution (saline) - and the heat generated is then transferred to the target tissues. This study investigated the heat generation within the simulated in-vitro test model to review the level of local heat production and potential local tissue heat.

Methods: In a simulated In-vitro testing environment the local heat generation using bipolar or monopolar electro-surgical probes at standard power setting in either saline or water was tested, both touching and not touching a simulated tissue target, and for variable on-times.

Results: Monopolar generated relatively little heat when used in water and not touching the tissue. By contrast the bipolar wand generated potentially damaging local tissue temperature rises when used in saline and not touching the tissue. Both probes generated high local tissue heat when touching the tissue in their recommended irrigation solution.

Conclusions: Monopolar electro-surgery delivered high localized temperature to the simulated tissue surface, but produced relatively little heat when not touching the tissue in a water solution. Bipolar however created high local temperature within the fluid adjacent to the probe irrespective if it was touching the tissue or not. Activation of the bipolar probe away from the tissue in saline irrigation may create a potential harmful temperature within the fluid medium without delivering therapeutic thermal effect to the target tissues. Monopolar electro-surgery appears to deliver a more controlled thermal effect, and only when in contact with the target tissues – potentially creating a reduced collateral thermal footprint.

EP.03.146

COMPARING CLINICAL RESULTS OF ANTERIOR AND POSTERIOR TRANSFER OF LATISSIMUS DORSI TENDON TO HUMERAL HEAD IN PATIENTS WITH MASSIVE AND IRREPARABLE ROTATOR CUFF TEAR

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Background: Latissimus dorsi tendon transfer is a treatment option in patients with irreparable rotator cuff tears. We compared the effectiveness and safety of anterior and posterior transfer of latissimus dorsi tendon for anterosuperior or posterosuperior massive irreparable rotator cuff tears.

Methods: In this prospective clinical trial, 27 patients with irreparable rotator cuff tears were treated with latissimus dorsi transfer. The transfer was from the anterior in 14 patients for anterosuperior cuff deficiency (group A) and from the posterior in 13 patients for posterosuperior cuff deficiency (group B). Pain, shoulder range of motion in forward elevation, abduction, external rotation and functional scores were evaluated 12 months after surgery.

Results: Two patients were excluded from the study due to not referring in time for follow-up and one patient because of infection. Thus, 13 patients remained in group A and 11 patients in group B. Visual analog scale scores decreased from 6.5 to 3.0 in group A ($P = 0.016$) and from 5.909 to 2.818 in group B ($P = 0.028$). The constant scores improved from 41 to 50.2 ($P = 0.010$) in group A and from 30.2 to 42.5 ($P = 0.001$) in group B. There was a significant improvement of abduction and forward elevation in both groups which was more significant in group B. The posterior transfer made significant improvement in external rotation, but the anterior transfer did not change external rotation. There was no radial or axillary nerve injury was seen in any of two groups.

Conclusions: Latissimus dorsi transfer in patients with irreparable rotator cuff tears has a significant effect on recovery. It improves shoulder function and range of motion and reduces pain. Improvement of shoulder elevation and abduction is more significant in posterior transfer. The anterior transfer is as safe as the posterior transfer for nerve injury.

EP.03.147

RELATIONSHIP BETWEEN THE PREOPERATIVE TEAR AREA OF THE ROTATOR CUFF MEASURED USING RADIAL-SLICE MAGNETIC RESONANCE IMAGES AND THE POSTOPERATIVE ROTATOR CUFF INTEGRITY: A PROSPECTIVE CASE-CONTROL STUDY

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Background: Arthroscopic rotator cuff repair provides satisfactory clinical results. However, the retear sometimes occur and lead to a bad postoperative clinical outcome. The factors that contribute to retear have attracted attention recently. Increased tear size, muscle atrophy, and fatty infiltration are known to be the most important factor to an increased retear rates. Therefore, MRI is the most useful examination tool. Recently, there are a few reports that radial-slice MRI is useful for diagnosis of rotator cuff tears. Radial-slice MRI that provides cross slice perpendicular to rotator cuff insertions may acquire high ability of capturing rotator cuff tear. However, to our knowledge, there is no report evaluation of the preoperative risk factor of retear by using radial-slice MRI. The purpose of this study was to investigate the relationship between tear area of rotator cuff evaluated by radial-slice MRI and post-operative rotator cuff integrity.

Methods: We treated 102 consecutive patients who underwent shoulder arthroscopy for repairable rotator cuff tears. The patient demographics, medical comorbidities, radiologic factors, tear size, fatty infiltration, muscle atrophy measured using oblique coronal and oblique sagittal MRI, and the tear area calculated using radial-slice MRI were assessed to compare the intact and retear groups in univariate and multivariate logistic regression analyses. The cut-off values of the independent factors were obtained using the receiver operating characteristic curve.

Results: Retears occurred in 15/102 (14.7%) patients. In the univariate analysis, significant differences were found between the two groups for tear size, fatty infiltration of the supraspinatus and infraspinatus, muscle atrophy, and tear area. In the multivariate analysis, the tear area was the independent factor that significantly affected the rate of retear. It was a tear area of 6.3 cm² that was the strongest predictor of retear with an area under the curve of 0.965, sensitivity of 86.7%, and specificity of 96.6%.

Conclusions: The tear area was the independent factor that most significantly affected the rate of retear and showed excellent accuracy with a cut-off value of 6.3 cm². Radial-slice MRI may be a valuable diagnostic tool for assessing the postoperative rotator cuff integrity.

EP.03.148

PROBING USING NEEDLE AFTER ULTRASOUND-GUIDED SUBACROMIAL INJECTION

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Background: Accuracy of the ultrasound is good for the diagnosis of full-thickness tear of supraspinatus tendon. However, it is difficult to diagnose the degree of the bursal side partial-thickness tear on the ultrasound images. The purpose was to analyze the changes of the diagnosis of the tear extent after probing.

Methods: Among cases undertook an ultrasonography at our hospital, total 53 cases were enrolled in which the supraspinatus has been examined using needle after ultrasound-guided subacromial injection. For 46 cases who were followed clinically, the change of symptoms were analyzed. Injection into the subacromial space under the ultrasound-guide was followed by probing and elevating the bursal side of supraspinatus tendon using the needle. Initial and probing ultrasound image videos were analyzed. Blind interpretation was carried out using each video and the extent of tear was diagnosed.

Results: Probing using the needle changed the diagnosis in 53%. There was no change of diagnosis in 5 cases of group I (45%), 5 cases of group II (31%), 12 cases of group III (75%), 6 cases of group IV (67%), and none of group V.

Conclusions: In 53% cases, diagnosis were changed on the ultrasound studies by probing using needle after ultrasound-guided subacromial injection. Probing using needle was helpful in diagnosis about tear extent for the cases who were suspected as a bursal side, partial-thickness tear of supraspinatus tendon.

EP.03.150

THE EFFICACY OF ANCHORLESS ARTHROSCOPIC TRANSOSSEOUS VERSUS ANCHORED ARTHROSCOPIC TRANSOSSEOUS EQUIVALENT ROTATOR CUFF REPAIR: A 5-YEAR PROSPECTIVE CLINICAL TRIAL

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Background: Over the past 20 years, arthroscopic techniques have been the preferred modality for rotator cuff repair. Currently, the suture bridge double-row technique, also called the transosseous equivalent construct (TOE), has been the arthroscopic technique of choice. However, the arthroscopic anchorless transosseous technique (TO) is a recently developed approach that combines the advantages of open and arthroscopic repair. Comparing the two approaches, a matched analysis demonstrated equivalent patient-reported outcomes (PROM) and structural integrity at 2-years follow-up. The purpose of this study was to expand preliminary studies to compare five-year PROMs and structural integrity between the two approaches.

Methods: A prospective cohort analysis of 30 arthroscopic repairs (12 TOE vs. 18 TO) for full-thickness rotator cuff tears was conducted by a single surgeon from December 2011 through February 2015. Pain (visual analog scale), American Shoulder and Elbow Surgery (ASES) score, range of motion (ROM), subjective shoulder value (SSV), and repair integrity assessed using ultrasonography were assessed at each visit. The median values were compared using student t-tests. The mean follow-up was 4.6 years.

Results: In terms of ROM, there was no significance in median forward flexion (TOE: 170° vs TO: 170° for TO; $p = 0.50$), abduction (TOE: 95° vs TO: 90°; $p = 0.67$), or external rotation (TOE: 60° vs TO: 60°; $p = 0.55$). There was no significant difference in median ASES scores (TOE: 71.71 vs TO: 88; $p=0.36$) between the cohorts. Additionally, there was no difference in median pain score (TOE: 1.0 vs TO: 0.5; $p=0.27$) between the two cohorts.

Conclusions: Within five years, our results show no significant difference in clinical or patient-reported outcomes between anchorless arthroscopic transosseous and anchored arthroscopic transosseous equivalent rotator cuff repair, advocating for the continued usage of either approach based on efficacy. Future studies can compare the cost-effectiveness of the approaches to determine the relative value of each approach.

EP.03.151

COMPARISON OF CLINICAL AND RADIOGRAPHIC OUTCOMES BETWEEN ARTHROSCOPIC ADDITIONAL BICEPS AUGMENTATION AND BICEPS SUPERIOR CAPSULAR RECONSTRUCTION FOR DIFFERENT SIZES OF ROTATOR CUFF TEARS

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Background: To analyze the results of rotator cuff tears (RCTs) treated arthroscopically with additional biceps augmentation (ABA) and biceps superior capsule reconstruction (BSCR) techniques. We hypothesized that both techniques yield comparable retear rates and clinical and radiological results at two-year follow-up.

Methods: Patients who underwent ABA and BSCR between January 2019 to May 2020 were enrolled in this retrospective comparative study. All patients had acromiohumeral distance (AHD) >7 mm, and less than Goutallier grade 3 supraspinatus muscle fatty infiltration (FI). Ten, two, and twenty-nine Collin A, C, and D RCTs were treated with the ABA technique. Eight, eight, and ten Collin A, C, and D RCTs were treated with the BSCR technique ($p=0.008$). Constant-Murley score (CMS), American Shoulder and Elbow Surgeons (ASES) score, Subjective shoulder value (SSV), visual analog scale (VAS), and active range of motion (ROM) were recorded. AHD, Superior capsular distance (SCD), and the Hamada classification were used for the radiographic survey. Magnetic resonance imaging (MRI) was used to evaluate the preoperative rotator cuff integrity and muscle FI. The retear was evaluated by ultrasonography.

Results: Sixty-seven patients were included (41 ABA and 26 BSCR). No significant differences were found in patient demographics such as sex, age, AHD, Hamada, and Collin classification. The tendon length (11.4 ± 5.0 vs. 8.0 ± 4.2 , $p=0.006$), tendon retraction (26.9 ± 9.3 vs. 37.6 ± 8.1 mm, $p<0.001$), tangent sign (14.6% vs. 50%, $p=0.001$), and Goutallier grade of supraspinatus and infraspinatus muscle FI ($p<0.001$, $p=0.03$) were significantly different between ABA and BSCR groups. Both groups exhibited significant improvement in VAS, functional outcomes, and active ROM at the final follow-up. The retear rate of the ABA and BSCR groups were 0% and 7.7% ($p<0.001$).

Conclusions: Both ABA and BSCR techniques provide comparable clinical and radiological results in patients with different sizes of RCTs and muscle FI. The BSCR group had more retear rate compared with ABA group.

EP.03.153

THE PREDICTIVE VALUE OF INDIVIDUAL ANATOMICAL MEASUREMENT OF SCAPULA IN THE DIAGNOSIS OF ROTATOR CUFF INJURY

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Background: This study analyzed the relationship between critical shoulder angle (CSA) and lateral acromion angle (LAA) and rotator cuff injury, and discussed their value in predicting rotator cuff injury.

Methods: Seventy one patients with shoulder joint disease, 40 patients with rotator cuff injury were in the rotator cuff injury group, and 31 patients without rotator cuff injury were in the non rotator cuff injury group. The gender, age, critical shoulder angle (CSA) and lateral acromion angle (LAA) of the two groups were compared, and the influencing factors of rotator cuff injury were analyzed by multivariate logistic regression; ROC curve was drawn to evaluate the diagnostic efficacy of LAA and CSA for rotator cuff injury.

Results: The age [54.8 ± 11.5 years old] and CSA [40.6 ± 4.7 °] of patients with rotator cuff injury were significantly higher than those of patients without rotator cuff injury [47.7 ± 11.4 years old and 36.8 ± 5.5 °] ($P < 0.05$), while LAA [70.9 ± 7.0 °] was less than those of patients without rotator cuff injury [76.5 ± 7.2 °] ($P < 0.05$). Age (OR=0.952, 95% CI: 0.911 - 0.994, $P = 0.027$), LAA (OR=1.114, 95% CI: 1.034 - 1.199, $P = 0.004$) and CSA (OR=0.844, 95% CI: 0.752 - 0.947, $P = 0.004$) were the influencing factors of rotator cuff injury. When the optimal cutoff values of age, LAA and CSA were 55.50 years old, 72.67 ° and 37.10 ° respectively, the AUC predicting rotator cuff injury was 0.680 (95% CI: 0.554-0.805, $P = 0.010$), 0.719 (95% CI: 0.597 - 0.840, $P = 0.002$) 0.737 (95% CI: 0.612-0.862, $P = 0.001$), LAA and CSA have a certain predictive effect on rotator cuff injury ($AUC > 0.7$), while age has a poor predictive effect on rotator cuff injury.

Conclusions: Both CSA and LAA are influencing factors of rotator cuff injury; The increase of CSA of shoulder joint and the decrease of LAA suggest rotator cuff injury.

EP.03.154

MID-TERM PATIENT SATISFACTION AFTER ARTHROSCOPIC REPAIR OF MASSIVE ROTATOR CUFF TEARS

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Background: With the shift toward value-based care, there is growing interest in evaluating patient satisfaction. To date, factors associated with dissatisfaction after arthroscopic repair (ARCR), include female sex, younger age, and poor rotator cuff quality. These studies, however, are single-center case series with limited follow-up and not specific to ARCR of massive rotator cuff tears (MRCTs). The purpose of this study was to evaluate mid-term patient satisfaction after ARCR of MRCT, identify preoperative and intraoperative characteristics associated with satisfaction, and compare clinical outcomes between satisfied and dissatisfied patients.

Methods: A retrospective review was conducted on ARCRs of MRCTs performed at two institutions with 4-year minimum follow-up. A total of 100 patients were available for follow-up at a mean of 64 months postoperative. Patient satisfaction was analyzed according to patient demographics, patient-reported outcome measures (American Shoulder and Elbow Surgeons score [ASES], visual analog scale for pain [VAS], Veteran Rands 12-Item Health survey [VR-12], and Subjective Shoulder Value [SSV]), range of motion (forward flexion [FF], external rotation [ER], and internal rotation [IR]), and tear characteristics (fatty infiltration, tendon involvement, and tear size). Rotator cuff healing was also assessed on ultrasound at the final follow-up.

Results: Overall, 89% of patients were satisfied with ARCR for an MRCT. Female sex ($p=0.007$) and increased preoperative infraspinatus fatty infiltration ($p=0.005$) were negatively associated with satisfaction. Those in the dissatisfied cohort had significantly lower postoperative ASES (80.7 vs 55.7, $p=0.002$), VR-12 (49 vs 37.1, $p=0.002$), and SSV scores (88.1 vs 56, $p=0.003$), higher VAS pain (1.1 vs 4.1, $p=0.002$) and lower postoperative range of motion in FF (147 vs 117, $p=0.04$), ER (46 vs 26, $p=0.003$), and IR (L2 vs L4, $p=0.04$). Healing did not have an influence on patient satisfaction ($p=0.306$). Satisfied patients were more likely to return to work than dissatisfied patients (96.6% vs 54.5%, $p<0.001$).

Conclusions: Nearly 90% of patients who undergo an ARCR for an MRCT are satisfied at mid-term follow-up. Negative preoperative factors include female sex and increased preoperative infraspinatus fatty infiltration, but no association was observed with rotator cuff healing. This information can be used to counsel patients and set realistic expectations about recovery.

EP.03.155

RELATIONSHIP BETWEEN FATTY CHANGE AND MUSCLE ATROPHY IN PATIENTS WITH ROTATOR CUFF TEAR: A PROSPECTIVE STUDY WITH A MEAN OF 6 YEAR-FOLLOW-UP

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Background: Muscle atrophy and fatty change are commonly seen in patients with rotator cuff tear, but it is unclear how they progress over time. We need to know it and the relationship between them when considering the surgical indication. The purpose of this study was to prospectively investigate the relationship between muscle atrophy and fatty change in patients with symptomatic rotator cuff tears using MRI.

Methods: Among 225 patients with symptomatic rotator cuff tears treated conservatively between 2006 and 2015, 58 patients with 59 shoulders who could be followed up for more than 30 months were prospectively studied. The mean age was 64 years, and the mean follow-up was 72 (range, 30-146) months. Supraspinatus tears were included in this analysis. To evaluate muscle atrophy, the cross-sectional area of the supraspinatus muscle was measured in ImageJ (NIH, Bethesda), and the occupation ratio to the supraspinatus fossa was calculated. The Goutallier classification was used for the fatty change evaluation.

Results: The relationship between muscle atrophy and fatty change on the first MRI was 67.6 ± 6.8 % occupancy for the Goutallier classification grade 0, 56.9 ± 11.1% for grade 1, 48.7 ± 14.6% for grade 2, 41.0 ± 0% for grade 3, 35.5 ± 2.1% for grade 4 (P<0.0001). Compared with those who had no fatty change progression (n = 52), those who had progression (n = 7) were more likely to have larger supraspinatus tendon tears in length and width at the first MRI. They also had more severe muscle atrophy and fatty change at the first MRI. Moreover, with the increase of the length and the width of the supraspinatus tendon tear significantly increased, and supraspinatus muscle atrophy progressed between the first and last MRI. Among the shoulders whose fatty change progressed, one grade progression was in 5 shoulders, and two grade progression was in 2 shoulders. Grade progression took 51 months (17 to 87 months).

Conclusions: During an average follow-up of 6 years, fatty change developed in 7 of 59 shoulders (12%), and the average time until progression was confirmed was 51 months. As muscle atrophy progressed, so did fatty change.

EP.03.156

EVIDENCE FOR UTILIZATION OF INJECTABLE BIOLOGIC AUGMENTATION IN PRIMARY ROTATOR CUFF REPAIR: A SYSTEMATIC REVIEW OF RECENT DATA FROM 2010-2022

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Background: Biologic healing remains a significant challenge as tendon tear recurrence is associated with clinical deterioration in the long-term. Injectable biologic augmentation has been hypothesized to improve tissue quality at the suture-tendon interface. The purpose of this study is to systematically review updated preclinical and clinical evidence from 2010 to 2022 regarding the utilization of injectable biologic supplementation in rotator cuff repair.

Methods: A systematic review was conducted following PRISMA guidelines. Two reviewers performed relevant paper selection with a third arbitrating disputes. In total 40 studies, consisting of 29 preclinical and 11 clinical, were included in the study.

Results: Injectables reported included growth factors, bone marrow- & adipose-derived mesenchymal stem cells (ADSC), and other agents (namely platelet-rich plasma (PRP) & hyaluronic acid). The most common findings for preclinical injectables were increased load-to-failure and improved collagen histological quality. Clinically, all eleven clinical studies (10 PRP, 1 ADSC) indicated no adverse events with similar or improved patient-reported outcomes measures compared to control repairs. In one study, a concentrated PRP globule with fibrin matrix was shuttled over a suture to maintain concentrated PRP at the repair site and demonstrated a statistically significant decrease in retears ($P=0.03$) on MRI evaluation at 31-month follow-up. A matched cohort study investigating augmentation with ADSCs demonstrated a significantly lower retear rate in the ADSC augmented group than in the control repair group at 28-month follow-up ($P<.001$).

Conclusions: Clinically, while there remains scant data at long term follow-up in favor of PRP, utilization of innovative delivery techniques may reduce the risk of arthroscopic washout of PRP and has been shown to potentially improve retear rates. Further, ADSCs have been shown to reduce retear rates at 28-month follow-up.

EP.03.157

ARTHROSCOPIC REPAIR OF MASSIVE ROTATOR CUFF TEAR. THE ROLE OF THE LHB DISTAL TENOTOMY

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Background: The aim of the study was to evaluate the results of an all arthroscopic technique for the treatment of massive rotator cuff tears using the long head of biceps as a graft to reconstruct the superior capsule and to reinforce the cuff.

Methods: A retrospective review of a consecutive series of arthroscopic repair of massive rotator cuff tears using the long head of biceps tendon was conducted. Twenty-five patients underwent surgery, and none were lost at follow-up. Minimum follow-up period was more than 12 months. Constant, UCLA and VAS scores as clinical outcome were analyzed. Time for surgical procedures was also registered. Two alternative procedures (transosseous or anchors) were employed to fix laterally the long head of biceps to the greater tuberosity and to reinforce the cuff. This choice was essentially determined by the bone quality of the greater tuberosity.

Results: All patients of both groups (Transosseous: 15 and Anchors: 10) showed a significant improvement of clinical and functional scores. Difference of the operative times between two procedures was statistically significant in favor of the anchor approach. No intraoperative complications were recorded. Postoperative shoulder stiffness was found in two male patients. In no case biceps tenodesis was performed: Popeye sign was easily detected in 16 patients but they did not complain any superior arm pain and weakness.

Conclusions: This technique represents a valid solution for treatment of massive rotator cuff tears resulting safe, easier and cost saving in comparison with other published techniques.

EP.03.159

RESULTS OF LATISSIMUS DORSI TRANSFER USING A TENDINOUS ALLOGRAFT THROUGH A SINGLE DELTOPECTORAL APPROACH FOR IRREPARABLE POSTEROSUPERIOR ROTATOR CUFF TEARS

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Background: Chronic irreparable rotator cuff tendon tears lead to atrophy and fatty infiltration. When they affect the posterosuperior rotator cuff, they mostly result in pain, reduction of shoulder strength for external rotation and forward flexion. Several surgical techniques were described to improve shoulder function. LDT transfer was initially described by Gerber et al, and there are several publications about its results. However, up to 36% of clinical failures were found. The evidence that most failures are: transfer rupture from the greater tuberosity and deltoid origin disruption. With this in mind, we have proposed and recently published the surgical technique: the LDT is elongated and reinforced with a tendinous allograft, enabling its transfer to be performed through a single deltopectoral approach. The aim of the present study is to evaluate the functional results of a modification to the latissimus dorsi (LD) transfer around the shoulder for irreparable posterosuperior rotator cuff tears.

Methods: The surgical technique is consist through a single deltopectoral approach, the LD tendon is detached, reinforced, and elongated with a tendinous allograft, transferred around the humerus, and fixed superolaterally to the greater tuberosity and anteriorly to the subscapularis. We did a retrospective functional evaluation of 16 cases. The average follow-up was 21 months (12-47). The postoperative results (at last follow-up) were compared with the preoperative ones, as well as to other pre, intra, and postoperative variables.

Results: All (but one) patients were satisfied. Average UCLA score increased from 11.6 (8-16) to 27.3 (17-30) ($p < 0.001$). Improvements of shoulder pain, function, and strength achieved statistical significance ($p < 0.001$). Nonetheless, normal strength was never restored. Average active ROM improved as follows: forward elevation, from 106 (60-140) to 145 (130- 160) ($p < 0.001$); external rotation from 30 (0 to 60) to 54 (40-70) ($p < 0.001$); and internal rotation from L1 (gluteus to T7) to T10 (T12-T3) ($p < 0.05$). No complication has occurred. Preoperative pseudoparesis was reverted in all the six cases in which it was present. None of the variables analyzed influenced the outcomes.

Conclusions: At early follow-up, this technique is safe and effective at recovering from pseudoparesis and at improving shoulder pain, function, and strength.

EP.03.160

OUTCOME OF REVISION OF FAILED ROTATOR CUFF REPAIR; ARTHROSCOPIC ANCHOR REMOVAL AND TRANSOSSEOUS RECONSTRUCTION

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Background: Revision of failed arthroscopic rotator cuff repair done with anchor fixation is a difficult problem facing the surgeon. This study will report the technical challenge and the outcome of arthroscopic anchor removal and transosseous tendon repair as well as the clinical outcome after surgery. The failure rates among surgeons have been reported to range from 11% to 94%.

Methods: Presented will be the technique of removing the anchors without damaging the bone and transosseous giant needle fixation of the tendon to the footprint area. 42 cases of failed arthroscopic rotator cuff repair were treated between 2015 and 2019 by one surgeon in two centers. There were 20 males and 21 females with an average age of 50 years . 22 of the failed cases were repaired using double row anchor fixation in 20 and single row in 22. In 5 cases absorbable anchors were used. The size of the recurrent tear was 16 small, 16 medium and 10 large. Eight cases couldn't actively elevate the shoulder above 70° and six had no active external rotation. Arthroscopic anchor removal was done in 25 cases and a transosseous repair was done in 38 cases. Two cases of rotator cuff arthropathy, one case of massive irreparable tear and one case of post infection osteoarthritis were not repaired.

Results: Examined were 34 cases treated with arthroscopic transosseous repair, with an average follow up of 31 months. The range of motion passive motion range in all cases was normal. The strength varied from equal strength to 70% weakness compared to the opposite normal side. Active elevation and external rotation was possible in all cases except four. No patient was complaining of pain. The x-rays done six months after surgery showed filling of the empty bone spaces, were the anchors were inserted. According to Neer score 68% of the cases were rated excellent 23% satisfactory and 9% unsatisfactory.

Conclusions: The clinical and radiographic result strongly encourage using the arthroscopic transosseous suture fixation techniques for revision rotator cuff repair done with anchor tendon fixation. Age or osteoporosis is not a contraindication.

EP.03.161

ALLOGRAFT AUGMENTATION OF IRREPARABLE SUPRASPINATUS TENDON TEARS, HIGH GRAFT HEALING RATE WITH IMPROVED CLINICAL FUNCTION: A CASE SERIES STUDY

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Background: Massive rotator cuff tears (RCTs) present a challenge for shoulder surgeons. The use of scaffolds to augment cuff repair is gradually gaining popularity, and it is nowadays, the preferred methods used by many shoulder surgeons worldwide. AlloPatch HD® is a donated human allograft dermis, minimally processed, which has the potential to maintain the graft's natural biomechanical and biochemical properties. The purpose of this study was to evaluate the functional outcome and retear rate of an arthroscopic AlloPatch augmentation for irreparable supraspinatus tendon tears.

Methods: Patients who underwent arthroscopic rotator cuff repair with AlloPatch allograft augmentation for the treatment of massive RCTs, between January 2019 and July 2021, by a single surgeon were included in the study. The unique surgical technique was developed and well-documented by the surgeon. It allows maximum contact of the AlloPatch to the bone in a double-row configuration. It further ensures optimal graft fixation, with medial, anterior, and posterior attachments. The assessment included ultrasound and clinical review at 6 weeks, 12 weeks, 24 weeks. Cuff and AlloPatch integrity on ultrasound were classified as intact, segmental, or complete retear. Patient-reported outcome measures were analyzed including WORC and Oxford Shoulder Score (OSS) performed pre-operatively and at 12 months following surgery.

Results: Overall, 26 patients (21 males and 5 females) with an average age at surgery of 57.5 years (range 43-71), were included in the study. 22 were primary and 4 were revision procedures. All patients underwent a check ultrasound at 24 weeks following surgery and all, 100%, demonstrated intact AlloPatch integration. OSS significantly increased from 27.07 to 43.2 and WORC significantly increased from 28.38% to 76.02% percentage of normal.

Conclusions: Arthroscopic cuff repair of large/massive RCTs in which complete repair does not appear achievable and therefore requires an augment were included in this study. The use of a human dermal allograft is an excellent option, although when performed arthroscopically it is a technically demanding procedure. Nevertheless, for the augmentation of irreparable supraspinatus tendon tears, 100% graft integrity at the 24 weeks follow-up with significantly improved functional scores at 1 year of follow-up was achieved in our case series.

EP.03.162

CHANGES IN THE GREATER TUBEROSITY SPUR AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR WITHOUT TUBEROPLASTY

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Background: The impingement between the acromion and greater tuberosity is thought to be caused by chronic tensile loading and heterogeneous strain from a full-thickness rotator cuff tear. This subacromial impingement is most often attributed to the formation of the subacromial and greater tuberosity spur. We assumed that if the cause of the impingement is eliminated through acromioplasty and rotator cuff repair, a GT spur can be resorbed by bone adaptation, such as Wolff's law. This study aims to prove the hypothesis through a quantitative analysis using a 3D model and further investigate the factors affecting GT spur resorption.

Methods: The morphology of the greater tuberosity was retrospectively evaluated using radiographs and MR images. The greater tuberosity angle (GTA) was measured on radiographs, and GT volume was calculated on MR images. The GTA was defined by the angle between a parallel line to the humerus diaphysis and a line that connects the superior head border to the superolateral edge of the GT. Semi-automatic segmentation using ITK-SNAP applications was used to reconstruct three-dimensional volumetric models of the greater tuberosity.

Results: The study included 57 patients (36 men and 21 women) with a mean age of 59 (range, 35–74) years. The mean follow-up period was 13 (range, 11–24) months. The mean GTA value significantly decreased from $71.1 \pm 7.1^\circ$ to $67.4 \pm 5.9^\circ$ postoperatively ($P = 0.003$). The mean GT volume decreased from $9.8 \pm 2.9 \text{ cm}^3$ to $7.9 \pm 2.3 \text{ cm}^3$ postoperatively ($P = 0.002$). The retraction size of the supraspinatus was the factor that had the greatest influence on GT bone resorption after rotator cuff repair. ($R^2 = 0.0944$, $P = 0.02$)

Conclusions: Given that all patients had a decrease in GT volume postoperatively, tuberoplasty may not be a necessary procedure during the rotator cuff repair. Our findings support the theory that GT spur formation is caused by subacromial impingement of rotator cuff tear.

EP.03.163

QUANTITATIVELY EVALUATION OF FATTY DEGENERATION AND ATROPHY IN THE INFRASPINATUS AND TERES MINOR MUSCLE USING MRI IDEAL TECHNIQUE

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Background: Although external rotators such as infraspinatus (ISP) and teres minor muscles (TM) are important for shoulder function, there have been only few studies to evaluate rotator cuff muscles using MRI quantitatively. The purpose of this study was to evaluate external rotator cuff muscles quantitatively using MRI IDEAL technique which can evaluate fatty infiltration of muscle quantitatively.

Methods: 549 shoulders were included in this study. Cross-sectional area and fatty infiltration of ISP and TM were evaluated using MRI IDEAL technique. Patients were classified into three groups; ISP intact group (I group; intact rotator cuff, ARCR for small tear), ISP tear group (T group; ARCR for medium, large and massive tear, Reverse shoulder arthroplasty(RSA) for large to massive rotator cuff tear), combined loss of active elevation and external rotation(CLEER) group (C group; RSA and modified L'episcopo procedure for CLEER). MRI was performed, and a freehand ROI was set at ISP and TM in the outermost part of the scapula Y view of the oblique sagittal section. The fatty infiltration was defined as Fat-phase/In-phase*100(%) using the average signal intensity in the ROI in Fat-phase and In-phase obtained by the IDEAL technique.

Results: The mean age was 65.3, 72.5, and 72.1 years in groups I, T, and C. Fatty infiltration of ISP was 19.4%, 43.8%, and 60.8%, and TM was 25.9%, 32.2% and 64.9% in groups I, T and C, respectively, and significantly higher in groups C, T and I in that order. Cross-sectional areas were 7.5cm², 5.5cm², 4.8cm² in ISP, 2.7cm², 2.5cm², 1.5cm² in TM. The cross-sectional area of ISP was significantly smaller in groups C, T and I in that order and TM was significantly smaller in group C. The cut-off values of ISP and TM for cross-sectional area and fatty infiltration were 6.24cm², 36% and 2.31cm², 46% for ISP and TM, respectively, when group C was considered positive.

Conclusions: Our results showed that the cross-sectional area was significantly decreased, and fatty infiltration significantly become worse with tear become larger. Furthermore, dysfunction of external rotation may occur when the fatty infiltration exceeds 36% in ISP and 46% in TM.

EP.03.165

REVISION ROTATOR CUFF REPAIR: CAN A SUGAYA 3 TENDON CONSIDERED TO BE HEALED OR NOT?

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Background: Sugaya et al. described a classification system to assess postoperative rotator cuff tendon healing. While Sugaya 1 and 2 tendons can be considered as healed and Sugaya type 4 and 5 can be considered as return, the exact status of Sugaya 3 tendons remains unclear. The objective of this study was to evaluate the influence of Sugaya 3 tendons on postoperative functional scores in a population of revision rotator cuff repairs.

Methods: We retrospectively studied the records of all patients who underwent revision rotator cuff in one of 12 different institutions between July 2001 and December 2020. We separated these patients into two different populations: short-term follow-up (minimum 2-year follow-up) and long-term follow-up (minimum 10-year follow-up). A total of 197 shoulders were included in the short-term follow-up group (59% males, mean age: 55 years old, mean follow-up 7 years (range; 2-20)). A total of 54 patients (61% males, mean age 52 ± 6 years old, mean follow-up 14.1 years (range; 10.4-20.5)) were included in the long-term follow-up group. Structural integrity of the repaired tendon was evaluated on MRI or CT-arthrogram. Functional scores, acromio-humeral index (AHI), progression of fatty infiltration and of osteoarthritis were compared according to Sugaya type.

Results: In both groups, similar characteristics were observed with the Sugaya 3 population. Mean Constant score and mean strength were significantly higher in Sugaya 1-2 tendons than in Sugaya 3 ($p < 0.05$) and Sugaya 4-5 tendons ($p < 0.05$) but did not differ between Sugaya 3 and Sugaya 4-5 tendons. Mean SSV, pain, AHI were significantly higher and fatty infiltration and progression in the Hamada classification were significantly lower in Sugaya 1-2 tendons and in Sugaya 3 than in Sugaya 4-5 tendons ($p < 0.05$) but did not differ between Sugaya 1-2 and Sugaya 3 tendons.

Conclusions: Sugaya 3 tendons after revision rotator cuff repair do not allow restoration of strength thereby impacting the Constant score. However, they seem to have a protective effect with regards to pain, progression of upwards migration, osteoarthritis and fatty infiltration at both short- and long-term follow-up.

EP.03.166

DOES RETEAR AFFECT RETURN TO PREVIOUS WORK AND SPORTS IN NON-ATHLETES?

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Background: The impact of retear after arthroscopic rotator cuff repair (ARCR) on clinical outcomes of patients remain controversial. Therefore, we determined the effects of retear on strength recovery, return to previous levels of work, and return to sports participation. We hypothesized that 1) retear would not have a significant effect on patient-reported outcome measures (PROMs), and 2) retear would significantly inhibit strength recovery and return to previous work and sports.

Methods: We collected data from patients who underwent ARCR between January 2015 and December 2019 and underwent magnetic resonance imaging and strength measurements 1 year postoperatively. PROMs (i.e., constant score, pain visual analog scale, American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form, and Single Assessment Numeric Evaluation) and status on work and sports participation were measured at least 2 years postoperatively using a telephone survey. The associations between radiological retear and PROMs, strength recovery (i.e., final strength percentage compared with the contralateral shoulder), return to work, and return to sports were analyzed. Patients who failed to return to work or sports because of non-shoulder-related reasons were excluded from the analysis. Additionally, factors related to return to work and sports were identified through multivariable regression analysis.

Results: In the final study, 159 patients were included, of whom 19 (11.9%) had retear. Moreover, 134 (84.3%) and 93 (58.5%) patients were evaluated for return to work and sports status, respectively. Retear did not have a significant effect on PROMs; however, patients with retear exhibited significantly worse supraspinatus and external rotation strength recovery. Retear did not have a statistically significant effect on return to work or sports. Active workload was associated with unsuccessful return to work, whereas preoperative participation in shoulder sports was associated with successful return.

Conclusions: Retear is not significantly associated with postoperative PROMs, but is a significant factor for postoperative strength recovery. Though the association between retear and return to work and sports was not statistically significant, retear decreased successful return to sports. Active workload and preoperative shoulder sports participation influenced return to previous work.

EP.03.167

ARTHROSCOPIC INCOMPLETE ROTATOR CUFF REPAIR WITH HUMAN ALLO-DERMAL PATCH AUGMENTATION: PRELIMINARY RESULTS

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Background: Several methods have been tried to improve the healing rate of incomplete rotator cuff (RC) repair, and surgery using a patch to cover the defect has been tried. This study aimed to report structural and clinical outcomes of arthroscopic hybrid rotator cuff repair using an acellular human allo-dermal graft.

Methods: From 2017 to 2021, arthroscopic hybrid repair with allo-dermal patch augmentation was performed on the patients eligible for incomplete RC repair. A retrospective analysis was performed on patients over 6 months of follow-up with magnetic resonance imaging (MRI). Tendon integrity, acromiohumeral distance (AHD), and pre-and postoperative functional scores were analyzed.

Results: 17 patients (16 females) with a mean age of 63.3 ± 4.3 years were analyzed. Twelve large- and five massive-sized RC tears were observed in the initial MRI. Three retears (17.6%) were observed in patients with one massive-sized tear and two large-sized tears. AHD was significantly increased from 8.3 ± 1.5 to 9.4 ± 1.7 mm after the surgery ($P < 0.01$). Pain visual analog scale, functional visual analog scale, American Shoulder and Elbow Surgeons, Constant, and Simple Shoulder Test scores improved postoperatively (5.0 ± 1.2 to 3.6 ± 1.5 , 4.8 ± 2.0 to 5.9 ± 1.7 , 45.6 ± 13.1 to 52.8 ± 13.9 , 46.2 ± 14.3 to 45.2 ± 11.9 , and 3.6 ± 2.1 to 5.2 ± 2.0 , all $p < 0.05$)

Conclusions: In arthroscopic incomplete RC repair, allo-dermal patch augmentation induces good tendon healing and increases AHD, suggesting promising clinical outcomes from short-term follow-up. Further studies on large populations with long follow-up periods appear to be necessary.

EP.03.170

MUSCULAR DEGENERATION WILL NOT RECOVER EVEN AFTER SUCCESSFUL ROTATOR CUFF REPAIR

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Background: In cases with a rotator cuff tear, muscle atrophy and fatty infiltration of the rotator cuff muscle are risk factors for irreparable tears and poor outcomes after surgical repair. However, the mechanism of muscular degeneration remained unclear. Although muscular condition predicts the prognosis of the patients, quantitative evaluation of the rotator cuff muscles is not well established. We evaluated the quantity and quality of the whole rotator cuff muscles after arthroscopic rotator cuff repair using three-dimensional magnetic resonance imaging (MRI).

Methods: We included 37 shoulders with posterosuperior rotator cuff tears, which were treated by arthroscopic rotator cuff repair. MRI, including a 3-dimensional 2-point Dixon sequence, was prospectively taken before surgery, 1 year after surgery, and 2 years after surgery. The muscle boundaries were outlined on all MRI slices including the rotator cuff muscles on OsiriX MD software 13.0. Then, we calculated the 3-dimensional total muscle volume of the whole muscles. Using the Dixon method, %fat in the whole muscles of each muscle was also evaluated before and after rotator cuff repair. Sequential changes of muscular degeneration were statistically analyzed using paired t-tests with Bonferroni correction.

Results: In a case with retear of the repaired cuff, %fat in the supraspinatus and infraspinatus gradually increased after surgery. In the other 36 cases with successful repair, the total muscle volume and %fat before surgery was $30.2 \pm 10.9 \text{ cm}^3$ and $18.5 \pm 7.5\%$ in supraspinatus, $119.7 \pm 37.6 \text{ cm}^3$ and $15.5 \pm 5.9\%$ in the infraspinatus and teres minor, and $130.5 \pm 39.8 \text{ cm}^3$ and $16.9 \pm 5.6\%$ in the subscapularis, respectively. However, both the total muscle volume and %fat of all muscles did not change 1 year and 2 years after surgery even with successful rotator cuff repair.

Conclusions: In our cases, the muscular atrophy and fatty infiltration could be stopped by rotator cuff repair, but it did not improve even with a successful repair. These results indicated that muscular degeneration after a rotator cuff tear is irreversible. Early intervention might be recommended before muscular degeneration if surgical treatment is needed in cases with rotator cuff tears.

EP.03.172

CADAVERIC ASSESSMENT OF TWO DISTINCT ANATOMICAL INJECTION SITES FOR SUPRASCAPULAR NERVE BLOCK COVERAGE

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Background: The suprascapular nerve block (SSNB) is a commonly utilized procedure that helps treat shoulder pain from many different pathologies. This study aims to describe a reliable technique for performing an SSNB using anatomic landmarks by assessing two distinct landmark-based injection locations on cadaveric shoulder specimens: 1cm medial to the posterior acromioclavicular (AC) junction and 3cm medial to the posterior AC junction.

Methods: A study of 14 fresh-frozen cadaveric specimens was randomized to either the 1 cm or 3 cm group. 10 mL of 1:9 methylene blue concentrate to water mixture was injected into the shoulder at the specified location; then, the cadaver specimen was dissected to visualize the spread of the methylene blue relative to the anatomic path of the suprascapular nerve. The presence of methylene blue was specifically evaluated at three anatomic locations: the suprascapular notch, the supraspinatus fossa, and the spinoglenoid notch.

Results: mean specimen age of 77.6 years. Methylene Blue covered the suprascapular nerve at the suprascapular notch (A) in 57.1% of the 1 cm group and 100% of the 3 cm group. The supraspinatus fossa was covered in 71.4% of the 1 cm group and 100% of the 3 cm groups. In comparison, the spinoglenoid notch was covered in 100% of the 1 cm group and 42.9% of the 3 cm group. When the suprascapular notch was covered in both groups, the supraspinatus fossa was also covered in 92.8% of the cases.

Conclusions: Of the evaluated locations, the most important anatomic location for anesthetic coverage of the suprascapular nerve is at the suprascapular notch, as it covers the most proximal sensory branches of the nerve. The 3cm group showed more consistent coverage at this location, indicating that SSNB injection is more effective when the injection site is 3 cm medial to the AC junction than an injection site 1 cm medial to the AC junction.

EP.03.173

CLINICAL OUTCOMES AND STRUCTURAL INTEGRITY RATE OF ARTHROSCOPIC AUGMENTED ROTATOR CUFF REPAIRS USING EXTRACELLULAR PORCINE MATRIX PATCH

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Background: Structural failure rate in rotator cuff repairs is still high. The purpose of the study is to assess the structural integrity of a series of augmented rotator cuff repairs with porcine matrix patch and report the functional outcomes.

Methods: Between 2014 and 2017, 44 consecutive patients underwent arthroscopic double-row repair of medium to massive rotator cuff tears with extracellular porcine dermal matrix augmentation. At one-year follow-up, magnetic resonance imaging scan was performed to assess the integrity of the repair. Oxford Shoulder Score (OSS), Constant Score (CS) and Visual Analogue Scale pain score, together with range of motion were used to assess patients.

Results: Patients mean age was 68 (53-82); mean follow-up was 17.2 (12-24) months. On magnetic resonance imaging scans, seven rotator cuff repair failures (15.9%) were observed: tear size was an independent predictor of re-rupture at one-year follow-up. Clinical scores showed a statistically significant improvement at three months and until final follow-up ($p < 0.001$). No complications occurred.

Conclusions: Observed structural failure rate of 15.9% is lower than those reported in the literature for standard rotator cuff repair of medium to massive tears in similar cohorts to ours. Extracellular matrix augmentation for rotator cuff repair was shown to be a safe and reliable support to the repairs and patients recovered good shoulder function. Level of Evidence: Level IV.

EP.03.175

THE INDICATION FOR DEBEYRE-PATTE PROCEDURE WITH INCLUDING EVALUATION OF TERES MINOR

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Background: The modified Debeyre-Patte procedure (mDP) is a muscle advancement technique in which the fascial connections of the supraspinatus and infraspinatus muscles to the rhomboids at the medial border of the scapula are maintained, and a subperiosteal dissection is performed from the scapula. We have performed arthroscopic rotator cuff repair (ARCR) with mDP for large and massive rotator cuff tears with grade 3 or lower Goutallier classification of the supraspinatus, infraspinatus, and subscapularis. It is well known that teres minor is important for postoperative outcomes in patients with massive rotator cuff tears. In this study, we retrospectively evaluated teres minor degeneration using MRI and investigated the clinical outcomes of patients who underwent mDP.

Methods: This study recruited 19 patients with 19 shoulders who had undergone ARCR with mDP for large and massive rotator cuff tears. The clinical outcomes were compared using Constant score before and after surgery. We evaluated Goutallier classification and Global fatty degeneration index (GFDI). Furthermore, we investigated the incidence of teres minor tear and determined the modified GFDI, which included the evaluation of teres minor. Postoperative cuff integrity was classified according to Sugaya's classification with MRI at one year after surgery, and type 4 and 5 were assessed re-tear.

Results: The mean age was 64.6 years, and the mean follow-up period was 29.8 months. The Constant score was improved from 45.8 to 75.5. Goutallier classification of supraspinatus, infraspinatus, and subscapularis was 3 or lower in all cases. There were no cases of teres minor rupture, but fatty infiltration was observed in four cases. The average of GFDI and modified GFDI was 1.86 and 1.68 respectively. The re-tear rate was 15.8%. The average of GFDI and modified GFDI in re-tear cases was 2.55 and 2.5 respectively, which is significantly higher than the average in non-tear cases. In the re-tear cases, either GFDI or mGFDI was greater than 2.5.

Conclusions: We considered that mDP was a good indication for large and massive rotator cuff tears with grade 3 or lower Goutallier classification. However, the indication for mDP should be considered to include an evaluation of the degeneration of teres minor.

EP.03.177

PERIPHERAL MICROCIRCULATION ALTERATION AS CAUSE OF POSTERO-SUPERIOR ROTATOR CUFF TEAR: THE POSSIBLE INDIRECT CONTRIBUTION OF NAILFOLD CAPILLAROSCOPY

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Background: Most of the recent literature regarding rotator cuff tear etiology identifies in peripheral microcirculation disorders the probable main cause of tissue degeneration, and consequently of tendon rupture. Nailfold capillaroscopy is a practical and inexpensive diagnostic technique used to evaluate the health status of the peripheral microcirculation and, recently, its use has found other indications in addition to that of diagnosing connective tissue diseases and Raynaud's phenomenon. We verified the possible indirect contribution of nailfold capillaroscopy in the identification of peripheral microcirculation disturbances in a group of patients with rotator cuff tear and whether these possible alterations could be related to rotator cuff tear size.

Methods: A case control study was performed. 100 patients [(56M-44F; mean age(SD): 60.46 (5.46)] with different sized postero-superior cuff tears and 100 healthy controls [(38M:62F mean age (SD):60.40(6.34)] were submitted to capillaroscopic exam. The following parameters were examined: capillary morphology and density; avascular areas; visibility of the sub-papillary venous plexus; enlarged and giant capillaries; ectasias and microaneurysms; neo-angiogenesis; hemosiderin deposits; pericapillary oedema; capillary blood flow. Severe exclusion criteria were applied. Statistical analysis was performed.

Results: Visibility of SPVP ($p < 0.001$), pericapillary oedema ($p < 0.001$), capillary blood flow ($p < 0.001$), ectasias and microaneurysms ($p < 0.001$) and neo-angiogenesis ($p = 0.04$) were significantly associated with presence of RCT.

Conclusions: Our results contribute to support the hypothesis that microcirculation disorder has a relevant role on the genesis of cuff degeneration and, consequently, of tendon rupture. However, these alterations do not seem to be related to rotator cuff tear size.

EP.03.178

SHOULDER INTRA-ARTICULAR TEMPERATURE IN DIFFERENT SIZED ROTATOR CUFF TEARS: THE CORRELATION BETWEEN INCREASED TEMPERATURE AND TEAR SIZE

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Background: Previous studies have observed that the intra-articular temperature of arthritic joints is higher than that found in healthy joints and that increase in temperature can facilitate collagenolysis. Since the shoulders affected by rotator cuff tear (RCT) are characterized by an intra-articular and subacromial inflammatory process, we hypothesized that the intra-articular temperature of these patients might be comparable to that of other inflamed human joints. Furthermore, an increased intra-articular temperature in small RCTs, which might play a significant role in the evolution of the tear size was hypothesized.

Methods: During the arthroscopic repair of 75 consecutive [32F; 43M, mean age 61.12 SD: 7.10] patients with varied sizes of RCT, the intra-articular temperature was recorded, at first in two well-defined points previous to water infusion followed by a third measurement taken after the arthroscope in-flow was opened. A fourth measurement, represented by the patient's temperature was taken upon admission to the ward. The RCTs were intraoperatively classified according to the Southern California Orthopedic Institute classification system as small, large, and massive. Data were submitted to statistical analysis.

Results: The shoulder intra-articular temperature was higher than that registered in other healthy joints. Temperatures significantly differ in patients with different sized RCTs. Regardless of the location of the thermometer, a significantly higher temperature was found in patients with small RCTs. When the in-flow of the arthroscopic fluid was opened the temperature dropped by an average of 11 °C.

Conclusions: The shoulder intra-articular temperature was found to be significantly associated with RCT size; in fact, a significantly higher temperature was found in small RCTs, which are characterized by the greater amount of inflammation and hypervascularization. RCT size progression can be justified by our findings which support the importance of temperature rise as cause of severe and irreversible damage to the collagen fibers.

EP.03.179

CRITICAL SHOULDER ANGLE : IMPACT OF GLENOID INCLINATION AND ACROMIAL ANGLE ON SHOULDER ARTHRITIS ?

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Background: Critical Shoulder Angle (CSA) measurement is described to be correlated with primary glenohumeral osteoarthritis (PGHOA) and massive rotator cuff tear (MRCT) that lead to cuff tear arthropathy. CSA takes into account both glenoid inclination (GI) and acromial angle (AA). In order to evaluate the impact of GI and AA on CSA measurement in prevention of PGHOA and MRCT we hypothesized that GI was the main predictive factor of CSA-related shoulder omarthrosis.

Methods: CT-scans of 186 patients were retrospectively retrieved from our data base and assigned into 3 groups: a control (48 healthy shoulders) and two pathological shoulder groups without glenoid erosion : 66 MRCT (hamada 2, E0 glenoids) and 72 PGHOA (A1 or B1 glenoids). CT-scans were analyzed using an automatic software (Glenosys, Imascap, Brest). The following variables were compared according to AA+GI=CSA.

Results: There was a significant difference ($p < 0.001$) in CSA between the MRCT, PGHOA and control groups, respectively (33° , 29° and 32°). There was a significant difference between the MRCT and PGHOA (GI 8° , 6° , $p = 0.026$), and no difference with the control group, respectively, in GI (GI 7° , $p > 0.05$). The AA was not statistically different among the three groups (25, 23, 24, $p = 0.063$). Within each group, GI and AA displayed a negative linear correlation (PGHOA $r = 0.75$ and MRCT $r = 0.71$ and Control group $r = 0.80$). Interestingly we found that AA and GI values were spread harmoniously in each group.

Conclusions: In contrast with CSA, GI and AA do not seem to be independent predictive factors of CSA-related shoulder pathologies. However, the linear correlation between GI and AA suggests the presence of a balance between the glenoid inclination and the acromial coverage in a healthy shoulder. This analyse in pathological shoulder would allow to select patient with an increased AA that would be eligible to acromioplasty.

EP.03.180

ARTHROSCOPIC SUBSCAPULARIS TENDON REPAIR: NEW TRANSOSSEOUS SUTURE REPAIR TECHNIQUE AND PRELIMINARY RESULTS

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Background: Reduction and fixation of subscapular tendon tears appears to be technically challenging. This study aims to describe a new arthroscopic transosseous repair of the subscapularis: a procedure of subscapularis tendon repair performed with the aid of a suture passing wire and Giant needle transosseous suturing. Our objective was to evaluate the preliminary results of 8 consecutive arthroscopic subscapularis tendon repairs. To our knowledge there is no technique of arthroscopic transosseous repair described in the literature.

Methods: All 8 shoulders had longer than 3 months follow-up, with an average of 18 months (range, 3 to 37 months). The average age was 61 years (range, 41 to 75 years). The average time from onset of symptoms to surgery was 3.2 months (range, 1 to 5 months). The shoulders were evaluated using a modified UCLA score, Napoleon test, radiographs, and magnetic resonance imaging (MRI). Indications for surgery included clinical and/or MRI evidence of a rotator cuff tear. An arthroscopic transosseous repair suture technique was used for repair.

Results: UCLA scores increased from a preoperative average of 11.6 to a postoperative average of 30.6 ($P < .0001$). By UCLA criteria, excellent and good results were obtained in seven patient and 1 fair result. Forward flexion increased from an average 100.3 degrees preoperatively to an average 175.1 degrees postoperatively ($P = .0016$). 5 patients had isolated tears of the subscapularis. The remaining 3 patients had associated supraspinatus tear. 3 patients had proximal migration of the humerus preoperatively. Postoperative no migration was present, and the Napoleon test was negative in 7 and weak in one. The postoperative rehabilitation was more difficult the isolated supraspinatus tear in gaining active and passive range of motion.

Conclusions: We were able to consistently perform arthroscopic repair of torn subscapularis tendons, with good and excellent results, in all of the 8 patients. Repair of The Arthroscopic repair of combined tears of the subscapularis, supraspinatus can produce durable reversal of proximal humeral migration and restoration of overhead function.

EP.03.181

THE MODIFIED PATTE CLASSIFICATION: A PRACTICAL TOOL TO PREDICT IRREPARABILITY AND RETEAR AFTER LARGE TO MASSIVE ROTATOR CUFF REPAIRS

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Background: The modified Patte classification was proposed to evaluate tendon retraction on 2 specific MRI coronal sections. The purpose was to compare the diagnostic value between modified Patte classification and other factors for predicting irreparability and re-tear after large to massive rotator cuff repairs.

Methods: A retrospective study of 187 large to massive rotator cuff repairs was performed. Fatty infiltration (Goutallier classification), tendon retraction (modified Patte classification), tangent sign of supraspinatus, teres minor hypertrophy and acromiohumeral distance (AHD) was evaluated. Univariate analysis and Binary logistic regression analysis was performed to determine the independent risk factors of irreparability and re-tear. The accuracy of using the risk factors to predict irreparability and re-tear was estimated.

Results: Among the 187 included cases, 18 partial repairs and 169 complete repairs were performed. Re-tear occurred in 32 cases. In binary logistic regression analysis, modified Patte stage III ($P=.002$) and AHD < 4 mm ($P=.022$) were risk factors of irreparability, modified Patte stage III ($P=.029$) and repair quality grade 2 ($P=.001$) were risk factors of re-tear. When used for predicting irreparability and re-tear, modified Patte stage III exhibited high crude agreement (89.8% and 84.0%), specificity (95.9% and 99.3%) and negative predictive value (93.1% and 84.0%).

Conclusions: Modified Patte stage III is a risk factor for irreparability and re-tear after large to massive rotator cuff repairs. Modified Patte stage III exhibited superior diagnostic value for predicting irreparability and re-tear, with high crude agreement, specificity and negative predictive value.

EP.03.182

NEW BIOACTIVE SPATIALLY-EMBEDDED GROWTH FACTOR (SEGF) SCAFFOLD PROMOTES BONE-TO-TENDON INTERFACE HEALING AFTER CHRONIC ROTATOR CUFF REPAIR

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Background: Restoration of the original anatomical bone-to-tendon interface (BTI) after rotator cuff repair (RCR) remains a significant challenge, therefore a multitude of biocompatible biomaterials has been investigated to promote rotator cuff healing after repair. To investigate the efficacy of 3D-printed scaffolds incorporated with spatiotemporal delivery of growth factors (GF) to accelerate BTI healing after RCR

Methods: Advanced 3D printing was used to fabricate the spatially-embedded growth factor (SEGF) scaffolds, which could spatiotemporally deliver the GFs to target region. Total of 50 rabbits, with induced chronic rotator cuff injuries, were divided into 4 groups: normal (N, n = 2), saline (A, n = 16), scaffold without GF (B, n = 16), and SEGF scaffold (C, n = 16). At 6 weeks after the creation of rotator cuff tears, surgical repairs were performed when scaffolds were implanted between the bony footprint and supraspinatus tendon. RT-qPCR and immunofluorescence analyses were performed at 4 weeks after the repair, and histological, biomechanical and micro-CT analyses were performed at 12 weeks after repair.

Results: For genetic evaluation, Group C showed higher mRNA expression levels of collagen type Ia1, collagen type IIIa1, and aggrecan than the other groups ($P < 0.001$, $= 0.005$ and $= 0.006$, respectively) at 4 weeks after repair. Meanwhile, through the immunofluorescence analysis, there were more initial formation of collagen I and II contents in group C (all $P < 0.001$). For histological evaluation, group C showed greater collagen fiber continuity, denser collagen fibers, and more mature tendon-to-bone junction than did in the other groups ($P = 0.004$, 0.002 , and 0.004 , respectively) at 12 weeks. For the biomechanical evaluation, group C showed a significantly higher load-to-failure rate than the other groups ($P = 0.003$). For the micro-CT analysis, group C showed higher bone mineral density and bone volume/total volume rate than the other groups ($P = 0.001$ and < 0.001 , respectively).

Conclusions: This new bioactive SEGF scaffold effectively accelerated BTI healing in chronic rotator cuff tear model of rabbits.

EP.03.183

OUTCOMES OF BICEPS TENODESIS VARIATIONS WITH CONCOMITANT ROTATOR CUFF REPAIR: A MULTICENTER DATABASE ANALYSIS

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Background: Studies to date comparing biceps tenodesis methods in the setting of concomitant rotator cuff repair (RCR) have demonstrated relatively equivalent pain and functional outcomes. The purpose of this study was to compare biceps tenodesis constructs, locations, and techniques in patients undergoing rotator cuff repair using a large multicenter database.

Methods: A retrospective cohort study was performed using the Arthrex Surgical Outcomes Systems (SOS) database to compare pain and functional outcome scores in patients undergoing biceps tenodesis in the setting of concomitant rotator cuff repair. A global outcomes database was queried for patients who underwent biceps tenodesis with RCR for medium and large sized tears (1-5cm). Patients ≥ 18 years with minimum 1-year follow-up were included. The ASES, SANE, VAS, and VR-12 scores were compared at 1- and 2-year follow-up based on construct (anchor, screw, suture), location (subpectoral, suprapectoral, top of groove), and technique (inlay, onlay).

Results: Improvement in VR-12 Mental Score favored anchor and suture fixation at 1 year ($P=.042$) and onlay tenodesis technique at 2-year follow-up ($P=.029$). No additional tenodesis comparisons demonstrated statistical significance. The proportion of patients with improvement exceeding the MCID did not differ based on tenodesis methods for any outcome score assessed at 1- or 2-year follow-up.

Conclusions: Biceps tenodesis with concomitant rotator cuff repair for medium and large tears leads to improved outcomes regardless of tenodesis fixation construct, location, or technique. A clear optimal tenodesis method remains to be determined and the decision should be left to the surgeon and patient.

EP.03.184

FIVE-YEAR POSTOPERATIVE MRI ASSESSMENT OF BONE-REPLACEABLE ANCHORS USED FOR ARTHROSCOPIC ROTATOR CUFF REPAIR

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Background: Biocomposite anchors reportedly take approximately 2 years to be replaced by a bone; nonetheless, none of the cases encountered at our hospital exhibited complete degradation under magnetic resonance imaging (MRI) 2 years postoperatively. Therefore, our objective was to use MRI for evaluating the degree of degradation of these anchors used in ARCR at 5 years postoperatively.

Methods: The participants were selected from 53 patients who underwent ARCR at our hospital and had MRI images captured from 2 years and 5 years postoperatively. We examined 38 anchors from 21 patients with possible complete repair, who did not experience a re-tear. We evaluated the degree of degradation as grade 1 to 4 using the classification system proposed by Haneveld et al. Furthermore, we examined the degree of degradation (2 years and 5 years postoperatively) and the progression of degradation (up to 2 years and from 2 years to 5 years postoperatively).

Results: The bone had replaced the anchors by the Haneveld classification by grade 1 and grade 2 in 35 anchors and three anchors, respectively, at 2 years postoperatively. By contrast, 13, 24, and one anchor were replaced by grade 2, grade 3, and grade 4, respectively, at 5 years postoperatively, thus revealing the replacement had significantly progressed at 5 years. However, almost no anchors had been completely replaced at 5 years. The progression of degradation persisted at grade 1 until 2 years, with all but three of the 35 anchors clearly visible at grade 1. From the year 2 to 5, 15 and 23 anchors displayed advanced 1 stage and 2 stages, respectively, with the stages of degradation significantly progressing during this period.

Conclusions: Biopomposite anchors take approximately 2 years to be replaced by a bone; nonetheless, marginal degradation had occurred at 2 years in practice. The majority of the degradation occurred after 2 years, and we observed substantial progress after 5 years. However, the majority of anchors had not been completely degradation. Despite the steady degradation of biocomposite anchors in clinical practice, the degradation often requires at least 5 years.

EP.03.186

RETEAR AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR IN PATIENTS WITH SMALL AND MEDIUM ROTATOR CUFF TEARS

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Background: One of the problems with arthroscopic rotator cuff repair is postoperative retear, and it has been shown that the risk of retear increases with the size of the preoperative tear and the older the patient. We report a study of risk factors and outcomes of retear after ARCR in patients with small and medium size tears performed at our hospital.

Methods: Patients were divided into Healed and Retear groups according to SUGAYA classification at 2 years postoperatively, and risk factors for retear and Constant score before and at 2 years postoperatively were evaluated. Logistic regression analysis was performed for risk factors, and postoperative outcomes were examined using the unpaired t-test for comparisons between groups and the corresponding t-test for comparisons within groups.

Results: Risk factors for retear were age, tear size for SSP, and Goutallier classification for SSP. There were no significant differences in preoperative clinical outcomes between the two groups. At 2 years postoperatively, Constant scores improved significantly in all items in the Healed group, but significantly in the Retear group except for muscle strength. In the postoperative comparison between the groups, the score improved more in the Healed group except for the pain item, and the pain was not significantly different.

Conclusions: Age, tear size, and fatty infiltration were risk factors. The Retear group didn't regain significant muscle strength postoperatively and was inferior to the Healed group in all endpoints except pain. Pain improved significantly postoperatively in both groups, with no significant difference between the groups.

EP.03.187

SERIAL CHANGES OF PERIMUSCULAR AND INTRAMUSCULAR FAT AND CLINICAL SCORES IN TERMS OF HEALING DEGREE AFTER 2 MEDIUM-SIZED ROTATOR CUFF TEAR REPAIR

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Background: The progression of fatty degeneration after rotator cuff repair is controversial. The purpose of this study is to (1) longitudinally analyze quantitative intramuscular and perimuscular fat and (2) evaluate clinical outcomes according to healing degree after rotator cuff repair.

Methods: June 2013 through October 2018, patients who had undergone (1) repair due to medium-sized rotator cuff tear and (2) preoperative, early (6-12 months), and late (at least 3 years) postoperative chest computed tomography (CT). Supraspinatus (SST) intramuscular fat fraction ratio (IFFR) and perimuscular fat fraction ratio (PFFR) were calculated using chest CT. The rotator cuff integrity was categorized as healed, smaller retear (SRT) and larger retear (LRT) via comparisons of preoperative and postoperative radiographic evaluations. Clinical outcomes were evaluated using the American Shoulder and Elbow Surgeons (ASES) score, the Shoulder Rating Scale of the University of California at Los Angeles (UCLA), and the Constant score.

Results: In the LRT group, compared with the preoperative values, there were increases in the SST IFFR and PFFR at the early ($P=.002$, $P=.006$, respectively) and late ($P<.001$, $P<.001$, respectively) postoperative time. Late postoperative clinical scores (mean UCLA and Constant scores) were not improved compared to preoperative scores ($P=.156$, $P=.094$, respectively). In the SRT group, there was no difference in the mean SST IFFR and PFFR between preoperative and early postoperative time. ($P=.18$, $P=.766$, respectively), but the late postoperative values were higher than preoperative values ($P=.009$, $P=.051$, respectively). Late postoperative clinical scores (mean ASES, UCLA, and Constant score) in the smaller retear group improved compared to preoperative time. ($P<.001$, $P<.001$, $P=.002$). In the healed group, compared with the preoperative values, there was no difference in the mean SST IFFR and PFFR at postoperative time ; however, the late postoperative clinical scores were improved (all $P<.001$).

Conclusions: In smaller retear group, intramuscular fat changes at late postoperative time and clinical scores improve as time goes by. However, in larger retear, intramuscular and perimuscular fat changes at early and late postoperative time and clinical scores did not improve at late postoperative time.

EP.03.188

RECOVERY FOR SPORTS ACTIVITY OF ELDERLY PEOPLE AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR

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Background: With the aging of the population, the number of elderly people who enjoy sports has been increasing. On the other hand, rotator cuff tears in the elderly are common and Arthroscopic Rotator Cuff Repair (ARCR) for the elderly has been widely performed. Although there are quite a few studies on the return to sports by middle-aged patients after ARCR, only few are focused on over 65 years. In this study, we tracked ARCR cases performed on elderly patients over 65 years old who had been active in sports, and their return to sports.

Methods: 14 cases with patients aged 65 or older who were actively engaged in sports and underwent ARCR at our hospital since 2013 were examined in the study. The mean age was 71.3 years (65-81). The mean observation period was 29.5 months (6-60 months). The sports the patients engaged were golf in eight cases, tennis in four, badminton in one, and kendo in one. Six patients had single supraspinatus muscle injuries, one had single subscapularis muscle injury, and seven had multiple tendon injuries. Tear size was partial in three cases, small in four, medium in five, and large in two. The performance levels of patients before and after surgery were evaluated based on the Japanese Orthopaedic Association (JOA) Score and the Japanese Shoulder Society Shoulder Sports Score (JSS-SSS).

Results: The average time required to return to sports was 10.2 months after surgery. Six patients (three in golf, two in tennis, and one in kendo) returned to the same level of performance as before the injury, and two patients (one in golf and one in badminton) got back to more than 80% level of their pre-injury performance level. Three patients (two in golf and one in tennis) were able to the level of 50% or less only. There was no difference in the performance level based on the number of injured rotator cuffs or the size of the tear.

Conclusions: Despite the advanced age, patients of over 65 years have a good potential for recovery after ARCR to enjoy sports again.

EP.03.189

SARS-COV-2 RELATED SHOULDER PAIN AND STIFFNESS ASSOCIATED TO HUMERAL OSTEOLYSIS AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR: A CASE REPORT

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Background: Bioresorbable anchors are widely used in arthroscopic rotator cuff surgery. Complications include osteolysis, aseptic synovitis, and foreign reaction. However, it is not known whether there are precise triggering factors.

Methods: A healthy, 63-year-old male patient diagnosed of full-thickness tear of subscapularis, supraspinatus, infraspinatus tendon and acromioclavicular osteoarthritis underwent rotator cuff repair using with 7 PLGA/b-TCP anchors and acromioclavicular resection. The final six-months postoperative check showed painless, recovered mobility. Nine months after surgery the patient came back to the senior author because of severe right shoulder pain and stiffness, pain in the right hand, right foot and right leg, and presence of erythematous patches at the aforementioned joints following SARS-Cov-2 infection, as well as increasing in blood inflammatory markers. Arthro-MRI showed no rotator cuff tendons re-tear but extremely marked intra-articular synovitis, subacromial bursitis and humeral osteitis. A diagnostic arthroscopy, intra-articular fluid collection, biopsy and joint lavage was performed in order to rule out a septic arthritis. Co-amoxicillin 2.2 g treatment was administered intravenously every 8h following samples. Histological analysis of synovial tissue showed significant fibrin-exudative synovitis, while humeral bone biopsy was consistent with an anchor resorption reaction. Cytopathology showed neutrophil-rich inflammation. All microbiological analysis showed sterile samples. The antibiotic treatment was stopped after negative microbiological results.

Results: At 6 weeks post-lavage follow-up pain was decreased, scars showed no signs of inflammation, erythema was disappeared and the presence of several foci of osteolysis in the humeral head was found on X-Ray. Three months post-lavage follow-up physical examination showed painless, recovered mobility, while arthro-MRI showed a significant post-refixation remodeling of the rotator cuff tendons and reduction in signs of osteitis of the humeral head and synovitis.

Conclusions: The abrupt onset of symptomatology and the close chronological link with SARS-Cov-2 infection suggests a causal relationship between clinical manifestations and the infection itself. The presence of skin manifestations concurrent with SARS-Cov-2 infection has already been described in several studies as the result of a viral host response, suggesting that shoulder pain, stiffness and humeral osteitis could be manifestations of a viral host response to SARS-Cov-2 infection too.

EP.03.190

COST EFFECTIVENESS ANALYSIS BASED ON CONSTRUCT, TEAR SIZE, AND IMPLANT COST FOR ROTATOR CUFF REPAIR AT 1, 2, 5 AND 10 YEARS

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Background: Techniques for arthroscopic rotator cuff repair continue to improve, and there is increasing interest in cost effectiveness of different implants and constructs. No cost effectiveness study to date has evaluated specific suture anchors and constructs for short- and long-term cost effectiveness.

Methods: Real-world cost data and previously published data on both anchor failure strengths and retear rates by tear size & construct were input into a Markov model with time points of one, two, five, and ten years. Cost effectiveness was assessed in terms of cost per quality adjusted life year. Health states included intact repair, asymptomatic or symptomatic retear, revision RCR, and cuff tear arthropathy. Knotted and knotless single row (SR) and double row (DR) constructs using anchors from Smith and Nephew, Arthrex, and Stryker were included.

Results: For small tears, the optimal 10-year strategy was Arthrex SR knotless, which had an incremental cost effectiveness ratio (ICER) of \$11,869/QALY over nonoperative treatment while adding 0.54 QALY. For medium tears, the optimal strategy was Arthrex DR knotted, which had an ICER of \$16,678/QALY and added 0.51 QALY. For large and massive tears, DR knotless strategies from all three manufacturers were preferred and were all similar in cost, while providing equivalent effectiveness. These added up to 0.543 QALY (large) and 0.46 QALY (massive) over nonoperative treatment.

Conclusions: Surgeons and healthcare providers may use the results of this study to help with anchor and construct selection when performing arthroscopic rotator cuff repairs for optimum value based care.

EP.03.191

FUNCTIONAL OUTCOMES AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR AMONG CHINESE, MALAYS AND INDIANS: AN ASIAN ETHNIC STUDY

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Background: Arthroscopic rotator cuff surgery has been shown to significantly reduce pain and improve patient function and quality of life. However, pre and postoperative functional outcomes may be influenced by patient characteristics. Asia is a multiracial community made up of Chinese (East Asians), Indians (South Asians) and Malays (Southeast Asians). The aim of this study is to evaluate the functional outcomes after arthroscopic rotator cuff repair among Chinese, Indians and Malays.

Methods: From 2010 to 2016, 375 patients who underwent unilateral arthroscopic double row rotator cuff repair by a fellowship trained Shoulder Orthopaedic surgeon at our tertiary hospital were included in this study. All patients had full thickness tear on preoperative imaging. All patients were prospectively followed up for 2 years and the following outcome measures were collected: Demographics, VAS score, CONS score, UCLA shoulder score and Oxford shoulder score.

Results: The ethnic breakdown of 375 patients revealed 294 Chinese (78.4%), 57 Indian (15.2%) and 24 Malay patients. The average age of the study cohort was 60.1 years old with the Chinese group (60.9) and Indian group (58.1) having a higher average than Malay group (55.4) ($P=0.012$). Among the ethnic groups, there was no significant difference in gender distribution and BMI. The Malay group reported the highest preoperative VAS score ($P=0.005$) but experienced the greatest improvement in VAS score at 24 months postoperatively ($P=0.010$). In terms of functional outcomes, the Malay group started with the poorest CONS, UCLA and OXF (all $P < 0.05$). However, the Malay group showed the greatest improvement in OXF scores among the three groups. ($P < 0.001$) All 3 ethnic groups showed improvements in VAS, CONS, UCLA and OXF at 12 and 24 months postoperatively.

Conclusions: This is the first study to evaluate the influence of Asian ethnic groups on functional outcomes after arthroscopic rotator cuff repair. Malays undergo arthroscopic rotator cuff repair at a younger age, presenting with higher VAS score and poorer functional outcome scores preoperatively. However, all three ethnic groups experienced comparable improvements in functional outcome scores. We conclude that patients in all three Asian ethnic groups benefit significantly after arthroscopic rotator cuff repair.

EP.03.192

ARTHROSCOPIC TRANS-OSSEOUS MULTI-SUTURE (TOMS) REPAIR USING CORTICAL BONE AUGMENTATION IN 2-4CM ROTATOR CUFF TEARS

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Background: Arthroscopic trans-osseous rotator cuff repair is a reliable technique and has many advantages. However, bone laceration, one of the complications, has been reported and there is concern that it may affect the occurrence of repair failure. We hypothesized that cortical bone lacerations could be reduced through cortical bone augmentation using knotless anchor. We also hypothesized that this method could improve clinical and anatomical outcomes. The purpose of this study is to confirm the clinical and anatomical results of arthroscopic Trans-Osseous Multi-Suture (TOMS) rotator cuff repair with cortical bone augmentation, and to investigate factors affecting repair failure.

Methods: From March 2016 to September 2019, patients with symptomatic 2 to 4 cm fullthickness tears underwent rotator cuff repair using arthroscopic Trans-Osseous Multi-Suture (TOMS) technique were enrolled. Some patients underwent additional cortical augmentation using knotless anchor. Functional and anatomical outcomes were assessed preoperatively and at least 2 years postoperatively. Factors influencing repair failure were evaluated, using univariate and multivariate analyses.

Results: Patients who did not undergo cortical augmentation were classified as TOMS group (n=30), and those who underwent were classified as TOMS-A group (n=31). The functional scores of both groups significantly increased, and the increase was significantly greater in the TOMS-A group. The TOMS-A group showed lower repair failure rate (29.03%) and bone lacerations (0%) than the TOMS group. Larger retraction (p=0.016) and osteoporosis (p=0.039) were associated with repair failure as independent preoperative factors in TOMS-A group. At final follow-up, the anterior and posterior tunnel intersection angle (TIA) between the medial and lateral tunnels and postoperative posterior TIA are higher in osteoporotic patients.

Conclusions: When performing arthroscopic trans-osseous rotator cuff repair, cortical augmentation can prevent bone lacerations, achieve better clinical results, and expect successful repair. Larger retraction size and osteoporosis are preoperative factors associated with repair failure in trans-osseous rotator cuff repair. Osteoporosis also negatively affects the integrity of the bone tunnel in arthroscopic trans-osseous rotator cuff repair, so it should be fully considered when choosing repair technique.

EP.03.193

ACROMIOPLASTY TO MITIGATE SUBACROMIAL IMPINGEMENT: A BIOMECHANICAL STUDY

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Background: Background: Subacromial impingement (SAI) associated with rotator cuff tears (RCTs) commonly results in joint instability. Acromioplasty is undertaken to treat SAI, but has not yielded consistent positive clinical results, flagging the need for further biomechanical investigation. This study aimed to determine which RCT conditions and joint positions lead to SAI and whether acromioplasty decreases or eliminates contact pressure in cases of impingement.

Methods: Methods: Eight fresh-frozen human cadaveric upper limbs were mounted to a computer-controlled testing apparatus. Joint kinematics was measured via LabVIEW setup and subacromial contact pressure was measured by Tekscan 4000 sensor. Tendons were sutured and attached to pulleys controlled via motors that applied set forces to abduct the limb at 5°, 30°, 60° and 90°. At each angle the native arm then RCT configurations were simulated: isolated supraspinatus RCT; combined supraspinatus and infraspinatus RCTs; combined supraspinatus and subscapularis RCTs. Testing was undertaken pre-operatively, then repeated post acromioplasty.

Results: Results: Peak subacromial pressure increased significantly for combined supraspinatus and infraspinatus RCTs at 30° (mean difference=-109.5kPa, p=0.04) and 90° (mean difference=-188.1kPa, p=0.04). Anterior acromion thickness decreased significantly post-operatively (mean difference=5.7mm, p=0.004). Peak subacromial pressure decreased significantly post-operatively, for combined supraspinatus and infraspinatus tear at 30° (mean decrease=110.9kPa, p=0.03).

Conclusions: Conclusion: Combined supraspinatus and infraspinatus RCTs significantly increase contact pressure within the subacromial space, indicating patients with these tears should undergo RCT repair as a matter of priority. For patients with this tear combination, acromioplasty may aid in further decreasing subacromial contact pressure, but results indicate it does not completely bring it back to normal.

EP.03.194

VALIDATION OF ULTRASOUND CLASSIFICATION OF RE-TEARS FOLLOWING ARTHROSCOPIC ROTATOR CUFF REPAIR

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Background: Despite advances in surgical technology, there is a high re-tear rate for large and massive rotator cuff tears, up to 90%. With increasing number of these procedures being performed, it is expected that there will be an increased need for accessible, cost-effective postoperative imaging to evaluate for re-tears. The purpose of our study was to evaluate and validate the use of ultrasound (US) to evaluate retears after rotator cuff repair (RCR).

Methods: An US based classification to assess postoperative integrity or healing after RCR was developed based on a validated MRI classification system and previously published. A pilot study of this classification was applied to patients who underwent a large or massive RCR by two fellowship-trained shoulder surgeons. Ultrasound evaluations were performed at 6 weeks, 3 months, and 1 year postoperatively by sports medicine fellowship-trained providers.

Results: A case series of 8 patients with serial US and MRI postoperatively were reviewed. The average preoperative tear size was 3.35cm AP x 3.00cm ML, and all cuffs were successfully repaired. At the 6 week follow up, all patients were visualized as Type IB (RCR normal thickness with heterogeneous hypo-echogenicity). At 3 months, 4 remained at IB, while 2 converted to IIB (RCR loss of normal thickness and contour without anechoic defect evident) and 2 were read as IIIB (>1 cm defect evident). At six months follow up, an additional patient converted from IB to IIB. When comparing postoperative 1 year MRI results, 2 patients showed evidence of re-tearing, one from the IB classification and one from the IIB classification. For the IB tear on US, the location of the re-tear was obscured by the acromion on the US. For the IIB classification on the US, MRI demonstrated re-tearing of the supraspinatus.

Conclusions: Our initial findings demonstrate that early re-tears may be more easily detectable via US evaluation following arthroscopic RCR for large and massive cuff tears that are located in the visible field. Loss of thickness, as seen on US, may be a risk factor for re-tear at one year, whereas maintenance of cuff thickness is a positive sign of healing on US.

EP.03.195

TRANSOSSEOUS AND HYBRID ROTATOR CUFF REPAIR WITH A REUSABLE TRANSOSSEOUS DEVICE, PILOT STUDY CLINICAL RESULTS FOR VALUE BASED ROTATOR CUFF REPAIR

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Background: Anchor-based and transosseous techniques are both clinically effective means for cuff repair; however, modern arthroscopic surgery has increased cost burden to achieve the same double row tendon footprint repair as the traditional transosseous gold standard. In the era of value based medicine where cost pressures are affecting care delivery, a reusable arthroscopic transosseous cuff repair device was designed to facilitate value based care delivery in modern arthroscopic shoulder surgery. This study reports the clinical results of the pilot group of fully transosseous cuff repair. In addition, a novel "true transosseous hybrid" technique which maximizes the advantages and minimizes the disadvantages of both transosseous and anchor based strategies together was evaluated as a transition technique for surgeons.

Methods: Two repair techniques of a single surgeon were evaluated prospectively from October 2014 through July 2015 with ASES and VAS scores. Group 1 (Transosseous cuff repair) was composed of 59 patients, mean age 61, mean follow up 14.4 months. Group 2 (true transosseous hybrid technique) was composed of 45 patients, mean age 64, mean follow up 16 months. Two sample T tests were performed for statistical analysis.

Results: Group 1 (transosseous cuff repair), mean preop ASES scores improved from 49 to 92 post op ($p = .0001$). Mean VAS pain scores improved from 5.10 to 0.61 ($P < 0.0001$). 3 patients suffered re-tears (5.08%). In group 2 (true transosseous hybrid repair), mean preop ASES scores improved from 44 to 85 ($p < 0.0001$); VAS scores improved from 5.36 to 1.11 ($p < 0.0001$). 2 patients suffered a re-tear (4.44%). There were no intra-operative device related complications.

Conclusions: The results of this study show that arthroscopic "true" transosseous as well as hybrid techniques for rotator cuff repair techniques have equivalent or superior clinical results to previous reported rotator cuff repair outcomes. The addition of a technique utilizing a reusable transosseous cuff repair device also reduces or eliminates implant cost, creating an opportunity for increased value of care delivery.

EP.03.196

MRI IS A RELIABLE METHOD FOR MEASUREMENT OF CRITICAL SHOULDER ANGLE AND ACROMIAL INDEX

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Background: Although MRI is the gold standard in diagnosing rotator cuff tears, there is still controversy on whether it can reliably provide acromial index measurement of (AI) and critical shoulder angle (CSA). The objectives of this study are to determine the interobserver and intra-observer agreement for AI and CSA values measured in both radiographs and MRI of the shoulder; and to compare absolute values of AI and CSA obtained in these image modalities, assessing whether MRI is a reliable method in determining both anatomical parameters.

Methods: Consecutive, skeletally mature patients who had medical indication of investigating shoulders conditions through radiographs and MRI were included. Only true AP views of the shoulder were accepted, and all the exams followed a strict technical protocol. Images of both radiographs and MRI exams were taken to two examiners, both fellowship-trained shoulder surgeons, which conducted measurements of AI and CSA in radiographs and in MRI. Twelve weeks after the first evaluation, a second evaluation was conducted. Inter- and intra-observer reliability was presented as an Intraclass Correlation Coefficient (ICC) and agreement was classified according to Landis & Koch criteria. The differences between two measurements were evaluated using Bland-Altman plots.

Results: 134 shoulders in 124 subjects were included, with a mean age of 52 years old, there were 68 females and 56 males. Mean intra-observer ICC for CSA in X-rays and in MRI were 0.936 and 0.940, respectively; for AI, 0.908 and 0.922. Mean inter-observer ICC for CSA were 0.892 and 0.752 in X-rays and MRI respectively; for AI, ICC values were 0.849 and 0.685. All individual analysis reached statistical power ($p < 0.001$). Mean difference for AI values measured in X-rays and in MRI was 0.01 and 0.03 for observers 1 and 2, respectively. Mean difference for CSA values obtained in X-rays and MRI was 0.16 and 0.58 for observers 1 and 2, respectively.

Conclusions: Both MRI and X-rays provided high intra- and interobserver agreement for measurement of AI and CSA. Absolute values found for AI and CSA were highly correlated in both image modalities. These findings suggest that MRI is a suitable method to measure AI and CSA.

EP.03.197

CLINICAL AND RADIOLOGICAL OUTCOMES OF ROTATOR CUFF REPAIRS USING ALL-SUTURE ANCHORS AS MEDIAL ROW ANCHORS

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Background: The aim of our study is to report the clinical and radiological outcomes of a series of prospectively enrolled patients who have had double-row transosseous equivalent rotator cuff repairs, where all-suture anchors were used as medial-row anchors, with a minimum follow-up of 1 year

Methods: Twenty-two consecutive patients underwent arthroscopic transosseous equivalent double-row rotator cuff repair using all-suture anchors as medial-row anchors. Oxford Shoulder Score, Constant Score and Visual Analogue Scale pain score, together with shoulder range of motion, were used preoperatively and at 3 months, 6 months and final follow-up. Radiological evaluation was performed with magnetic resonance imaging at one-year post surgery to assess the structural integrity of the repair and the rate of cyst formation in greater tuberosity

Results: The patient mean age was 61 years (range 46-75). Minimum follow-up was 1 year, and the mean final follow-up was 15 months (range 12-24). Healing failure in our patients was less than 5% (1/22 patients). There were significant improvements in shoulder function outcome scores at final follow-up. The Constant and Oxford scores were 78 and 44 at final follow-up respectively. There were similar magnitudes of improvement in range of motion (combined abduction and rotation), pain score and supraspinatus strength at final follow up. The improvements in outcome scores were already statistically significant at 3 months ($P < .001$). Using Kim's classification for cyst formation on T2-weighted MRI images, we observed no fluid or minimal fluid collection in 85% of the patients (17/22 patients). There were no correlations between the grade of bone changes and the clinical outcomes.

Conclusions: It is safe to use all-suture anchors as medial-row anchors when performing double-row anchor transosseous equivalent rotator cuff repairs. The purported advantages of all-suture anchors may outweigh their perceived disadvantages in rotator cuff repair surgery.

EP.03.198

ARTHROSCOPIC SUPERIOR CAPSULE RECONSTRUCTION USING 3D PREOPERATIVE PLANNING: TECHNIQUE DESCRIPTION

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Background: We describe a technique using a fascia lata autograft with 3D printing to reconstruct the rotator cuff. Prototyping constitutes the construction of physical prototypes with high complexity after virtual studies. Such models increase the knowledge of the characteristics and size of rotator cuff injuries, thus improving the accuracy of determining the correct size of the graft to be used in superior capsule reconstruction. We aimed to present a case of superior capsule reconstruction using 3D printing for enhancing the accuracy of fascia lata allograft size and tension determination; 3D reconstruction has never been described in the literature for rotator cuff injuries.

Methods: Right shoulder magnetic resonance imaging (MRI) demonstrated a supraspinatus tendon tear with retraction to the glenoid. After extracting the MR image in digital imaging and communications in medicine (DICOM) format, the image data were transferred to a dedicated image post-processing workstation, on which 3D segmentation and visualization were performed to create a computer-aided design model based on non-uniform rational B-spline technology. The sizes and anatomy of lesions created reflected those of a real patient, and the lesion was measured from the glenoid to the entire coverage of the greater tuberosity. The printed lesion was 3.8 mm thick and measured 4.2 and 5.6 cm. A humeral model with a rotator cuff injury and a tear model were applied to the software (Simplify 3d), and thereafter sent to the printer for physical object manufacture and printing. All configurations used were for printing with TPU (Thermoplastic polyurethane) with printing by Sethi3D.

Results: We found the model useful for preoperative simulation and determination of the placement, number of anchors and sutures. In our experience, the use of preoperative 3D printed models reduced surgical time (30 to 40 min), decreased anesthesia time, and demonstrated the required graft size and tension. Finally, the prototype also functioned as an educational tool in and out of the operating room.

Conclusions: We hope that our 3D models will reduce the complexity of this procedure and enhance efficient surgical performance and reproducibly. Moreover, we believe that this new technology is an excellent way to facilitate SCR by an arthroscopic shoulder surgeon.

EP.03.199

THE COMBINATION OF RADIAL-SLICE MAGNETIC RESONANCE IMAGES AND BICEPS-RADIAL- SLICE MAGNETIC RESONANCE IMAGES IS RELIABLE FOR DIAGNOSING THE SUBSCAPULARIS TENDON TEARS

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Background: Radial-slice magnetic resonance images (R-MRI) have high diagnostic accuracy for subscapularis tendon tears. However, the sensitivity for tears in the superior part of the subscapularis tendon is lower than in another part. This study investigated the validity of R-MRI in combination with biceps-radial-slice magnetic resonance images (BR-MRI) for diagnosing subscapularis tendon tears.

Methods: We investigated 56 shoulders in 56 patients with rotator cuff tears evident during arthroscopic shoulder surgery. The intraoperative finding of a subscapularis tendon tear was compared with identifying a subscapularis tendon tear on preoperative R-MRI and BR-MRI. The morphology of the subscapularis tendon tears was classified as Lafosse classification (type I - IV). The sensitivity and specificity of diagnostic images generated using different imaging methods were investigated.

Results: A subscapularis tendon tear was present in 48 shoulders, with the tendon tear morphology categorized as type I in 24, type II in 15, type III in 6, and type IV in 3. When the diagnostic accuracy of the magnetic resonance images was compared with the arthroscopic findings, the sensitivity-specificity of (R-MRI/ BR-MRI/ R-MRI and BR-MRI) was the type I (83.3-90.6/ 95.8-96.9/ 95.8-96.9)%, the type II (93.3-92.7/ 100-90.2/ 100-97.6)%, the type III (100-100/ 50-100/ 100-100)%, the type IV (100-100/ 100-100/ 100-100)%.

Conclusions: R-MRI, in combination with BR-MRI, has a high sensitivity for subscapularis tendon tears and helps diagnose these lesions. In particular, the accuracy for tears in the superior part of the subscapularis tendon is higher than that of isolated methods.

EP.03.200

SUPERIOR CAPSULE RECONSTRUCTION WITH LONG HEAD OF THE BICEPS TENDON FOR MASSIVE IRREPARABLE ROTATOR CUFF TEARS

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Background: The use of the long head of the biceps tendon (LHBT) as autograft for superior capsule reconstruction is a well described treatment in literature. Recent studies showed that it is biomechanically equivalent and potentially even stronger than fascia lata autograft in the prevention of superior humeral migration. The aim of the present study was to evaluate the clinical outcome of arthroscopic superior capsular reconstruction with LHBT for the treatment of massive irreparable rotator cuff tears. The hypothesis of the study was that this technique could improve subjective and functional outcomes.

Methods: A retrospective study was conducted. Patients with massive irreparable rotator cuff tears of the posterosuperior rotator cuff who underwent arthroscopic superior capsular reconstruction with autologous LHBT were included. Exclusion criteria were: shoulder stiffness, cuff-tear arthropathy, glenohumeral and/or acromioclavicular joint osteoarthritis, previous fractures and/or previous surgery to the same shoulder. An intraoperative assessment of cuff irreparability and testing of LHBT status were always performed to confirm indication. All patients underwent the same surgical technique and rehabilitation protocol. The LHBT was first freed from its groove and then mobilized posteriorly. Two #2 high-strength non-absorbable braided sutures were passed through the distal aspect of the intraarticular part of the tendon. It was then released distal to the most lateral suture and re-routed over the footprint of the posterior aspect of the supraspinatus tendon. The proximal stump of the LHBT was fixed to the greater tuberosity using one knotless suture anchor. The infraspinatus tendon was partially repaired. Side-to-side repair between LHBT and the infraspinatus tendon was attempted. Primary outcome was the ASES score. Secondary outcomes were: QuickDASH and WORC score. A paired t-test was used to compare pre and postoperative outcomes. Significance was set at $p < 0.05$.

Results: Results: The study included 12 males and 7 females. Mean age (+ SD) of patients was 61.74 ± 6.13 years. Mean follow-up was 26.61 ± 5.67 . Comparison between pre- and postoperative functional scores showed significant clinical improvement ($p < 0.001$).

Conclusions: Arthroscopic superior capsular reconstruction with LHBT for the treatment of massive irreparable rotator cuff tears provides satisfactory subjective and functional outcomes.

EP.03.201

COMPARISON OF CLINICAL AND STRUCTURAL OUTCOMES IN PATIENTS WITH AND WITHOUT DIABETES MELLITUS AFTER SUPERIOR CAPSULE RECONSTRUCTION FOR IRREPARABLE ROTATOR CUFF TEARS

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Background: This study aimed to compare the clinical and structural outcomes of superior capsule reconstruction (SCR) for irreparable rotator cuff tears (RCTs) in patients with and without diabetes mellitus (DM).

Methods: Overall, 182 patients with irreparable RCTs underwent SCR using fascia lata autografts between 2012 and 2020. Patients were allocated to either the non-DM (153 patients; mean age: 70.1 years) or the DM (29 patients; mean age: 71.0 years) group. Only patients with glycemic control (HbA1c<8%) were eligible for SCR. Fasting glucose levels of patients with DM were maintained under 200 mg/dL for 2 weeks after SCR. The Visual Analog Scale (VAS) for shoulder pain and the American Shoulder and Elbow Surgeons (ASES) score were evaluated preoperatively and at the final follow up (mean: 33 months; range, 1–10 years). Shoulder active range of motion (ROM) was evaluated preoperatively, at 6 and 12 months, and at the final follow up. At the final follow up, graft integrity was evaluated using magnetic resonance imaging and full thickness defects within the graft was diagnosed as graft tears. Additionally, postoperative infection rate was evaluated.

Results: The VAS and ASES scores, forward flexion, and external rotation improved significantly after SCR in both the non-DM (5.9–0.5, 40.8–91.9, 95.1°–155.8°, and 25.9°–42.8°, respectively) and DM (5.4–0.4, 41.3–91.0, 89.8°–154.3°, and 22.6°–40.0°, respectively; all $P<0.05$) groups. We found no significant difference in the outcomes measured between both groups preoperatively and at the final follow up. The forward flexion and external rotation increased significantly at 6 and 12 months after SCR, respectively, in the non-DM group (both $P<0.001$) and increased significantly at 12 months after SCR and at the final follow up (mean: 33 months), respectively, in the DM group (both $P<0.05$). Between the non-DM and DM groups, the graft tear rates (9.8% and 10.3%, respectively) and postoperative infection rates (3.3% and 0%, respectively) were not significantly different.

Conclusions: Compared with patients without DM, those with DM showed favorable clinical and structural outcomes at the final follow up after SCR. However, patients with DM required a longer duration to improve their ROM than those without DM.

EP.03.202

ARTHROSCOPIC SURGERY OF ROTATOR CUFF RETEAR: NEW REPAIR VERSUS TENDON TRANSFER

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Background: Rotator cuff re-tear has a prevalence of 20%-40%. For symptomatic patients with rotator cuff re-tear several surgical techniques have been proposed but none has proved superiority over another. The main goal of this study was to analyze the clinical results of failed rotator cuff repair treated by a new repair versus a tendon transfer (isolated or combined with partial repair). The secondary objective was to evaluate whether partial repair associated with tendon transfer could improve the clinical outcome of isolated tendon transfer.

Methods: Forty-four patients (mean age 55years, range 25-77) were included in this retrospective study with minimum follow-up of 12 months. Twenty-two patients underwent new arthroscopic repair (Group A) when local conditions allowed for an anatomic repair, either tension-free or by medializing the attachment site. Twenty-two had tendon transfers (latissimus dorsi or lower trapezius assisted by arthroscopy) of which thirteen isolated (Group B) and nine associated with a partial repair of the rotator cuff (advancement or convergence) (Group C). The results were evaluated for the overall series as well as each group according to the Constant score, the VAS pain score, and the subjective shoulder value (SSV).

Results: All preoperative scores were significantly improved postoperatively. The Constant score increased from 40.4 to 56.3, the VAS from 5.9 to 2.4 and the SSV from 44.5 to 66.4% ($p < 0.05$). The group of isolated tendon transfer (Group B) had an average final Constant score of 43.8 and SSV of 59.1% which were lower than the groups of new repairs (Constant 64.6, SSV 72.2%) and partial repair associated with a tendon transfer (Constant 63.8, SSV 72%). The gain was lower for the isolated tendon transfer in terms of Constant and SSV scores, but the gain on pain was the same regardless of the group.

Conclusions: The clinical results of different treatment options for failed rotator cuff repairs showed improvements in the clinical scores and decreased pain especially in patients treated with a new repair. Tendon transfer (latissimus dorsi or lower trapezius) combined with partial repair yielded better results than isolated transfer. The isolated transfer relieved the patients' pain but gave them a limited functional gain.

EP.03.204

TWO ARTHROSCOPIC PROCEDURES COMPARED FOR THE TREATMENT OF ROTATOR CUFF TEAR: TRANSOSSEOUS EQUIVALENT VS AUGMENTED TRANSOSSEOUS TECHNIQUE. ONE IS SUPERIOR TO THE OTHER?

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Background: The purpose of this study is to compare and evaluate the short-term functional and recovery outcomes of the shoulder of patients undergoing arthroscopic RC repair surgery with two different suture techniques: 1) transosseous equivalent and 2) transosseous.

Methods: 87 patients affected with rotator cuff tear (out of 112) were eligible for the study after applying the inclusion/exclusion criteria. Patients were randomized into two different treatment groups: 1 - transosoeus equivalent (TOE), 2 - augmented transosseous (TO). Both shoulders (operated and contralateral) for each patient were evaluated, clinically with Constant-Murley score (CMS) and for kinematic recordings with Showmotion, at different times: T-0 (pre-op), T-1 (3 months post-op) T-2 (6 months post-op) and T-3 (24 months post-op)

Results: The patients evaluated were respectively 69 (out of 87) at T1, 61 (out of 87) at T2 and 58 at T3.

At T0, statistically significant differences ($p < 0.05$) were found in comparing both ROM FLEX-EXT and ROM ABD-ADD of the pathological with the healthy side. Comparing different groups at T1, the only statistically significant difference ($p < 0.05$) was found between ROM FLEX-EXT of the pathological side and ROM FLEX-EXT of the healthy side. No statistical difference was found comparing ROM ABD-ADD in the healthy and pathological sides.

At T2 and T3 no significant differences were found comparing healthy with pathological side. A progressive increase in the average CMS value in the recovery of the pathological side is recognized with a decrease in the standard deviation value. Statistically significant difference ($p < 0.05$) was found in comparing CMS values of the pathological side at time T0, T1, T2 and T3 with CMS values of the healthy side. Moreover, CMS values in T3, T2 and T1 are significantly bigger that CMS values in T0. The effect of the surgical treatment on the Scapular humeral rhythm revealed no significant difference.

Conclusions: TOE and augmented TO techniques have equivalent results in terms of kinematics and bring to an analogous scapular-humerus rhythm.

EP.03.205

RECONSTRUCTION USING BICEPS TENDON GRAFT IN CASES IN MASSIVE, SEVERELY RETRACTED ROTATOR CUFF TEARS (SANDWICH TECHNIQUE)

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Background: Prevalence of massive rotator cuff tears is 40% of all rotator cuff tears. Some consider all rotator cuff tears to be repairable. Others affirm that some lesions are irreparable or should not be repaired. Repair of such tears is often associated with structural failure, poor outcomes and high re-rupture rate depending on the age, tear size, repair technique used and most importantly existing muscle atrophy or fatty degeneration. Various treatment options are available. The selection of the most appropriate of which may be challenging.

Methods: Inclusion criteria:

Intact or repairable Subscapularis (subscap)/ Supraspinatus (SS) retracted beyond the glenoid/ Retracted Infraspinatus (IS) tear/ Intact Biceps tendon (BT) 4 cm from its glenoid attachment/ Fatty Degeneration <50%

Exclusion criteria:

Gleno-Humeral Arthrosis/ Damaged BT within 4 cm from its glenoid attachment

In the beach-chair position and under general anesthesia, arthroscopic rotator cuff reconstruction was performed using BT as a graft. First, release of the rotator cuff is performed. Then, the upper subscap is sutured to the BT by side to side sutures according to the margin convergence technique. In turn, the BT is also sutured to the upper edge of the IS using side to side sutures. This procedure is repeated 2 to 3 times, thus creating a kind of -sandwich- system, where the BT is positioned between the subscap and IS. Then, BT tenotomy is performed at the upper edge of the bicipital groove. The rotator cuff footprint is prepared by performing microfracturing. Then, the whole construct ("sandwich" system of subscap/BT/IS) is fixed to the footprint on the humeral head (HH). This fixation was performed in 38 cases using double row anchor technique. In the other 34 cases this was performed using transosseous technique.

Results: After a minimum of 6 years follow up, there was a significant improvement in the postoperative outcome according to the VAS, ASES and UCLA scores. There was no significant difference between both groups that used the two different fixation methods.

Conclusions: Rotator cuff reconstruction using BT graft -sandwich technique- yields good outcome with early functional recovery and low re-rupture rate

EP.03.206

RETROSPECTIVE COMPARISON OF FUNCTIONAL SURGICAL OUTCOME IN YOUNG OBESE PATIENTS FOLLOWING FULL-THICKNESS ROTATOR CUFF TEARS

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Background: This study aims to determine the outcomes of young obese patients (<50 years) after a full-thickness rotator cuff (FTRC) repair compared to nonobese patients under 50 years as well as obese and nonobese older patients (>50 years). We hypothesize that following FTRC repair, patients who are obese and under 50 years will have worse clinical outcomes than nonobese patients under 50 years at different post-op time intervals.

Methods: A retrospective review of patients who underwent surgical repair of FTRC tears was performed between January 2016-December 2021. Patients included in this study were > 18 years old and underwent FTRC repair. Obesity was defined as BMI >30, and patient-reported outcomes were evaluated using ASES and SANE scores. We further categorized into four groups: obese and under 50 years; nonobese and under 50 years; obese and over 50 years; nonobese and over 50 years. To determine the significance between groups, we used t-test and ANOVA. A p-value <0.05 was considered significant.

Results: The study included 569 patients. Of these patients, 267 (46.4%) were obese, and 302 (52.5%) were nonobese, with an overall mean BMI of 30.49. The sample had slightly more males (52.8%) than females (45.9%). The overall mean age was 58.44 years, and a total of 84 (14.8%) patients were under 50 years. Of subjects under 50 years, 47 (55.9%) patients were in the obese group, and 37 (44.0%) patients were in the nonobese group. Preliminary analysis shows the mean postoperative ASES score was 81.69 (range, 29.29 to 100), and the mean SANE score was 82.76 (range, 0 to 100). Compared to the nonobese group, patients in the obese group had statistically worse ASES score (p=0.0057) scores but had no difference in SANE scores (p=0.2478). We found patients under 50 years with BMI >30 to have worse ASES scores compared to the other groups (p=0.0449). However, there was no difference when compared with SANE scores (p=0.429).

Conclusions: Our results demonstrated that following FTRC repair, obese patients under 50 years have significantly worse ASES scores with no significance in SANE scores.

EP.03.207

COMPARISON OF CRITICAL SHOULDER ANGLE BETWEEN PATIENTS WITH AND WITHOUT ROTATOR CUFF TEARS

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Background: Critical shoulder angle (CSA) is one of the image measurement parameters defined by Moor et al. They reported the higher CSA (>35°) was associated with rotator cuff tears and lower CSA (<30°) was associated with osteoarthritis. A purpose of this study is to compare Critical Shoulder Angle between patients with and without rotator cuff tears.

Methods: From April 2020 to April 2021, we evaluated patients who is above 60 years old and divided patients into two groups: Rotator cuff tears group (RCT Group), Intact rotator cuff group (No RCT Group). RCT Group is twenty-two patients (7 males, 15 females, average 74.5 years) who underwent arthroscopic surgeries for rotator cuff tears. No RCT Group is twelve patients (1 males, 11 females, average 71.2 years) who has intact rotator cuff by MRI. Exclusion criteria were 1) osteoarthritis of shoulder, 2) a history of shoulder trauma, 3) previous shoulder surgery, 4) age younger than 60 years. We measured CSA by true-AP radiograph. We compared age and CSA between 2 groups. For the statistical analyses, unpaired t-test were used.

Results: Age showed no significant difference between two groups (RCT Group:74.5±6.9 years old vs No RCT Group:71.2±5.6 years old, p=0.14). CSA showed significant difference between two groups (RCT Group:34.0±4.1° vs No RCT Group 31.1±3.9°, p=0.0493).

Conclusions: We compared the CSA between patients with and without rotator cuff tears. CSA in patients with rotator cuff tears was increased compared to patients without rotator cuff tears, but mean CSA was less than 35° in this study.

EP.03.208

ARTHROSCOPIC ROTATOR CUFF MUSCLE ADVANCEMENT TO REPAIR FOR MASSIVE ROTATOR CUFF TEARS

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Background: Massive rotator cuff tears are often difficult to repair, therefore partial repair or alternative surgeries such as superior capsular reconstruction and tendon transfer are performed. Arthroscopic detachment of the origin of the rotator cuff and lateral advancement of the rotator cuff can repair massive medial retraction of the rotator cuff. In this study, we report the results of arthroscopic rotator cuff muscle advancement.

Methods: The subjects were 24 shoulders of 24 patients with symptomatic massive rotator cuff tears. There were 11 males and 13 females, the average age was 66 (45-81) years old, and the average postoperative follow-up period was 25.8 (17-36) months. Surgery was performed in the beach chair position, a portal for supraspinatus muscle and infraspinatus muscle release was made on the medial border of the scapula to detach the medial border of the rotator cuff. Using them as working portals, radiofrequency coblation was used to release the rotator cuff muscles from the glenoid fossa. The medial edge of the rotator cuff attached to the medial border of the scapula was separated using an elevator while remaining continuous with the rhomboid muscle fascia. After arthroscopic muscle advancement, the torn of the rotator cuff reached the greater tuberosity and the triple row technique was used to repair the rotator cuff. Postoperative cuff integrity was examined using MR images.

Results: Complete repair was achieved in all cases. Postoperative cuff integrity was Sugaya classification type I in 21 cases, type II in 1 case, type III in 1 case, and type IV in 1 case. Postoperative re-tear rate was 5.8%.

Conclusions: Arthroscopic rotator cuff muscle advancement was performed for massive rotator cuff tears, and complete repair was possible in all cases. Advancing the rotator cuff laterally resulted in a low-tension repair and a high healing rate. This method enables reconstruction of the rotator cuff anatomically and repair with lower tension.

EP.03.209

DEMOGRAPHIC AND RADIOLOGICAL FACTORS THAT NEGATIVELY INFLUENCE THE CONSERVATIVE TREATMENT OF COMPLETE DEGENERATIVE SUPRASPINATUS TEARS

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Background: Conservative treatment of degenerative supraspinatus tears offers satisfactory results in most of the patients. However, predicting which patients will eventually require surgical treatment is still a challenge.

Methods: We conducted a prospective study including patients with complete degenerative supraspinatus tears who attended our institution between 2021 and 2022. Patients older than 80 years old, traumatic ruptures, no diagnostic MRI, massive ruptures, rotator cuff arthropathy Hamada 3 and with less than 1 year of follow-up were excluded. All patients were initially treated conservatively, with the same exercises protocol based on strengthening the rotator cuff and scapular muscles. Clinical follow-up was performed at 3, 6, 12 months and yearly after. Failure of conservative treatment was defined as requiring surgical treatment at some point of the follow-up. Pain, range of motion and rotator cuff strength were registered in each consultation. Tears were analyzed with MRI and were classified according the size (C1, C2, C3) and the location (central, anterior, posterior). Size was also measured in mm, in both sagittal and coronal views. All patients and MRI were reviewed by the same fellowship-trained shoulder orthopaedic surgeon.

Results: A total of 127 patients were included with a mean age of 64,2 years. The mean follow-up was 12.7 months. 41.7% had a C1 tear, 42.5% C2 and 84.2% C3. Infrapinatus and subscapularis tears were associated in 12% and 22% respectively. At the end of follow-up, 82.3% obtained satisfactory result with conservative treatment with most patients being pain free. Comparing patients who required surgery with patients that did not, there was significant difference only in age (59.9 vs 64.9, $p=0,001$). No difference was found regarding smoking status, manual or non-manual workers, or dominant arm involvement. Analyzing the MRI, patients who required surgery had larger tears in the sagittal view (15mm vs 18mm, $p=0,05$) and tears were most frequently located in the anterior region (35% vs 65%, $p=0,006$).

Conclusions: Conservative management of degenerative supraspinatus tears based on specific rotator cuff-strengthening program leads to pain relief in the majority of patients. Younger patients, with anterior and larger sagittal tears are at higher risk of requiring surgery.

EP.03.210

TRANEXAMIC ACID FOR ROTATOR CUFF REPAIR: A SYSTEMATIC REVIEW & META-ANALYSIS OF RANDOMIZED CONTROLLED TRIALS

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Background: The purpose of this study was to perform a systematic review of the RCTs in the literature to evaluate the use of TXA on ARCR.

Methods: Two independent reviewers performed the literature search based on the PRISMA guidelines with a third author resolving any discrepancies. Randomized control trials (RCTs) comparing TXA to a control in ARCR were included. Visualization, post-operative pain, operative time, pump pressures and shoulder swelling. A p value < 0.05 was deemed statistically significant.

Results: Six RCTs with 450 patients were included in this review. Overall, 6 studies evaluated intra-operative visualization with 4 studies finding a significant difference in favor of TXA. With TXA patients had a lower average post-operative VAS score of 3.3, and with the control, patients had an average VAS score of 4.1, which was statistically significant ($p = 0.001$). With TXA the average weighted operation time was 79.3 minutes and with the control the average operation time was 88.8 minutes, which was statistically significant ($p = 0.001$). No study found any difference in post-operative pump pressures or swelling.

Conclusions: TXA improved visualization, operative time and subsequent post-operative pain levels in patients undergoing ARCR.

EP.03.211

PREVALENCE OF IMAGING ABNORMALITIES IN ADULT SHOULDERS: THE ROTATOR CUFF

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Background: Imaging of the shoulders is frequently performed to help inform management of individuals with shoulder symptoms. Imaging will often reveal abnormalities, which are often a target of surgical interventions. Imaging abnormalities, however, are also common in persons without symptoms. Reliable estimates of the prevalence of abnormalities in asymptomatic shoulders may help clinicians to interpret the relevance of these findings and minimise over-diagnosis and overtreatment. We performed a systematic review to determine the prevalence of imaging abnormalities in asymptomatic adult shoulders with a secondary aim to compare prevalence between symptomatic and asymptomatic shoulders. This paper reports on the prevalence of abnormalities of the rotator cuff (RC) tendons.

Methods: We conducted database and citation searches (1/12/2020) for studies reporting prevalence of x-ray, ultrasound (US), computed tomography (CT) and magnetic resonance imaging (MRI) abnormalities in asymptomatic adult shoulders. We assessed risk of bias in each study using an existing tool and explored heterogeneity in prevalence estimates with meta-regression.

Results: Of 79 included studies, 25 US and 20 MRI studies reported useable RC abnormalities prevalence data in 6748 and 1045 asymptomatic shoulders respectively. We did not pool study-specific prevalence estimates due to heterogeneity within study populations. On average, full thickness tears were present in 5% and 12% of asymptomatic shoulders of 60-year-olds and 11% and 22% of 75-year-olds on US and MRI respectively. Meta-regression showed the prevalence of abnormalities increased with age and was generally higher with MRI than US. Abnormalities may be more common in symptomatic shoulders but the difference was generally small.

Conclusions: The review findings are limited by high risk of bias across primary studies, few studies in nationally representative samples and large variation in study methodology. RC abnormalities are present in many asymptomatic shoulders. Consequently, abnormalities might be incidental rather than the cause of symptoms in symptomatic individuals. Ways of differentiating between incidental findings and those causing symptoms need to be identified.

EP.03.212

FACTORS INVOLVED IN THE SIZE OF A NON-TRAUMATIC FULL THICKNESS ROTATOR CUFF TEAR: FOCUSING ON SOCIOECONOMIC FACTORS

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Background: This study aimed to identify the risk factors for rotator cuff tearing in patients who had undergone surgical treatment, focusing on socioeconomic factors.

Methods: We conducted a retrospective study on 659 patients who were diagnosed with a full rotator cuff tear and underwent surgical treatment from March 2010 to March 2020. The outcome variable was the tear size indicated by the pre-surgery MRI. We used sex, age, obesity, diabetes, and symptom duration as independent variables. The socioeconomic variables were occupation, education level, insurance type, and residence area. We evaluated the correlation between rotator cuff tear size (mm) and the independent variables via univariate analyses and estimated the effects of the independent factors on tear size after adjusting for confounding variables using multivariate regression analysis.

Results: The mean age of the patients was 63.0 ± 8.0 years, mean symptom duration was 1.7 ± 1.8 years, and mean tear size was 25.4 ± 13.1 mm. We found statistically significant differences in the mean tear size according to age, occupation, residence area, and symptom duration ($p < .05$) in results of multivariate regression analysis. Compared with patients aged 30–49 years, those aged 50–69 and >70 years had significantly larger tearing (8.38 and 9.95 mm, 95% CI: 2.65–14.11 and 3.78–16.13, $p = .004$ and $.002$, respectively). Manual labor group had 2.73 mm (95% CI: 0.89–4.90, $p=0.013$) larger tearing compared with non-manual labor group. Rural residents had 2.12 mm (95% CI: 0.03–4.22, $p = .047$) larger tear size compared with urban residents. As symptom duration increased by 1 year, tear size significantly increased by 0.74 mm (95% CI: 0.16–1.31, $p=.012$). Compared with National Health Insurance patients, the tear size of Medicaid beneficiaries was significantly larger by 6.79 mm (95% CI: 1.33–12.25, $p = .015$).

Conclusions: The age and duration of symptoms significantly affected the size of the rotator cuff tear, as did socioeconomic factors. The larger the rotator cuff tear, the greater the risk of retear and poor shoulder function. Therefore, socioeconomically vulnerable patients may be exposed to a greater risk of complications. Policy efforts to expand access to medical care for vulnerable people are needed.

EP.03.213

THE RELATIONSHIP BETWEEN THE TEAR SIZE AND CUFF TEAR ARTHROPATHY: EVALUATION OF THE CARTILAGE THICKNESS BY MRI

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Background: It is not clarified yet when arthropathy change appears and how it progresses in cuff tear arthropathy (CTA). The purpose of this study was to investigate the relationship between the tear size and the prevalence of early CTA change.

Methods: Twenty-five patients with symptomatic cuff tear (mean age: 67 years) were enrolled in this study. The cartilage thickness was measured in MR images. Nine shoulders (mean age: 54 years) who had no cuff tears in MR images were also assessed as a control group. The humeral and glenoid articular surface in the sagittal, coronal, and axial images was partitioned into 5 portions of equal 30 degrees.

Results: The cartilage thickness measured at the footprint in the coronal image in the small tear group (0.95 ± 0.36 mm) was significantly thicker compared to that in the control group (0.60 ± 0.10 mm). The medium size tear group also showed thicker measured at 30 degrees from the footprint (0.69 ± 0.26 mm) in addition to it. However, there were some points where the cartilage thickness was significantly decreased in the large to massive tear group compared to the small to medium tear group near the top of the humeral head in the coronal and sagittal image.

Conclusions: In the small to medium tear group, the articular cartilage was thicker near the footprint, whereas in the large to massive tear group, the thickness of the cartilage was decreased, which could not be detected in the x-ray image and means early CTA change.

EP.03.214

LONG-TERM RESULTS OF ARTHROSCOPIC REPAIR OF MASSIVE IRREPARABLE ROTATOR CUFF TEARS WITH SYNTHETIC PATCH AND PLATELET-RICH PLASMA

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Background: Background: Treatment of massive irreparable rotator cuff tears (MIRCT) is challenging, with high rates of failure and re-tear. Often, complete repair cannot be achieved due to severe tendon retraction and poor tendon tissue quality. Here, we assessed the results of arthroscopic rotator cuff repair (aRCR) using a synthetic patch for bridging and augmenting MIRCT.

Methods: methods: A retrospective analysis of prospectively collected data between 2013 and 2020. All patients had MIRCT with tear retraction beyond the glenoid margin. All patients underwent arthroscopic MIRCT repair with a synthetic patch and administration of platelet-rich plasma (PRP). Collected data included patient demographics, diagnosis and comorbidities, intra-operative findings and treatment, Constant score, range of motion (ROM), subjective shoulder value (SSV) score, patient satisfaction, video recording of ROM and ultrasound or MRI scan at final follow-up.

Results: Results: 30 patients (mean age, 60 years) were included. Mean follow-up duration was 51 (range, 24 to 89) months. Mean preoperative Constant score of 36.0 increased to 75.0 (± 13.7 SD) ($p < 0.001$) at the last follow-up (Age/sex adjusted to 101 (± 18.8 SD) ($p < 0.001$)), Mean SSV increased from 1.14/10 to 7.9/10. One patient developed an acute infection, which resolved with arthroscopic washout, patch removal and antibiotic treatment. One patient needed removal of a loose anchor, but made a full recovery. Three patients were converted to a reverse total shoulder arthroplasty. Histopathologic examination of retrieved patches showed satisfactory fibroconnective tissue growth within and around the patch. There were no signs of inflammation, foreign reaction or infection. In all remaining cases, imaging results with Ultrasound or MRI scans showed good integrity of the repair with the patch with good thickness of the tissue integrated to the patch.

Conclusions: Conclusions: Treatment of MIRCT using aRCR with synthetic patch and PRP has positive long-term clinical and anatomic outcomes. Synthetic patches can serve as an excellent scaffold for incorporation of fibroconnective tissue growth.

EP.03.215

COMPARISON OF FUNCTIONAL POST-OPERATIVE OUTCOMES IN TRAUMATIC AND NONTRAUMATIC ARTHROSCOPIC ROTATOR CUFF REPAIRS

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Background: Rotator cuff repair (RCR) is one of the most common shoulder surgeries. Traumatic or atraumatic mechanisms of injury result in different pathophysiology, and thus, may lead to different postoperative functional outcomes after arthroscopic RCR.

Methods: Institutional records were used to identify patients who underwent arthroscopic RCR in 2019-2020. Retrospective review of medical records was performed to determine mechanism of injury, pre- and post-operative range of motion (ROM), and strength measures. Single assessment numeric evaluation (SANE) scores were obtained at a minimum of 2-year follow-up. Continuous, ordinal, and categorical variables were analyzed using Wilcoxon Rank-Sum test, ordered logistic regression, and Chi-Squared test, respectively.

Results: Among 100 arthroscopic RCR patients, 53 suffered a traumatic RC injury. Patients with traumatic rotator cuff tears presented to the clinic after onset of pain sooner than patients with atraumatic tears (166 ± 193 vs 595 ± 679 days; $p < 0.001$). Pre-operative ROM and strength measurements were generally significantly worse among traumatic patients than nontraumatic patients: forward elevation ($130^\circ \pm 48^\circ$ vs $152^\circ \pm 25^\circ$; $p = 0.036$), external rotation ($49^\circ \pm 17^\circ$ vs $55^\circ \pm 16^\circ$; $p = 0.076$), internal rotation (L4 vs L3; $p = 0.033$), forward elevation strength (4+/5 vs 5/5; $p = 0.024$), external rotation strength (5/5 vs 5+/5; $p = 0.055$), and internal rotation strength (5/5 vs 5/5; $p = 0.101$). However, there was no significant difference in post-operative ROM and strength measurements between cohorts: forward elevation ($158^\circ \pm 19^\circ$ vs $153^\circ \pm 28^\circ$; $p = 0.433$), external rotation ($53^\circ \pm 16^\circ$ vs $50^\circ \pm 15^\circ$; $p = 0.332$), internal rotation (L2 vs L2; $p = 0.703$), forward elevation strength (5+/5 vs 5+/5; $p = 0.547$), external rotation strength (5+/5 vs 5+/5; $p = 0.893$), and internal rotation strength (5+/5 vs 5+/5; $p = 0.885$). There was no difference in SANE score (78 ± 13 vs 79 ± 11 ; $p = 0.780$).

Conclusions: Traumatic RCR patients had significantly worse functional measurements during pre-operative physical exam than nontraumatic RCR patients, but there was no significant difference in post-operative outcomes.

EP.03.216

THE RELIABILITY OF MRI MEASUREMENTS FOR LARGE AND MASSIVE ROTATOR CUFF TEARS

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Background: Previous literature comparing magnetic resonance imaging (MRI) and intraoperative measurements for large and massive rotator cuff tears (RCTs) is limited and consists of small cohorts. Having reliable and accurate preoperative measurements is crucial in preoperative planning and assessment of reparability and treatment options for these types of rotator cuff tears. The purpose of this study was to establish accuracy of MRI measurements determined by a radiologist and senior surgeon in predicting intraoperative findings for large and massive rotator cuff tears.

Methods: Our analysis included twenty-four large/massive RCT successfully repaired by two fellowship trained shoulder surgeons from 2018-2020. The preoperative MRI measurements in the anterior-posterior (AP) and medial-lateral (ML) planes were measured by a musculoskeletal radiologist, senior attending surgeon, and shoulder fellow. Intraoperative measurements were then taken prior to debridement using a calibrated probe. An interrater reliability analysis was performed.

Results: There was moderate correlation in the AP direction which was statistically similar between the preoperative measurements determined by the radiologist and the intraoperative tear size ($R=0.65$). There was also similar moderate correlation between MRI and intraoperative ML measurements performed by the senior surgeon ($R=0.64$). There was no statistically significant correlation between the preoperative measurements from the fellow and intraoperative measurements in either direction ($R=0.36$ and $R=0.31$). Measurements between the senior surgeon and radiologist were significantly different in both directions.

Conclusions: Our results demonstrated MRI measurements interpreted by the radiologist and senior surgeon had a higher correlation to intraoperative measurements than a fellow's measurements. Experience and specialty training may play a role in accurately measuring large and massive rotator cuff tears and can provide accurate preoperative assessments of size and treatment plans.

EP.03.217

OUTCOMES OF LOWER TRAPEZIUS TENDON TRANSFER WITH ACHILLES TENDON ALLOGRAFT FOR IRREPARABLE POSTEROSUPERIOR ROTATOR CUFF TEARS, EXPERIENCE IN A DEVELOPING COUNTRY

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Background: Pain related to rotator cuff tears is estimated to account 30% to 40% of shoulder joint complains. Among rotator cuff tears, massive tears are a major challenge due to high rates of failure and limited treatment options. Muscle transfers have arise as a useful choice and lower trapezius tendon transference with Achilles tendon allograft is a promising treatment option, given its biomechanical similarity to infraspinatus muscle.

The aim of this study is to report experience and outcomes with lower trapezius tendon transfer for posterosuperior irreparable rotator cuff tears.

Methods: This is a retrospective cohort study performed by a single surgeon between January 2016 and February 2020, with minimum 24 months follow-up. Patients included were diagnosed with irreparable rotator cuff tears that were still symptomatic despite of receiving non-surgical treatment. They underwent lower trapezius tendon transference with Achilles tendon allograft. Outcomes included range of motion, satisfaction, return of work, complications, pre- and postoperative functional scores (American Shoulder and the Elbow Surgeons score and Single Assessment Numeric Evaluation score) and pain was assessed with the Visual Analogue Scale.

Results: A total of 34 patients were included, mean age was 54.8 years (range: 43–63 years) and 55.9% were male. A 61.8% of the participants reported a precedent arthroscopic procedure in the affected shoulder. More than a half of patients (70.6%) were classified as low income and only 2 of all patients received technical or university education. Mean follow-up time was of 37.9 months.

Significant improvement in function and pain ($p < 0.05$) was reported, high rate of satisfaction 82.4% with the procedure was also found. In terms of complications, 5.8% of all patients ended up in shoulder arthroplasty. Additionally, more than the half (58.8%) of patients returned to work after surgery.

Conclusions: This is the first study describing the experience with lower trapezius transfer in a developing country. Promising results in pain relief and shoulder function recovery were found in patients with irreparable posterosuperior rotator cuff tears, even patients with difficult socioeconomic context. However, more studies with larger and longer follow-up periods are needed to reinforce these results.

EP.03.218

CUFF PLUS PROCEDURE FOR THE TREATMENT OF LARGE TO MASSIVE ROTATOR CUFF TEARS

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Background: Biomechanical studies showed that anatomic reconstruction of the superior capsule and rotator cuff improves biomechanical properties in repairing delaminated rotator cuff tears. The aim of our study was to evaluate the clinical outcomes of the cuff plus procedure for the treatment of large to massive rotator cuff tears.

Methods: A retrospective study was conducted. Patients with large to massive rotator cuff tears of the posterosuperior rotator cuff who underwent the cuff plus procedure were included. Exclusion criteria were: shoulder stiffness, cuff-tear arthropathy, glenohumeral osteoarthritis, symptomatic acromioclavicular joint osteoarthritis, previous surgeries to the same shoulder. Indication to the procedure was always confirmed arthroscopically. All patients underwent the same rehabilitation protocol. The long head of the biceps tendon was freed from its groove using an electrocautery device and then mobilized posteriorly. Two #2 high-strength non-absorbable braided sutures were passed through the distal aspect of the intraarticular part of the tendon. The tendon was then released one centimeter distal to the most lateral suture and re-routed over the posterior footprint of the supraspinatus. A standard single row cuff repair, based on tear shape, was then performed by using two double or triple loaded anchors. Sutures were passed through the rotator cuff and through the most lateral part of the biceps stump to obtain a robust construct. Primary outcome was the ASES score. Secondary outcomes were: QuickDASH and WORC score. Six months after surgery a postoperative magnetic resonance imaging was performed to evaluate tendon integrity. A paired t-test was used to compare pre and postoperative outcomes. Significance was set at $p < 0.05$.

Results: The study included 11 males and 4 females. Mean age of patients was 63.3 ± 7.83 years. Mean follow-up was 28.40 ± 5.74 . Comparison between pre- and postoperative functional scores showed significant clinical improvement ($p < 0.001$). Postoperative imaging showed higher rate of tendon integrity compared to the current literature results.

Conclusions: Arthroscopic cuff plus technique for the treatment of large to massive rotator cuff tears provides satisfactory functional and structural outcomes.

EP.03.219

ACCURACY OF CRITICAL SHOULDER ANGLE MEASUREMENT FOR THE DIAGNOSIS OF PRIMARY SUBACROMIAL IMPINGEMENT: COMPARISON BETWEEN CT AND DYNAMIC US

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Background: Background: Subacromial impingement syndrome (SIS) is a common disorder of the shoulder that can lead to disability. Purpose: To compare CT and radiography for measurement of the critical shoulder angle (CSA), to determine whether the CSA is a reliable predictor of a diagnosis of SIS, as confirmed by dynamic US, and to assess how well the acromiohumeral distance (AHD), evaluated on US at rest and during impingement tests, correlates with that diagnosis.

Methods: Materials and Methods: Patients with shoulder pain and no history of trauma were included in this retrospective study. Clinical histories were taken, physical examinations were performed, and true anteroposterior radiographs of the shoulder were obtained. All of the patients underwent CT of the shoulder with three-dimensional reconstruction. The CSA was calculated from the radiographs and from the CT scans. All of the patients also underwent dynamic US of the shoulder, which was the reference standard for the diagnosis of SIS in this study. We looked for correlations between the AHD (measured at rest and during US impingement tests) and subacromial impingement.

Results: Results: Fifty patients (34 women; mean age, 55.4 ± 2.6 years) were included. Among the patients with and without impingement, the mean CSA was 36.01° and 34.83° , respectively, on radiographs, compared with 36.98° and 36.42° , respectively, on CT. The CT-measured CSA cutoff value for the diagnosis of SIS was 36.9° . The AHD at rest was found to be shorter in shoulders with impingement than in those without. The reduction in the AHD during the impingement tests was significant, being greatest during the Jobe test.

Conclusions: Conclusion: The CSA appears to be a more reliable predictor of a diagnosis of SIS when measured by CT than when measured by radiography. Further studies are needed in order to validate the CSA cutoff value proposed.

EP.03.220

LOW STIFFNESS RATES WITH USE OF A BIOINDUCTIVE BOVINE COLLAGEN IMPLANT IN ROTATOR CUFF REPAIR

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Background: Bioinductive bovine collagen implants have been growing in popularity for use in rotator cuff repair surgery over the last several years, but they have been criticized in recent literature as potentially causing stiffness. The purpose of this study was to review our stiffness rates with the use of this implant, with a hypothesis that they were lower than currently published rates.

Methods: We conducted a retrospective review of all cases of rotator cuff repair performed in our practice between September 2014 and October 2022 in which a bioinductive bovine collagen implant was utilized and with minimum 6 weeks of postoperative follow-up. The primary outcome measure was postoperative range of motion, with "significant stiffness" defined as loss of passive range of motion in at least two planes with cutoffs of 120 degrees of forward elevation, 30 degrees of external rotation, and internal rotation to the buttock. The secondary outcome measure was any revision surgery for stiffness.

Results: A total of 372 cases (337 individual patients) were included in our analysis. There were 152 females and 185 males with an average age of 56.5 years (range 30.2-80.0). Average length of follow-up was 15.1 months (range 6 weeks to 7.4 years). There were only 10 cases (2.4%) of significant post-operative stiffness, and only 6 cases (1.6%) requiring additional operative intervention for stiffness (5 arthroscopic lysis of adhesions, 1 manipulation). Of the 10 patients with stiffness, 5 were smokers, 5 were diabetics, and one had thyroid disease. Stiffness rates were 2/264 (0.8%) for full-thickness tears and 8/108 (7.4%) for partial-thickness tears.

Conclusions: Our study found a low incidence of significant post-operative stiffness in cases of rotator cuff repair associated with the use of a bioinductive bovine collagen implant. Very few patients required additional operative intervention for stiffness. A high percentage of patients with stiffness had known systemic risk factors for it. Stiffness rates were markedly higher for repairs of partial-thickness tears. While further study across larger groups is needed, our experience with bioinductive bovine collagen implants has not shown this complication to be a major problem.

EP.03.222

POLYPROPYLENE MESH REINFORCEMENT DOES NOT MAKE A DIFFERENCE IN SUPERIOR CAPSULAR RECONSTRUCTION: A BIOMECHANICAL STUDY

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Background: Superior capsular reconstruction (SCR) is one of the treatment modalities for irreparable rotator cuff tears (RCTs). Reinforcing the fascia lata (FL) graft with polypropylene mesh (PM) is a novel technique in reconstruction. However, the biomechanical characteristics have yet to be investigated. This study aimed to compare the effectiveness of SCR with PM-reinforced FL grafts (PMFL-SCR) to those using only FL grafts (FL-SCR). We hypothesized that reinforcement with PM would improve outcomes.

Methods: Ten fresh-frozen cadaveric ovine shoulders with totally excised supraspinatus tendons underwent SCR either reinforced with PM (PMFL-SCR) or without PM (FL-SCR). The specimens were potted and mounted onto the testing device with the glenohumeral joint at 30 degrees of abduction. The test was conducted with the humeral head moving forward in the superior-inferior direction to determine the cyclic loading characteristics of both PMFL-SCR and FL-SCR by loading from 10 N to 50 N at 0.5 Hertz for 1000 cycles. Following the cyclic loading assessment, load-to-failure characteristics were evaluated at a rate of 20 mm/min. Statistical analysis was conducted using the unpaired t-test with $p < 0.05$.

Results: In dynamic analysis, there was no statistically significant difference in displacement (Cycle 1 PMFL-SCR: 1.83 ± 0.78 mm vs. FL-SCR: 1.48 ± 0.67 mm; $p=0.74$. Cycle 1000 PMFL-SCR: 4.23 ± 2.06 mm vs. FL-SCR: 3.71 ± 1.18 mm; $p=0.83$) and linear stiffness (Cycle 1 PMFL-SCR: 24.36 ± 8.69 N/mm vs. FL-SCR: 32.6 ± 16.83 N/mm; $p=0.68$. Cycle 1000 PMFL-SCR: 70.63 ± 44.06 N/mm vs. FL-SCR: 59.25 ± 22.74 N/mm; $p=0.82$) between PMFL-SCR and FL-SCR. In static analysis, there was no statistically significant difference in ultimate force (PMFL-SCR: 232.65 ± 87.66 N vs. FL-SCR: 198.53 ± 53.93 N; $p=0.75$), ultimate xhead (PMFL-SCR: 17.47 ± 4.85 mm vs. FL-SCR: 13.87 ± 3.59 mm; $p=0.57$), yield load (PMFL-SCR: 137.66 ± 61.27 N vs. FL-SCR: 198.53 ± 53.93 N; $p=0.92$), yield xhead (PMFL-SCR: 6.84 ± 1.22 mm vs. FL-SCR: 6.27 ± 1.75 mm; $p=0.8$), and stiffness (PMFL-SCR: 18.76 ± 8.62 N/mm vs. FL-SCR: 23.77 ± 8.76 N/mm; $p=0.69$).

Conclusions: This study demonstrates that reinforcement with PM does not improve SCR outcomes for irreparable RCTs.

EP.03.223

COMPARISON OF EXTRACORPOREAL SHOCK WAVE THERAPY AND ULTRASOUND GUIDED SHOULDER INJECTION THERAPY TO TREAT PATIENTS WITH SUPRASPINATUS TENDINITIS

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Background: The present study compared the clinical effect of extracorporeal shock wave therapy (ESWT) with that of ultrasound (US)-guided shoulder steroid injection in patients with supraspinatus tendinitis. We hypothesized that the two treatments would show comparable results.

Methods: The inclusion criteria were (1) age over 20 years and (2) diagnosis of supraspinatus tendinitis using US. Ultimately, 26 subjects were assigned using blocked randomization: 13 in the US-guided shoulder injection group and 13 in the ESWT group. Treatment outcomes were evaluated using the pain visual analogue scale (pVAS), the American Shoulder and Elbow Society (ASES) score, and the constant score at baseline and at 1 and 3 months after the procedure.

Results: After 1 month of intervention, pVAS, ASES, and constant score were significantly higher in the US-guided shoulder injection group than in the ESWT group, but not after 3 months. Both groups showed clinically significant treatment effects after 3 months compared to baseline. No significance was shown using equivalence testing.

Conclusions: US-guided shoulder injection is not superior to ESWT therapy. Considering the complications and rebound phenomenon of steroid injection, intervention using ESWT may be a good alternative to treat patients with supraspinatus tendinitis.

EP.03.224

SUBACUTE ONSET ROTATOR CUFF TEAR AFTER ARTHROSCOPIC ACROMIOPLASTY AND SUBACROMIAL BURSECTOMY

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Background: Arthroscopic acromioplasty and subacromial bursectomy (AASB) are performed in the patients of subacromial impingement syndrome (SIS) to prevent progression to rotator cuff tear and gain pain relief. There is no study that have reported subacute onset rotator cuff tear (SORCT) after acromioplasty and subacromial bursectomy. This study aimed to analyze the clinical and radiologic features of patients with SORCT after AASB.

Methods: Data and medical records of 11 patients were retrospectively analyzed. All of the enrolled patients underwent extensive AASB under the diagnosis of SIS from November, 2018 and December, 2021 and were confirmed rotator cuff tear (RCT) on postoperative MRI. None of the patients were confirmed RCT on preoperative MRI and intraoperative arthroscopic finding.

Results: Seven patients were men and four patients were women with a mean age of 59.6 years (range, 30-88). Eight of them (73%) underwent AASB on their dominant side. The mean duration between the day of surgery and MRI follow-up was 17.1 months (range, 3-34). Two patients (18%) showed Bigliani type 3 acromion and nine patients (82%) showed Bigliani type 2 acromion on the preoperative shoulder X-ray. Two patients (18%) had no pain during postoperative follow-up period but another two patients (18%) complained persistent pain after AASB. Mean pain free period of other seven patients was 10.7 months (range 6-30). Postoperative MRI of all patients showed RCT (full thickness tear of supraspinatus tendon; 4, bursal side partial thickness tear of supraspinatus tendon; 6, intratendinous partial thickness tear of supraspinatus tendon; 1). Four patients with full thickness RCT underwent arthroscopic rotator cuff repair and seven patients with partial thickness RCT had conservative care including steroid injection and home stretching exercise.

Conclusions: Although AASB are performed to prevent progression to RCT and gain pain relief in the patients of SIS, surgeons should be aware of the possible development of SORCT after AASB.

EP.03.225

QUANTITATIVE MRI MEASUREMENT OF MUSCLE ATROPHY AND FATTY DEGENERATION AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR

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Background: It is unclear whether muscle atrophy (MA) and fatty degeneration (FD) have improved after arthroscopic rotator cuff repair (ARCR). Therefore, the objective of this study was to perform quantitative magnetic resonance imaging (MRI) measurement to evaluate MA and FD before and after surgery. Correlations of clinical outcome with changes in MA and FD were also analyzed.

Methods: From March 2013 to March 2017, 40 patients who had no re-tear up to 1 year after ARCR were enrolled. MA and FD of supraspinatus muscle before surgery, at 3 days after surgery, and at 1 year after surgery were measured quantitatively in conventional Y-view and supraspinatus origin-view (SOV). Measurement items were muscle area (mm²), occupation ratio (%), fatty infiltration (FI, %), and fatty degenerative area (mm²). Postoperative clinical outcomes were measured at 1 year after ARCR. Correlation between measure values and outcome scores were analyzed.

Results: Inter-measurement reliability was high (ICC = 0.933, Cronbach-alpha = 0.963). There was no significant change in MA in conventional Y-view at 1 year after surgery (Occupation ratio, $p = 0.2770$; MA, $p = 0.3049$) or in SOV (MA, $p = 0.5953$). FI and fat area measured with the conventional method on Y-view and showed significant differences ($p = 0.0001$). However, FI and fat area measured with the modified method on Y-view and SOV showed no significant difference (all $p > 0.05$). Postoperative clinical outcomes showed significant improvement compared to preoperative ones ($p = 0.0001$). However, there was no significant correlation between FD and FA ($p = 0.653$)

Conclusions: Quantitative MRI measurement was shown to be a reliable and valid method. MA and FD do not improve after ARCR considering postoperative anatomical changes of supraspinatus at 1-year follow-up. FD of the supraspinatus in conventional Y-view, but not in SOV, showed a significant change at 1 year postoperatively. MA showed no significant improvement. There was no correlation between improvement in clinical scores and changes in FD and MA.

EP.03.226

L-SHAPED MASSIVE ROTATOR CUFF TEAR IS MORE REPARABLE THAN OTHER SHAPES

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Background: The treatment option for massive rotator cuff tear without osteoarthritis (mRCT) was still debated. Popular treatments are reverse total arthroplasty, superior capsular reconstruction, and partial repair due to less reparability. Therefore, we compared the reparability of different shapes of mRCT, and we hypothesized that the L-shaped tear was more reparable than U or C-shaped tear.

Methods: Among 152 patients who underwent repair and arthroplasty for mRCT between January 2008 and October 2022, 56 met the inclusion criteria. The inclusion criteria were as follows: (1) who underwent arthroscopic cuff repair with or without additional treatment such as patch graft, superior capsular reconstruction(SCR) (2) preoperative MRI . They were divided into L shaped mRCT (Group I, n=39), U or C- shaped mRCT (Group II, n=17). The configuration of rotator cuff tear and reparability were evaluated with preoperative MRI and arthroscopic findings.

Results: The mean age was 62.7(50~77) years. Demographic data was shown no statistical differences between the two groups. However, fatty degeneration of supraspinatus and infraspinatus was significantly worse in group II ($p<0.05$). Nevertheless, the L-shaped tear was easily repaired and showed better clinical results. In subgroup analysis, two patients needed additional treatment in group I; in Group II, further treatment was necessary for nine patients ($p<0.05$).

Conclusions: Reverse total arthroplasty or SCR was very popular for mRCT patients, but L-shaped mRCT could be repaired more easily than the U or C-shaped mRCT. Therefore, a thorough evaluation of preoperative MRI and complete mobilization and proper release to understand tear configuration and extent accurately is an excellent way to reduce unnecessary treatment such as reverse arthroplasty or SCR for mRCT.

EP.03.227

REUSABLE INSTRUMENTATION FOR FOUR-ANCHOR ROTATOR CUFF REPAIR OFFERS DECREASED WASTE DISPOSAL COSTS AND LOW CARBON FOOTPRINT

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Background: Operating rooms produce a disproportionately large amount of waste among hospital departments. Orthopaedic surgery is culpable, in part, for the excessive carbon emissions in healthcare partly due to the utilization of disposable instrumentation in most procedures, such as rotator cuff repair. To address growing concerns of hospital waste, some have considered replacing disposable instrumentation with reusable instrumentation. The purpose of this study was to estimate the cost of waste disposal and the carbon footprint for rotator cuff repair kits that use disposable instrumentation compared to reusable instrumentation.

Methods: The mass of the necessary materials and their packaging to complete a four-anchor rotator cuff repair from four vendors that use disposable instrumentation and one that uses reusable instrumentation were recorded. Utilizing reported values from the literature for medical waste disposal and carbon emissions, a cost analysis and a carbon footprint analysis were performed to estimate the cost of disposal of and carbon footprint produced by 1000 rotator cuff repair kits.

Results: The disposable systems of four commercial medical device companies had 783%, 570%, 1051%, and 478%, respectively, greater mass and medical waste cost when compared to the reusable system. Accounting for practical waste segregation practices, the cost of waste disposal for 1000 procedures with the reusable instrumentation system costs on average \$232 less than the disposable instrumentation systems. The estimated carbon footprint produced from the disposal of 1000 RCR kits which utilize reusable instrumentation was on average 167.66 kg CO₂e less than the disposable instrumentation systems.

Conclusions: According to our projections, reusable instrumentation in four-anchor rotator cuff repair leads to decreased waste disposal, reduced costs, and lower carbon footprint for hospitals. Further research should be performed to assess the net benefit reusable systems may have on hospitals and the effect this may have on long-term decrease in carbon footprint.

EP.03.228

SUPERIOR GLENOHUMERAL JOINT INJECTION; ACCURACY, NEEDLE LENGTH, AND ASSOCIATION WITH BMI

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Background: Glenohumeral joint (GHJ) injection is a common procedure in the orthopedic clinic. Various approaches were documented in the literature to access the GHJ. Ultrasound and radiographs are known tools to guide GH injection. The primary aim of this work is to study the superior approach: 1- examine the minimum needed needle length to access the GHJ and the association with the patient's mass index (BMI), Obesity, Height, and Gender. 2- the accuracy of anatomical landmarks to access the joint.

Methods: fifty-seven shoulder arthroscopic procedures were included. The spinal needle was inserted superiorly (Nevesiar Portal), 5 mm medial to the posterior acromioclavicular joint, and oriented 30° laterally and 20° anteriorly. One-time needle redirection is permitted for each trial. The success and minimal length of the needle was determined by standard posterior portal arthroscopy. Patient demography was collected from the patient's charts.

Results: Data from 57 arthroscopic shoulders was analyzed (49.1% males vs. 50.9 females). The mean age was 57.6 years. 83% of the trials successfully accessed the GH joint, and 17% were documented as failed. In the Joint, the needle was located 77.4% posterior to the biceps tendon, 13.2% anterior to the biceps, and 5.7% in the biceps. The mean of the minimal needle length to access the GHJ through the superior approach was 45 mm (33-58 mm). Needle length was statistical significance associated with the patient's BMI and weight (P-value 0.001, 0.012) but not with height (P-value 0.949). There was no significant association between gender and needle length (P-value 0.573).

Conclusions: A superior approach guided by the anatomical landmarks is a safe and effective injection to access the GH joint. The minimum length needed for a needle to access the joint is 45 mm, which is significantly associated with BMI and weight.

EP.03.229

DO STEROID INJECTIONS AFFECT OUTCOMES FOR ARTHROSCOPIC ROTATOR CUFF REPAIR?

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Background: Rotator cuff pathology is a common problem, affecting approximately 17 million individuals in the US with initial treatment often includes corticosteroid injection. Although corticosteroids are the mainstay of conservative treatment recent studies have shown concerns for increased infections and revision surgeries. This study aimed to determine the effect of prior ipsilateral steroid injection on outcomes following arthroscopic rotator cuff repair.

Methods: A retrospective chart review was performed on 225 patients who underwent rotator cuff repair by a single fellowship-trained orthopedic surgeon from 2017-2019. 42 patients were in the injection group (IG) and 183 in the control group (CG). Demographics, range of motion (ROM), patient-reported pain and satisfaction (0- 10), SSV, complications and reoperations were compared between groups. Delta ROM, strength, and complications were also compared. Statistical analysis included chi-square and student t-tests.

Results: The cohort consisted of 57.4% males with an average age of 58.3 years, BMI of 29.5, and mean follow-up of 7.3 months. The mean time from injection to surgery was 5.6 months. There were no significant differences in demographics between the injection and control group. Preoperatively, the injection group had a significantly greater supraspinatus strength ($p=0.002$), forward elevation ($p=0.003$), abduction ($p=0.005$), and active external rotation ($p<0.001$). This was specific to injections received within the 12 months before surgery. Postoperatively, there were no significant differences between the groups on measures of pain, shoulder function, shoulder strength, range of motion, or SSV. The frequency of complications was also comparable between the control group and injection group, having similar rates of persistent pain, limited ROM or stiffness, numbness or tingling, weakness, cervicalgia, adhesions, retear, and upper extremity DVT, and postoperative infections.

Conclusions: The results of our study indicate that ipsilateral shoulder injection within one year of arthroscopic rotator cuff repair may limit functional outcomes, namely reduce improvement in forward flexion, abduction, and relative strength, postoperatively. Further research is needed in a larger population to determine if there is a frequency or time dependent nature to these findings. It is clear that surgeons need to be thoughtful on initial approach for treatment of rotator cuff tears.

EP.03.230

SUBACROMIAL INJECTION: EFFECT ON PREOPERATIVE PAIN AND FUNCTION IN ARTHROSCOPIC ROTATOR CUFF REPAIR

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Background: Subacromial corticosteroid injections are widely used as conservative treatment to reduce pain and improve function in patients with rotator cuff pathology. However, there is limited liteclinical effect of steroid injections in predicting which patients will ultimately undergo arthroscopic repair (RCR). The purpose of this study was to identify associated factors that impact patient decision to proceed with RCR following steroid injection.

Methods: A retrospective review was performed on 295 patients who underwent RCR by a single fellowship-trained orthopedic surgeon from 2017-2019. Patients were divided into two groups: 85 patients were placed in the injection group (IG) and 203 were placed in the control group (CG). Patients were required to have had at least one steroid injection within one-year prior to surgery for inclusion. Patient demographics, strength, range of motion (ROM), pain scores, and subjective shoulder value (SSV) collected from their preoperative visit were analyzed between groups.

Results: The cohort consisted of 58% males with an average age of 58.1, BMI of 29.8, and a mean time of 2.3 months from injection to preoperative visit. There were no significant differences in demographics aside from a higher proportion of males in the IG (56%) than the NG (50.7%) ($p = 0.04$). Average preoperative ROM was significantly higher in IG for forward flexion (137.6° vs 127.2° , $p = 0.03$) and external rotation (60.8° vs 54.8° , $p < 0.01$). Average supraspinatus strength (4.19 vs 3.99 , $p = 0.01$) and average infraspinatus strength (4.86 v. 4.7 , $p = 0.046$) were also statistically higher in the injection group. There were no significant differences between groups for preoperative pain scores, satisfaction, or SSV.

Conclusions: Patients who receive a subacromial steroid injection prior to arthroscopic rotator cuff repair demonstrated improved range of motion and supraspinatus strength. Despite these results, patients who received a subacromial injection continued to experience pain, decreased satisfaction and decreased SSV scores, likely leading to need for surgical intervention (RCR). This indicates that pain level and subjective shoulder assessments not correlated with function and may be more accurate predictors of whether patients will elect to undergo surgical RCR.

EP.03.231

SUPRASPINATUS TENDON RUPTURES: CORRELATION BETWEEN MRI AND SURGICAL FINDINGS

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Background: In rotator cuff rupture, the supraspinatus tendon ranks first in frequency. MRI is the study of choice for preoperative diagnosis and planning. The objective of this study was to assess the concordance between findings observed with MRI and transoperative in patients with supraspinatus tendon rupture.

Methods: A retrospective analysis was conducted from January 2014 to January 2020. Including patients over the age of 18, with MRI and supraspinatus tendon rupture report. A X2 analysis was performed for sensitivity, specificity, predictive values and diagnostic certainty using surgical findings as a reference. The kappa index was used to show the concordance between MRI and transoperative findings.

Results: A total of 79 patients were included in the study, 45 male and 34 female. The average age was 52.14 years. MRI correctly diagnosed 60.76% of supraspinatus ruptures, showing 74% sensitivity and 96% specificity for complete ruptures. For partial ruptures I show a sensitivity of 96%, a specificity of 33%. The kappa index showed a match of 0.90 for total ruptures and 0.53 for partial.

Conclusions: MRI demonstrated good sensitivity and specificity for diagnosing complete ruptures, with good match to surgical findings. MRI proved to be a nonspecific study for the identification of partial ruptures, which causes these lesions to be overdiagnosed

EP.03.232

SEPTUAGENARIAN MASSIVE CUFF TEAR REPAIRS – A GOOD OPTION WITH A KNOTLESS TRANSOSSEOUS ARTHROSCOPIC TECHNIQUE IN AN ELDERLY PATIENT COHORT

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Background: To improve the potential for rotator repair healing in an older group of patients, a new anchor was recently introduced that emulated the previous true transosseous technique, and with an improved tendon vascularity and fixation in softer elderly bone. This review presents the use of the Arthroscopic Transosseous Knotless (ATOK) anchor to repair rotator cuff tears in a consecutive series of patient older than 70.

Methods: A consecutive series of patient over the age of 70 underwent rotator cuff repair using the ATOK anchor. The lateral margin of the rotator tear was stabilized into a trench in the greater tuberosity using the ATOK anchors. Where the tendon retraction prevented reduction to the greater tuberosity, despite releases, an intercalary facia lata graft was used. Patients remained in a sling for 4 weeks and then progressively mobilized. Outcomes were quantified using the SPARDI scores and complications including conversion to Reverse shoulder arthroplasty and anchor displacement and poor outcome scores was deemed indicative of failure.

Results: 53 patients over the age of 70 (35 of which were over the age of 75) underwent repair. One patient noted a failure of the repair following a fall necessitating conversion to reverse shoulder arthroplasty and one patient required subsequent removal of an intraosseous anchor following a partial greater tuberosity fracture, but still achieved healing of the tear and a satisfactory outcome. 3 patients were deceased, but prior to their demise had achieved a satisfactory improvement in shoulder function. All other patient had either a good or excellent outcome on subjective and objective analysis.

Conclusions: An anchor that emulates the true transosseous repair but using an arthroscopic approach has shown efficacy in the restoration of shoulder function in a group of older patients in whom poor tendon vascularity and softer bone can compromised rotator cuff repair.

EP.03.233

THE USE OF ALL-SUTURE ANCHORS IN ARTHROSCOPIC SHOULDER SURGERY: A REVIEW OF CLINICAL AND RADIOLOGICAL OUTCOMES AND BIOMECHANICAL PROPERTIES

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Background: This study systematically reviews the evidence regarding all-suture anchors (ASA) and their use in shoulder surgery, comparing clinical and radiological outcomes and biomechanical properties with those of standard anchors (SA).

Methods: A literature search identified studies investigating the use of ASA in rotator cuff and labral repair. Clinical and radiological outcomes and biomechanical properties from included articles were combined and summarised systematically.

Results: Eleven clinical and/or radiological studies and 25 biomechanical were included. Clinical outcomes of ASA (range of motion and patient-reported outcome measures) were no different to those achieved with SA for rotator cuff and labral repair. Radiological parameters of ASA, including healing rates and bone reaction, reported no significance difference to those with SA. Biomechanical properties of ASA are not inferior to those of SA. However, some studies suggested ASA may be inferior to SA in decorticated or osteoporotic bone. The pull-out strengths of ASA and SA varied with anchor design, test material and protocol.

Conclusions: The evidence on using ASA for rotator cuff and labral repair suggests that clinical and radiological outcomes are neither inferior nor superior to those of SA. The biomechanical properties of ASA are comparable and adequate for ongoing use in these applications.

EP.03.234

CLINICAL OUTCOMES AFTER ARTHROSCOPIC SUPERIOR CAPSULAR RECONSTRUCTION VERSUS REVERSE SHOULDER ARTHROPLASTY IN IRREPARABLE ROTATOR CUFF TEARS WITHOUT OSTEOARTHRITIS: A RETROSPECTIVE COHORT STUDY

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Background: Arthroscopic superior capsular reconstruction (ASCR) and reverse shoulder arthroplasty (RSA) showed favorable outcomes for irreparable rotator cuff tears (IRCTs), however, there was no previous study comparing postoperative outcomes of ASCR and RSA. This study was to compare clinical outcomes of ASCR and RSA in IRCTs without glenohumeral OA, for patients aged between 65 and 80.

Methods: This retrospective study included patients with IRCTs without glenohumeral OA who underwent ASCR or RSA between March 2013 and December 2020 and followed-up for at least 2 years. Preoperative severity of rotator cuff tear was assessed by preoperative plain radiograph and magnetic resonance imaging. We assessed range of motion (further elevation, external rotation, internal rotation), visual analogue scale (VAS) pain score, American shoulder and elbow surgeons (ASES) score, single numeric assessment evaluation (SANE) score, preoperatively and at the final follow-up.

Results: A total of 64 patients (ASCR, 31 patients; RSA, 33 patients) were analyzed. The mean age was 71.3 ± 4.4 and 72.9 ± 4.1 years old ($P = 0.138$), and mean follow-up was 42.0 ± 21.8 and 37.7 ± 21.7 months ($P = 0.432$) in ASCR and RSA group, respectively. Preoperative patient demographics and severity of rotator cuff were comparable between two groups. Both ASCR and RSA showed significant improvements of all clinical outcomes except internal rotation in RSA group ($P = 0.252$) at the final follow-up. ASCR group showed better internal rotation ($P < 0.001$) and ASES score ($P = 0.020$) than RSA group at the final follow-up, while forward elevation ($P = 0.486$), external rotation ($P = 0.159$), VAS pain score ($P = 0.160$) and SANE score ($P = 0.399$) did not show significant difference.

Conclusions: Both ASCR and RSA showed favorable clinical outcomes at the final follow-up, for IRCTs without glenohumeral OA in age between 65 and 80. ASCR showed better postoperative IR and ASES score than RSA; while, FE, ER, SANE and VAS pain score were comparable between ASCR and RSA.

EP.03.235

TRENDS IN THE USE OF SUPERIOR CAPSULAR RECONSTRUCTION IN THE UNITED STATES USING THE AAOS SHOULDER AND ELBOW REGISTRY

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Background: Superior capsular reconstruction (SCR) has been described as a management option for irreparable rotator cuff tears. The purpose of this study is to report the frequency and demographic patterns for use of SCR in the US using the AAOS Shoulder and Elbow Registry (AAOS-SER).

Methods: All patients treated with a rotator cuff surgery as reported to the rotator cuff module of the AAOS-SER from January 2015 through March 2020 were analyzed. Cases were stratified into superior capsular reconstruction (SCR) versus non-SCR procedures. Bivariate analyses were performed to compare demographic characteristics between the two cohorts. Procedural volumes for each calendar year from 2015 through the first quarter of 2020 were compared to determine the overall frequency of SCR within the entire cohort of rotator cuff procedures.

Results: Of the total cohort of patients reported to the AAOS-SER who underwent rotator cuff surgery (N=7,040), 7.8% (N=547) were treated with an SCR procedure. Demographics are shown in Table 1. Mean age difference was significantly different at 29.3 and 55.0 years of age between the SCR and non-SCR groups, respectively ($p < 0.001$). An overwhelming majority (88.3%) of the SCR cohort was <50 years of age while only 28.9% of the non-SCR cohort was <50. Notably, approximately 64% of the SCR cohort was under the age of 30 at the time of their procedure. When compared to the non-SCR group, SCR was performed significantly more commonly in males and in patients within normal BMI range. While the yearly case volume of SCR procedures did increase slightly from 2015 to the present, the annual percentage of SCR procedures when compared to the overall cohort did not significantly change over that time period.

Conclusions: SCR has gained popularity in the US since 2015, accounting for approximately 8% of all rotator cuff procedures using the AAOS-SER registry data though this trend may have slowed in 2021. This procedure is employed more commonly in younger patients in particular. Future registry data will be essential to follow comparative patient reported outcomes for this procedure and to monitor complications and revision rates of SCR.

EP.03.236

OMALGIAS OF MIDDLE AGE: SUBCLINICAL VERTICAL TRANSLATION OF THE SHOULDER, A NEW RADIOLOGICAL METHOD TO IDENTIFY IT

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Background: We propose that subclinical humeral vertical translation plays a preponderant role in the genesis of shoulder pain, patients with shoulder pain should have a greater translation and therefore a greater decrease in the humerus-acromial space when raising the arm than patients who never had shoulder pain (control group).

Methods: 40 patients (80 shoulders), 20 with unilateral or bilateral shoulder pain and 20 who never had shoulder pain, from two health centers in Uruguay. Ages were between 30 and 60 years old, all subjects were similar in age and sex. Patients with rotator cuff tears, capsulitis, or glenohumeral arthropathy were excluded. Same radiologist, with the same receiving tube distance of one meter and twenty centimeters. Both front shoulders with caudal inclination of 20 degrees. One in the classic resting position of the limb and 20 degrees internal rotation, the other radiography in the impact position with 140 degrees of elevation and internal rotation of twenty degrees. In the DICOM images with the OsiriX program, a line was drawn following the lower edge of the acromion and another line parallel to the previous one that contacts the highest point of the proximal epiphysis of the humerus. The distance between the two lines was measured. It was evaluated by a single radiologist. Shoulder ultrasound was performed in all patients. The Mann-Whitney-Wilcoxon test was used for statistical analysis with Epi Info™ Version 7.2.5 software.

Results: The results showed that there is a statistically significant difference between both groups ($p=0.0045$) with greater excursion in patients with shoulder pain. Mean vertical translation in patients with shoulder pain was 4.13 millimeters, with no significant difference between the symptomatic and asymptomatic shoulder. In asymptomatic patients, the average was 2.95 millimeters. The standard deviation was 1.88 millimeters for the group with shoulder pain and 1.40 millimeter for the control group.

No similar papers were found on this topic, which encourages this investigation.

Conclusions: In patients with shoulder pain, the vertical excursion of the shoulder with 140-degree elevation is greater, in both shoulders, than in the control group.

Will the shoulder need to be stabilized early on?

EP.03.238

SPOON LESION; THINNING AND REDUNDANCY OF THE SUPRASPINATUS TENDON CAUSING SUPERIOR INSTABILITY AND DYNAMIC IMPINGEMENT - A NEW PATHOLOGY DESCRIPTION; DIAGNOSIS AND ARTHROSCOPIC TREATMENT AND RESULTS

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Background: Repeated elevation of the arm more than 80 degrees of abduction produces repeated micro-trauma to the critical hypo-vascular area of the supraspinatus leads to increased fibrous tissue in the tendon and elongation thus the head of the humerus is no longer secured in the inferior glenoid fossa with upward migration of the head by the over pull of the deltoid. Arthroscopic increasing of water filling pressure of the glenohumeral joint Shows ballooning of the tendon giving a spoon-like shape which diminishes with the lowering of the pressure (Spoon phenomena).

To establish a sound strong supraspinatus tendon for superior stability and function a transosseous repair was done. Presentation of the lesion, histological and radiological study as well as arthroscopic reefing will be presented.

Methods: This work was done on 38 patients 8 males and 30 females. 13 patients were below 40 years of age, 23 between 40 and 50 and five above 50y. they were between 26 and 73. All showed ballooning of the tendon on MRI and had a positive intra-arthroscopically spoon phenomena. 21 cases had a previous failed arthroscopic subacromial decompression. The average follow up was 16 months (between 7 and 31). A biopsy was taken from 10 cases showed increased fibrin cells compared to normal tendon.

Resection and with tension transosseous suture refixation using the Giant needle technique was done to all cases. We used the Neer score to evaluate the postoperative results.

Results: The improvement in the score of pain and score of function were dramatically obvious progressing with time at 6w, 3m, 6m and one year. They achieved improvement in the score from unsatisfactory to excellent in 32 cases and satisfactory in three. The postoperative rehabilitation program took 3 to months. In 4 patients the postoperative rehabilitation took 5 to 8 months. The preoperative superior instability impingement pain was diminished in all patients postoperatively.

Conclusions: This study showed the explanation of many cases of impingement like symptoms of the shoulder not responding to treatment although there is no subacromial narrowing nor partial tear. The radiological evaluation, spoon phenomena and the histological findings are clear signs of the lesion.

EP.03.239

IS THERE A ROLL OF ANTERIOR ACROMIOPLASTY IN TREATMENT OF ROTATOR CUFF TEARS OR CHRONIC SUBACROMIAL BURSTITIS? AN ARTHROSCOPIC STUDY FOR STANDARDIZING THE DECISION AND TECHNIQUE

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Background: The aim of this study is to answer the question of whether or not to do a subacromial decompression in cases of rotator cuff tear repair or chronic impingement syndrome and if needed, how much bone should be removed from the anterior acromion.

Methods: The subacromial space is divided into four types based on arthroscopic measuring of the space between the anterior acromion and the rotator cuff (Narrowing Type 3 space: no space (the anterior acromion is in contact with the supraspinatus), Type 2 space: 1-6 mm, Type 1 space: 6-12mm, Type 0: more than 12mm). 289 cases of outlet impingement had an arthroscopic measurement of the subacromial space in a sitting position with the arm hanging (As a standard for measurement).

Results: A direct relation between impingement syndrome pathology and the arthroscopic subacromial space classification was found. No outlet impingement pathology of rotator cuff tear was found with Type 0 space (more than 12mm) and there was a relation between the size of the tear and the narrowing of the subacromial space. This study showed no relation between the shape of the acromion and the presence of the tear, also no relation between the radiological measurement of the subacromial space and the tear.

All the 289 cases with outlet impingement syndrome with or without tear who had subacromial decompression for narrowing (Space less than 12mm) were followed for more than ten years. All cases were satisfied with the surgery and had a normal shoulder function.

Conclusions: according to this study indication for subacromial decompression in cases of rotator cuff tear or chronic bursitis is only to be done when the subacromial space is less than 12 mm. The long time results of cases of anterior acromioplasty done based on this treatment standards have a long term very good results.

EP.03.241

TENDON TRANSFER FOR MASSIVE IRREPARABLE CUFF TEARS; CHANGING CONCEPTS

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Background: Irreparable rotator cuff rupture is defined as the inability to reattach the cuff tendons on the greater tuberosity despite a release of the deep and superficial parts of cuff; it may be associated with persistent pain and functional disability. Several methods have been proposed to restore active elevation of the shoulder after irreparable rupture of the rotator cuff, most of which gave random results such as synthetic implants, deltoid flap, latissimus dorsi transfer, and more recently lower trapezius transfer. The transfer of the latissimus dorsi proposed for the first time in 1988 by Gerber et al. seems to yield better results. The transfer of the latissimus dorsi is a surgical technique useful if the cuff repair is not possible with conventional techniques such that all treatment options are very limited in this situation. The flap helps stabilize the humeral head and then potentiates the action of the deltoid to enhance forward elevation. It also improves external rotation by its posterolateral angle of attack. The transferred latissimus dorsi muscle serves for restoration of external rotation either primarily or in revision procedure for massive and irreparable cuff tears. We aim to represent surgical tips and tricks for performing latissimus transfer for irreparable and neglected massive cuff tears.

Methods: Highlighting surgical tips and tricks for performing successful Latissimus Dorsi transfer for such cases starting from indications, positioning, approach, surgical details based on anatomy and biomechanics, methods of fixation and post operative protocol. More recently, Lower trapezius transfer was used instead depending on biomechanical studies that showed better fiber directions as regards infraspinatus and supraspinatus fibers directions.

Results: At final follow up, most patients showed satisfactory results regarding pain and motion gained, however results are inferior in case of revision surgeries.

Conclusions: The prognostic factors are difficult to identify precisely, but it is necessary to have a competent deltoid and non-arthritis glenohumeral joint to expect a satisfactory. Furthermore, the role of the subscapularis, the fatty degeneration, and the possibility of suturing the stump of the cuff remain controversial. The revision surgery could be a factor of poor prognosis.

EP.03.242

SUBACROMIAL BALLOON SPACER AS AN ADJUNCTIVE ALTERNATIVE TO ARTHROSCOPIC REPAIR OF MASSIVE ROTATOR CUFF TEARS

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Background: The InSpace subacromial balloon is a biodegradable spacer, which is used as a treatment option in massive irreparable rotator cuff tears, it is surgically inserted arthroscopically or mini-open in the subacromial space, expanding the subacromial space, centralizing the humeral cephalic and balancing the forces in the vertical plane, improving pain and joint function.

Objective: To determine the effectiveness of the subacromial balloon spacer as an alternative to arthroscopic repair of massive rotator cuff tears.

Methods: Explanatory research, experimental design, longitudinal cut, prospective. The population consisted of 12 patients with massive repairable and irreparable rotator cuff tears jointly treated with subacromial balloon spacer who met the inclusion criteria: massive repairable and irreparable rotator cuff tears, age >60 years, with or without pseudoparalysis, uninjured subscapularis. or repairable, with retraction of the supraspinatus Patte > III, Hamada I or II, with a Constant Shoulder Score <30 points (poor). The statistical package Statistical Package for Social Sciences v23 was used and tabulated using descriptive statistics and frequency distribution tables.

Results: 83% of the patients were male, with 67% having a massive repairable rotator cuff tear, who underwent single-row arthroscopic repair, while 33% had an irreparable massive tear where a partial repair was performed in 16.5% and 16.5% without repair. A subacromial balloon spacer was placed in all patients. A Constant Shoulder Score of 80 or more points (Excellent) was obtained in 83% of the patients and 17% with a score <30 (poor), of which one patient did not undergo any repair and another one presented avascular necrosis of the humeral cephalic after complete repair and placement of the subacromial balloon spacer. These were treated in the second stage with reverse shoulder arthroplasty.

Conclusions: The subacromial balloon is a surgical alternative that offers good results in massive repairable and irreparable rotator cuff tears, the best results are obtained with partial or complete repair.

EP.03.243

REAL-TIME MONITORING OF SLEEP DISTURBANCE IN PATIENTS WITH PAINFUL ROTATOR CUFF TEAR

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Background: Nocturnal pain is a common distressing symptom in patients with rotator cuff tear (RCT) that has been described to impact their sleep quality. However, most of previous studies have been based on subjective questionnaires that tend to be less specific and may not correctly reflect a real sleep. The aim of this study was to conduct a real-time monitoring of sleep disturbance using a simple portable device and to clarify relationships between the extracted sleep data and nocturnal pain intensity.

Methods: Thirty-two RCT patients (19 men, mean age: 64) who underwent arthroscopic rotator cuff repair, without already-known sleep disorders or taking sleep medications, were included. Nocturnal pain intensity was evaluated using a 100mm visual analog scale (VAS). Patients were hospitalized before the surgery and monitored their sleep status through the night using WatchPAT Unified®, consists of a peripheral blood flow probe (put on finger), position sensor (chest), and recorder (wrist). Number of awakenings, sleep latency, distribution of light/deep sleep, and consistency between awakenings with movements were extracted. Correlations between the sleep data and nocturnal pain VAS were statistically analyzed.

Results: Median [IQR] nocturnal pain VAS was 68 [35-80] mm. Based on the sleep data, number of awakenings was 9 [5-13], sleep latency was 21 [19-26] minutes, and distribution of light/deep sleep was 63 [54-73] / 15 [11-20]%, respectively. Incidence of awakenings associated with movements were 56 [29-77]%, while it was 15 [0-33]% when patients lay down on their affected shoulder. Nocturnal pain VAS significantly correlated with the number of awakenings ($r=0.37$, $P<0.05$), but did not correlate with the other sleep data.

Conclusions: Our real-time monitoring demonstrated that nocturnal pain intensity was associated with mid-awakening, but not with induction or depth of the sleep. Interestingly, movements were not always consistent with the awakenings, suggesting that local biomechanical factors may not work greater than patients thought. This objective and specific approach will provide a better understanding of sleep disturbance in painful RCT patients.

EP.03.244

MANAGEMENT OF SHOULDER STIFFNESS FOLLOWING ROTATOR CUFF REPAIR: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Background: To systematically review and synthesize the literature on treatment modalities for shoulder stiffness following rotator cuff repair and investigate which modality provides the best range of motion (ROM).

Methods: A search was performed on PubMed, Embase®, and Cochrane. Clinical case series and comparative studies that report pre- and post-treatment ROM of shoulder stiffness following RCR were included. Studies that exclusively assess idiopathic frozen shoulder or primary shoulder stiffness were excluded.

Results: Five eligible studies that reported on a total of 177 patients that underwent treatment for shoulder stiffness following RCR were included.

Results: The ranges of postoperative ROM following arthroscopic capsular release were 158°-166° for AFE and 53°-59° for ER. The ranges of postoperative ROM following infiltration were 146°- 163° for AFE and 34°-35° for ER. The postoperative ROM following rehabilitation were 166° for AFE and 62° for ER. For AFE, 4 studies (5 datasets) were eligible for meta- analysis, which indicated better AFE when treated with a mean difference (MD) of 5.10° with no heterogeneity (I²=0%, CI, 0.83 - 9.38). For ER, 3 studies (4 datasets) were eligible for meta-analysis, which indicated better ER without treatment with a MD of 4.59° with no heterogeneity (I²=0%, CI, -7.04 - -2.13).

Conclusions: For the treatment of shoulder stiffness following RCR, all included treatments improved the ROM, resulting in comparable AFE and ER compared to the comparative group. Among the treatment modalities, the ranges of post-treatment AFE were the highest following arthroscopic capsular release, while the highest ER was following rehabilitation.

EP.03.245

PSYCHOLOGICAL BACKGROUND AFFECTS FUNCTIONAL RECOVERY AFTER ROTATOR RING SURGERY

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Background: In the salutogenetic approach, it is assumed that the tendency to recover depends on the amount of resources available to the individual. In the present study, it was hypothesized that the greater the amount of psychological resources, the easier/quicker the recovery after rotator ring surgery.

Methods: The scores of 34 patients 4 months after rotator ring surgery were used for the analysis.

A quantitative study of psychological resources was carried out using seven psychological questionnaires covering the thematic areas of psychology most frequently mentioned in the context of health. These were: Framingham Type A Behaviour Pattern Measure, D-Scale, Perceived Stress Scale, The Multidimensional Health Locus of Control Scale, Generalized Self-Efficacy Scale, The Sense of Coherence Scale (SOC-29) and The Multidimensional Scale of Perceived Social Support. Six of them relate to fixed traits, which do not change much under the influence of the experience of the moment.

The psychological test results were correlated with the most common questionnaires measuring patient recovery after shoulder surgery - Constant Score, UCLA, ASES and WOSI.

Results: 4 of the psychological characteristics have the significant correlations with function: tendency to rivalry (Constant Function $r=-0,35$), comprehensibility (Constant Function $r=0,45$), social inhibition (UCLA Function $r=-0,36$) and sense of efficacy (ASES Function $r=0,36$).

Pain is particularly associated with negative affectivity (UCLA Pain $r=-0,36$ and ASES Pain $r=0,4$) and also with an internal locus of health control (Constant Pain $r=0,34$).

4 months after surgery, recovery as examined with the WOSI has the significant relation with: negative affectivity ($r=-0,41$) and comprehensibility ($r=0,44$).

Conclusions: The study finds evidence supporting the association between psychological resources and postoperative outcomes of patients after rotator ring surgery. Understanding both the effect of emotional and cognitive approach on surgical outcomes and the potential benefits of psychological intervention may represent an opportunity to improve patient outcomes following rotator ring surgery.

EP.03.246

USEFULNESS OF A NOVEL POSTOPERATIVE ORIGINAL T-SHIRT FOR SHOULDER SURGERY

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Background: After shoulder joint surgery, it is quite difficult to wear a normal T-shirt for postoperative a few weeks because shoulder patients can't elevate their shoulders and make them difficult to change clothes by themselves. Postoperative wound observation is also difficult if they wear normal T-shirts. Then we devised a novel postoperative original T-shirt (Osaka Shoulder Team T-shirt: Ostive T-shirt) for shoulder patients to improve inconvenience of a normal T-shirt. Ostive T-shirts have characteristics of combined cuts at upper part, anterior part, lower sleeve and armpit around shoulder joint. The aim of this study was to evaluate the usefulness of a novel Ostive T-shirt in postoperative shoulder patients.

Methods: Thirty-eight patients (65.7 ± 11.7 years) after shoulder surgeries were involved in this study. Patients wore randomly four types of T-shirts as follows Ostive T-shirt, T-shirt A (upper cut), T-shirt B (lower sleeve and armpit cut) and T-shirt C (armpit cut). Four evaluation items: self-clothes change, clothes change by others, self-wound observation and wound observation by others were used in this study; four grade evaluations (0, 1, 2, 3 points) were scored and statistically analyzed.

Results: Ostive T-shirt was the most useful scored in the evaluation items of self-clothes change, self-wound observation and wound observation by others. T-shirt B was the most useful scored in the evaluation item of clothes change by others; followed by Ostive T-shirt. In addition, easy wound observation by others made decreased patients' shame.

Conclusions: Ostive T-shirt has a cut at anterior part of the shoulder, making it easy to change clothes and to observe the wound. This novel original T-shirt was useful to improve inconvenience in postoperative shoulder patients.

EP.03.249

THE GEYSER SIGN ASSOCIATED WITH AC JOINT CYST - A CASE REPORT

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Background: Rotator cuff muscle tear is a common finding among adults and acromioclavicular cyst is a rare secondary manifestation. This case report describes the clinical presentation and workup diagnosis of a patient with acromioclavicular cyst in context of massive rotator cuff tear.

Methods: A 85 -year-old female, right-hand dominant factory worker, presented to the consultation of our institution, with a slowly growing shoulder lump, no history of trauma and exacerbation of chronic shoulder pain. Physical examination revealed a tender ovoid mass, with normal overlying skin, in the superior aspect of the right shoulder . The range of motion of the shoulder was decreased in all axes and slightly painful. Massive rotator cuff tear with muscle atrophy and fatty infiltration, suggesting chronicity, was found on MRI. In addition, synovial fluid was seen erupting through the acromioclavicular joint space into the subcutaneous tissue, leading to fluid collection. The patient was proposed for total arthroplasty but refused all invasive intervention, only wanting removal of the cyst. The high risk of recurrence was explained. At surgery, prior to the incision, a partial ultrasound-guided drainage was performed to reduce tension on the cyst. Then a vertical incision was made over the prominence of the mass, a careful dissection was performed around the entirety of the mass, and subsequent sending for pathological analysis.

Results: After 1 month of surgery, the patient is satisfied, pain free. A longer follow up is needed to estimate the risk of recurrence. AC joint cysts are soft tissue masses that usually signify the underlying rotator cuff pathology. Magnetic resonance imaging is the preferred imaging modality today; we describe the MRI equivalent of the geyser sign, which means synovial fluid escaping through the cuff defect, through the subacromial bursa, and decompressing superiorly through a degenerated AC joint. Surgical management is preferred for symptomatic cysts. Repair of the rotator cuff is preferred whenever possible. Aspiration of these cysts should not be attempted, due to the high recurrence rate and potential for a draining sinus.

Conclusions: We present the case of an 85-year-old woman with a large acromioclavicular joint cyst successfully managed with surgical excision.

EP.03.250

FUNCTIONAL AND STRUCTURAL OUTCOMES AFTER ARTHROSCOPIC REPAIR OF ISOLATED SUBSCAPULARIS TEARS

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Background: The isolated subscapularis tear is relatively uncommon, with a prevalence of less than 5%. To date, studies addressing the isolated subscapularis tear are also limited because of its rarity. We aimed to investigate the functional and structural outcomes after arthroscopic repair of isolated subscapularis tears.

Methods: We retrospectively studied five patients (four males and one female, average age 67.8 years; range, 47–81 years) who underwent arthroscopic repair of isolated subscapularis tear from April 2016 to April 2021.

The average duration of follow-up was 14.6 months (12–24 months). All patients had traumatic onsets. The mean interval between trauma and surgery was 3.4 months (2–6 months). Clinical outcomes, including the Japanese Orthopedic Association (JOA), American Shoulder and Elbow Surgeons (ASES), and Visual Analogue Scale (VAS) for shoulder pain scores were evaluated preoperatively and at the time of the final follow-up. The structural integrity of the repaired subscapularis tendon was assessed by magnetic resonance imaging at 1 year after surgery. Additionally, subscapularis muscle strength was measured in the lift off position by using a digital handheld dynamometer. The Wilcoxon signed rank test was used for the statistical analyses.

Results: Arthroscopic evaluation of the subscapularis tendon showed that the average tear size was 1.5 cm (1–3 cm: four complete tear and one incomplete tear). The long head of the biceps tendon (LHBT) was dislocated in three of five cases, although the dislocation was reduced by repair of subscapularis tendon tears. Therefore, no additional treatment for the LHBT, such as tenodesis or tenotomy was performed in any of the patients. JOA (preoperatively, 70.2 points; postoperatively, 94.0 points, $P=0.04$), ASES (preoperatively, 63.0 points; postoperatively, 91.5 points, $P=0.04$), and VAS scores (preoperatively, 49.6; postoperatively, 7.4, $P=0.04$) were significantly improved after surgery. The structural integrity of all repaired subscapularis tendons was maintained intact postoperatively. There was no postoperative complication. Subscapularis muscle strength was significantly improved after surgery (preoperatively, 0.92N; postoperatively 3.50N, $P=0.04$).

Conclusions: Arthroscopic repair of isolated subscapularis tears achieved favorable functional and structural outcomes, as well as the significant improvement in internal rotation strength.

EP.03.251

THE MODERN USE OF THE EXTENDED HUMERAL HEAD (CUFF TEAR ARTHROPATHY) HEMIARTHROPLASTY

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Background: Today, the treatment of osteoarthritis in the rotator cuff-deficient population is largely dominated by reverse shoulder arthroplasty (RSA). Despite the popularity of and increased familiarity with this procedure, the complication rate of RSA remains significant. An extended humeral head hemiarthroplasty may provide a less invasive alternative for select patients with cuff tear arthropathy (CTA) and preserved glenohumeral active elevation. With the indications for reverse arthroplasty expanding to younger patients, there are concerns about the longevity of this implant, as well as the associated revision burden. In the setting of failed RSA, the bone stock available for glenosphere baseplate fixation can be inadequate for reimplantation.

Methods: The treatment strategies for complex shoulder deformities and failed RSA are limited by patient-specific issues, such as anatomy and risk factors. In this review, we discuss the potential role of extended humeral head hemiarthroplasty (CTA hemiarthroplasty) as a primary surgical option in select patients (1) who have preserved elevation > 90°, (2) who have maintained stability (intact coracoacromial ligament), and (3) who desire to circumvent the complications associated with RSA.

Results: Despite the increased utilization of the RSA, there is a surgical option for the use of the CTA hemiarthroplasty in select clinical presentations. This prosthesis may provide patients with improved comfort and function while avoiding many of the complications associated with RSA.

Conclusions: CTA hemiarthroplasty may be used for severe glenoid erosion, for a fragmented acromion, and in the revision setting for failed RSA aimed at a reliable salvage procedure. There is sparse literature regarding the use of the CTA prosthesis in this setting, and high-quality, prospective, comparative studies will be helpful for future guidance.

EP.03.254

THE CRITICAL SHOULDER ANGLE IN A MIDDLE EASTERN COHORT: IS THERE AN ASSOCIATION WITH ROTATOR CUFF TEAR?

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Background: The critical shoulder angle (CSA) has been used as a tool for identifying patients with a high risk of developing a rotator cuff tear (RCT). A CSA angle larger than 35 degrees has been shown to be associated with an increased risk of RCT. The aim of this study was to determine if this concept is applicable to a Middle Eastern cohort of patients.

Methods: This retrospective observational study included 44 patients who underwent rotator cuff repair between 2016 and 2021 in KFUH was compared to 45 patients with normal shoulders. The CSA was measured by two independent observers on anterior-posterior radiographs. The collected data was analyzed. P-values of < 0.05 were considered statistically significant.

Results: The mean \pm standard deviation (SD) CSA measured on pre-operative radiographs was significantly higher in patients with RCT ($36.66^\circ \pm 4.62^\circ$) compared to patients with normal shoulder ($31.97^\circ \pm 3.37^\circ$), P-value < 0.033.

Conclusions: Our current study confirms that the association of high CSA with the risk of rotator cuff tears is applicable in a cohort of Middle Eastern patients, as the CSA was higher in patients who underwent RCT repair when compared to patients with normal shoulders.

EP.03.255

ISOLATED FULL-THICKNESS SUPRASPINATUS TEAR WITH INTACT GLENOHUMERAL CAPSULE: CASE REPORT

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Background: Supraspinatus tendon is the most affected in rotator cuff traumatic lesions. Cadaveric studies and improvement of magnetic resonance imaging showed that, since 10th week of gestation, supraspinatus tendon consists of two different layers: the bursal layer, composed of tendon bundles with decreasing muscular component toward the insertion, and the articular layer, that is a complex of tendon, ligament, and joint capsule without transitional areas. The two layers also have different biomechanical properties: bursal layer is more resistant to tensile load because it elongates more than articular layer, which elongates poorly and torn easily. Full thickness supraspinatus tendon tears are usually associate to glenohumeral capsule rupture and we found no cases of isolated traumatic full-thickness supraspinatus tears in literature.

Methods: A 67-year-old manual working male patient diagnosed of traumatic full-thickness supraspinatus tear underwent arthroscopic tendon repair: diagnostic arthroscopy showed that glenohumeral capsule was intact while supraspinatus tendon was fully teared, retracted to glenoid. To achieve a triple-row supraspinatus repair, four bio-resorbable anchors were used. Two 5.5 Mitek Healix Advance™ BR DS anchors were positioned as the medial row and passed through the intact glenohumeral capsule, one 4.5 Mitek Healix Advance™ BR DS anchor was placed as the middle row, and one 5.5 Mitek Healix Advance™ Knotless anchor was placed in the greater tuberosity as the lateral row, with the medial-row sutures passing through the anchor. A side-to-side suture, involving supraspinatus posterior rim and infraspinatus anterior rim, was carried out.

Results: At 6 months follow-up patient's SSV was 85%. Physical examination revealed 150° of forward flexion, 140° of abduction, 45° of ER and IR was to D12, with excellent muscular strength. MRI revealed a healed supraspinatus insertion, type-II according to Sugaya classification.

Conclusions: Due to the anatomy and biomechanics of the supraspinatus tendon and glenohumeral capsule, the rupture of the former would lead to the rupture of the latter, therefore cases of isolated full-thickness supraspinatus tear with intact glenohumeral capsule are rare. Triple-row arthroscopic repair reduces gliding movements, simplifies anatomical reduction and implements contact pressure between supraspinatus tendon, glenohumeral capsule and supraspinatus footprint. We achieved an excellent clinical and radiological result with the triple-row repair.

EP.03.256

STIFFNESS AFTER ROTATOR CUFF REPAIR AND QUALITY OF POSTOPERATIVE FOLLOW-UP USING THE LIOTARD PROTOCOL

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Background: Stiffness after rotator cuff repair (RCR) is a common complication (10%). Inappropriate management can have harmful consequences for the operated shoulder. The main objective was to evaluate the consequences of pre-operative stiffness and the quality of post-operative follow-up using the Liotard protocol.

Methods: We conducted a single-center, retrospective study between January 2010 and January 2011. 372 patients were followed up pre- and post-RCR, and 362 were included. All patients were rehabilitated pre-operatively using the Liotard self-education protocol. They were then operated by one of the four surgeons in our centre and then reeducated using the same protocol in different center.

Results: Preoperative stiffness significantly increased the risk of developing stiffness at 1 month. The same was true at 6 months. The center did not significantly influence the stiffness except at 1 month where there was more stiff during physiotherapy. On the other hand, the stay in a specialised center gave better results when it was followed by self-rehabilitation at home rather than ambulatory physiotherapy ($p < 0.05$). The same was true for non-specialised center. In addition, there was a significantly lower mean duration of rehabilitation needed in the specialised center.

Conclusions: Overall, there is merit in recovering postoperative range of motion quickly. Pre and post-operative management using our self-help protocol allows for a rapid return to activity.

EP.03.257

FACTORS AFFECTING THE ONSET AND PROGRESSION OF ROTATOR CUFF TEARS IN THE GENERAL POPULATION

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Background: While previous studies have revealed factors affecting the progression of rotator cuff tear (RCT), none have yet described factors affecting its onset. The purpose of this longitudinal observational study was to analyze factors affecting the RCT onset and progression in the general population.

Methods: The present study included 185 shoulders from 93 participants who completed all the examinations in both 2012 and 2017. Participants received a questionnaire with age, gender, arm dominance, and presence of pain at rest, in motion, and at night. The range of motion (ROM), simple shoulder test (SST) were also examined. Anteroposterior radiograph of the shoulder joint was performed to evaluate the degree of osteoarthritic changes by the Samilson-Prieto (S-P) classification. The degree of RCT was examined by ultrasonography.

Results: There were 132 shoulders without RCT and 53 with RCT in 2012. RCT occurred in 21 of 132 shoulders, and the factor affecting the RCT onset was S-P grade 2 osteoarthritic change in 2012 (odds ratio [OR] 10.10). RCT progressed in 22 of 53 shoulders, and the factor affecting RCT progression was the presence of motion pain in 2012 (OR 13.76).

Conclusions: These results added new knowledge regarding the natural course of RCT onset and progression.

EP.03.258

THE VALIDITY OF ULTRASOUND AND SHEAR WAVE ELASTOGRAPHY TO ASSESS THE QUALITY OF THE ROTATOR CUFF

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Background: US in combination with shear wave elastography (SWE) could substantially reduce the burden and costs of the diagnostic process for patients with rotator cuff disorders. However, the validity of US and SWE compared to the current golden standard MRI for the assessment of muscle atrophy and FI has not yet been substantiated. The aim of this study is to investigate the validity of US and SWE in preoperative assessment of fatty infiltration (FI) and muscle atrophy of the supraspinatus (SSP) and infraspinatus (ISP) muscle.

Methods: Patients with a rotator cuff tear and a recent shoulder CT or MRI scan were eligible to participate. Goutallier and Warner stage of the SSP and ISP muscle were measured on CT and MRI, for assessment of FI and muscle atrophy, respectively. These findings were compared with shear wave velocities (SWVs) assessed on US. Visual assessment of FI on US was compared with Goutallier stage. To quantify the amount of muscle atrophy, the occupation ratio between SSP fossa and muscle was measured on MRI and US.

Results: Seventy-eight shoulders were included in the analysis. There was a poor correlation between the SWVs and scan results ($r=-0.116-0.07$). The correlation found between occupation ratio on US and Warner and Goutallier stage on MRI ranged between $r=-0.550-0.589$. The Goutallier stage of ISP and SSP muscle assessed on US showed a fair correlation with Goutallier stage, $r=0.574$ and $r=0.582$ respectively.

Conclusions: SWE is not a valid method to measure the amount of FI or muscle atrophy in the SSP muscle. Therefore, SWE is not a suitable alternative for MRI in standard preoperative diagnostics in rotator cuff pathologies.

EP.03.259

CLOSED JOINT MANIPULATION FOR THE CONTRACTURE AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR: A REPORT OF TWO CASES

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Background: Joint contracture is one of the complications after arthroscopic rotator cuff repair, which is difficult to manage and may require additional treatment. We reported two cases of the joint contracture after arthroscopic rotator cuff repair treated by the closed joint manipulation under the ultrasound-guided brachial plexus block.

Methods: 46-year-old female and 57-year-old male were included in this case series. Both the tear sizes were small and the male patient had a medical history of diabetes. After the arthroscopic rotator cuff repair, the abduction pillow was used for six weeks. MRI showed no re-rupture of the rotator cuff at six months postoperatively, however, the range of motion(ROM) of the shoulder joint was restricted and the motion pain remained. Furthermore, the ROM was restricted, flexion 90°, abduction 90°, external rotation 30° in the female patient, and flexion 120°, abduction 120° and external rotation 30° in the male patient. Then, the closed joint manipulation was performed under the brachial plexus block and simultaneously, steroid was injected into the glenohumeral joint under the ultrasound guidance. The ROM exercises were started from the next day.

Results: The ROM was improved gradually. At 6 months after the closed manipulation, both patients showed the improvement of the ROM from flexion 90°, abduction 90°, external rotation 30° to flexion 170°, abduction 170°, external rotation 70° in the female patient and from flexion 120°, abduction 120°, external rotation 30° to flexion 140°, abduction 140°, external rotation 70° in the male patient. Also, the motion pain was ceased and the ROM was maintained even after more than one year. There was no complication after the closed joint manipulation confirmed by MRI with no sign of rotator cuff re-tears.

Conclusions: Closed joint manipulation under the brachial plexus block was a useful method to treat the joint contracture after arthroscopic rotator cuff repair. If the ultrasound-guided brachial plexus block was chosen instead of general anesthesia, hospitalization is not required leading to reduce medical costs.

EP.03.261

SURGICAL TECHNIQUE FOR SUPERIOR CAPSULE RECONSTRUCTION WITH 6-MM ACELLULAR DERMAL ALLOGRAFT AND KNOTLESS GLENOID ANCHORS

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Background: Superior capsule reconstruction (SCR) creates a humeral head depressor in the setting of a massive, irreparable rotator cuff tear. Recently, a 6-mm-thick acellular dermal allograft (ACD) has been shown to be noninferior to the standard fascia lata autograft in recreating native shoulder biomechanics. This paper outlines a reproducible means by which to perform an arthroscopic SCR using a 6-mm ACD.

Methods: A standard diagnostic arthroscopy first assesses the integrity of the subscapularis and infraspinatus tendons. The glenoid anchors are then placed. Accessory anterior and posterolateral portals are made as well as a lateral portal by which to shuttle the graft. Suture management is paramount. Ideally allograft preparation occurs on the back table simultaneously to maintain efficiency. Suture passage through premade holes in the graft, and when the sutures have passed through and been tensioned, the graft is shuttled into place and tied down with medial and lateral row anchors in SpeedBridge fashion.

Results: The thickness of ACD has been shown to influence the ability of the reconstructed superior capsule to perform its role as a humeral head depressor.

Conclusions: This technique describes the use of a 6-mm-thick ACD to perform an arthroscopic SCR that minimizes both donor-site morbidity and operative time.

EP.04.001

SHOULDER STRETCHING VERSUS SHOULDER MUSCLE STRENGTH TRAINING FOR THE PREVENTION OF SHOULDER AND ELBOW INJURIES AMONG HIGH SCHOOL BASEBALL PITCHERS: A RANDOMIZED, ACTIVE-CONTROLLED, OPEN-LABEL, NON-INF

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Background: Glenohumeral internal rotation deficit (GIRD) and weakness in prone external rotation are risk factors for shoulder and elbow injuries in high school baseball pitchers. While a shoulder-stretching prevention program to improve GIRD decreases the injury rate, the effects of external rotation strength remain unclear.

Methods: This non-inferiority (NI) study investigates the hypothesis that external rotation strength training is not inferior to sleeper stretching for shoulder and elbow injury prevention in high school baseball pitchers. Participants were randomly allocated to the stretching (n=62; active control group) and muscle-training (n=51) groups. Specific exercises were performed each night. Elbow and shoulder injuries were monitored for 150 days. Kaplan–Meier survival curves were generated, and the hazard ratios (HRs) for injury occurrence were calculated using multivariate Cox regression. The log-rank test was used to compare the injury-free time. A one-sided NI test using a fixed NI margin was performed (significance level, P=0.025).

Results: The injury rates were 22.6% (n=14) in the stretching group and 9.8% (n=5) in the muscle-training group. The muscle-training group had a lower injury rate (P<0.001) and a lower risk of injury than the stretching group (HR=0.489).

Conclusions: Therefore, external rotation muscle strength training is not inferior to stretching for preventing baseball-related arm injuries.

EP.04.002

INTERRATER RELIABILITY AND ACCURACY AMONG ORTHOPEDIC SURGEONS IN VISUAL ESTIMATION OF SHOULDER RANGE OF MOTION

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Background: The popularity of telehealth technologies in the Orthopedic clinical setting has recently increased, spurred on by the initial challenges of the COVID-19 pandemic. Remote, video assessment is commonly used in this setting to evaluate a patient's function and range of motion (ROM). Variation in surgeon estimations of shoulder range of motion in the telehealth setting has yet to be evaluated. Additionally, the accuracy of estimations obtained via telehealth has not been validated against the gold standard goniometer-based measurement of shoulder ROM. The purpose of our study is to investigate interrater variation in assessments of shoulder range of motion in the telehealth setting with validation against goniometer-based measurements.

Methods: Video recordings were obtained for ten healthy subjects completing a set of shoulder maneuvers: forward flexion (FF), external rotation at 90° abduction (ER90), internal rotation at 90° abduction (IR90), external rotation at side (ER0), and internal rotation maximal spinal level reached (IRspine). Target shoulder ROM ranges were randomly assigned to each of the ten subjects to mimic shoulder ROM in pathologic settings. The recordings were then reviewed by 32 independent Orthopedic surgeons. The ROM estimations obtained from their review was used to calculate the intraclass correlation coefficients (ICC) to determine interrater reliability. Accuracy of the surgeon estimations was determined by comparison to goniometer-based measurements.

Results: Interrater reliability was excellent for ER90 (ICC=0.901) and good for FF (ICC=0.896), IR90 (ICC=0.781), ER0 (ICC=0.841), and IRspine (ICC=0.897). Surgeon examiners had substantial agreement with the gold standard goniometer measurements with average ICC values for FF, ER90, and IR90 of 0.947, 0.921, and 0.749.

Conclusions: This study establishes interrater reliability for shoulder ROM estimations obtained from a video modality. Interrater reliability was good to excellent among an expert examiner group of board-certified Orthopedic surgeons. There is good to excellent agreement with a goniometer-based gold standard for measurement of shoulder ROM. A telehealth-based assessment is a reliable and accurate method for shoulder ROM measurement in healthy and symptomatic patients.

EP.04.003

RELATIONSHIP BETWEEN UPPER LIMB INJURIES AND HIP RANGE OF MOTION IN ELEMENTARY AND JUNIOR HIGH SCHOOL BASEBALL PLAYERS

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Background: Shoulder and elbow injuries are major problems in baseball players. Tightness of the upper extremities has been reported as a risk factor for shoulder and elbow injuries in elementary and junior high school baseball players. However, few studies have been conducted on the relationship between decreased hip range of motion (ROM) and shoulder and elbow injuries. This study aimed to prospectively examine the relationship between hip ROM and throwing-related shoulder and elbow injuries in elementary and junior high school baseball players. The hypothesis was that players with unrestricted ROM in the hip would have a reduced risk of upper extremity injuries.

Methods: The study included 263 baseball players (mean \pm SD age, 10.5 ± 1.3 years; range, 7-14 years). The following physical parameters were assessed: (1) hip flexion ROM measured in the supine position and (2) hip internal and external rotation in the prone position. After the season, players completed questionnaires regarding shoulder and/or elbow injuries. For comparison, the players were classified as injured (not able to play for > 8 days because of shoulder and/or elbow problems) or noninjured.

Results: During the season, 52 players had shoulder and/or elbow injuries. When the injured and noninjured groups were compared, hip flexion on the dominant side ($121.5^\circ \pm 12.0^\circ$ vs $126.7^\circ \pm 9.8^\circ$, respectively; $P < .01$), hip flexion on the nondominant side ($119.6^\circ \pm 11.7^\circ$ vs $126.0^\circ \pm 9.9^\circ$, respectively; $P < .01$), and internal rotation on the dominant side ($52.5^\circ \pm 11.3^\circ$ vs $56.8^\circ \pm 10.8^\circ$, respectively; $P = .01$) were significantly reduced in the injured group.

Conclusions: We identified preseason decreases in flexion bilaterally and internal rotation on the dominant side as risk factors for shoulder and elbow injuries in elementary and junior high school baseball players. Further studies are required to prevent disabilities in elementary and junior high school baseball players through development of prevention and intervention programs.

EP.04.005

THE SURFER'S SHOULDER: A SYSTEMATIC REVIEW OF CURRENT LITERATURE AND POTENTIAL PATHOPHYSIOLOGICAL EXPLANATIONS OF CHRONIC SHOULDER COMPLAINTS IN WAVE SURFERS

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Background: Wave surfing is increasingly popular as a sport. Chronic shoulder complaints are frequently reported amongst surfers, though literature researching its pathophysiology and prevention is scarce. This poster provides an overview of the current literature, proposes a potential pathogenesis and a potential physiotherapeutic prevention program for surf-induced shoulder complaints.

Methods: A systematic review was performed considering the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for articles regarding kinematic analysis of the surf paddling movement. Data sources were Embase, MEDLINE (PubMed) and Research gate. We included case series and cohort studies that originally studied or described the paddle movement made by wave surfers, studies that reported on kinesiological analysis with nerve conduction studies and studies on 3D motion analysis of the shoulder while paddling.

Results: Eight original articles were included that analysed the shoulder movement in paddling surfers. Muscles that are active during paddling are mainly internal rotators and muscles that are involved in shoulder flexion. Internal rotators are active in propelling the surfer through the water, though external rotator strength is only used while the arm is out of the water. In surfers with shoulder complaints, external rotation range of motion and external rotation strength are impaired. Scapulothoracic dyskinesia may occur and subacromial pain syndrome may coincide. The surfer's shoulder is characterised by external rotation deficit, as opposed to internal rotation deficit in the thrower's shoulder, and it differs substantially from shoulder complaints in swimmers. Therefore, a specific prevention or rehabilitation protocol for surfers is required. Decreased thoracic extension may thereby alter the risk of scapular dyskinesia and hence increase the risk of impingement around the shoulder joint. A potential physiotherapeutic prevention programme should address all these aspects, with the main goal being to increase external rotator strength and to stretch the internal rotators.

Conclusions: There is a high incidence of chronic surf-induced shoulder complaints in surfers. Symptoms may arise due to imbalanced training or scapular dyskinesia, which may subsequently trigger subacromial pain. Physiotherapeutic prevention should include stretching of the internal rotators, external rotator training and optimisation of thoracic extension and scapulothoracic movement.

EP.04.006

THE CLINICAL OUTCOME OF A MODIFIED CORACOID TUNNEL-FREE CORACOCLAVICULAR SLING TECHNIQUE WITH REMNANT PRESERVATION FOR THE TREATMENT OF HIGH-GRADE ACROMIOCLAVICULAR JOINT SEPARATION

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Background: High-grade Acromioclavicular (AC) Joint Separation (Rockwood type IV to V) injuries are surgically indicated because of complete disruption of the AC and coracoclavicular (CC) ligaments leading to instability and pain. In surgical techniques that require suspensory system, the coracoid tunnel-related complications are not uncommon.

Methods: From January 2014 to January 2017, patients who underwent modified CC sling technique using the AC Tightrope System in a coracoid tunnel-free fashion that performed by one senior surgeon were prospectively enrolled. The CC distance (CCD), Rockwood AC joint classification was evaluated on trauma series X-rays preoperatively, immediate postoperatively and at the final follow-up. The Visual Analog Score (VAS) pain score, range of motion, American Shoulder and Elbow Surgeons (ASES) score, Constant-Murley score, and University of California at Los Angeles (UCLA) score were recorded preoperatively and at the final follow-up.

Results: Forty-eight of 54 patients (88.9%) were included for the evaluation with a mean follow-up 39.3 ± 8.9 months (range, 24.7-64.3 months). The CCD was significantly decreased from 22.7 ± 4.2 mm to 9.8 ± 2.3 mm ($p < 0.01$) immediately after surgery to 11.2 ± 1.8 mm ($p < 0.01$) at final follow-up. At the final follow-up, the side-to-side difference of CCD was 0.58 ± 1.40 mm. Comparing with the preoperative level, all subjective evaluations were significantly improved at the final follow-up. Four patients (4/48, 8.3%) were observed with a loss of reduction at the final follow-up, but no pain or instability was documented. And no coracoid-related complication or other complications were recorded.

Conclusions: The coracoid tunnel-free CC sling technique using the AC Tightrope system combined with CC ligament remnant preservation demonstrated significant improvement regarding both clinical and radiological outcomes, with a reduction loss rate of 8.3%. It is a safe method that could achieve satisfactory result without any coracoid drilling related complications.

EP.04.007

ARTHROSCOPICALLY ASSISTED CORACOCLAVICULAR LIGAMENT RECONSTRUCTION USING A HYBRID-GRAFT CONSIST OF SYNTHETIC TAPE MATERIAL AND AUTOLOGOUS PALMARIS LONGUS TENDON

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Background: A synthetic tape material and cortical button fixation has been commonly used for the treatment of acromioclavicular joint dislocation. However, using only the synthetic material remains concerns as it has no biological healing potential even though it has sufficient tensile strength. We considered that it may be optimal to use hybrid graft consist of synthetic tape material covered with autologous palmaris longus tendon. The aim of this study was to demonstrate the clinical outcomes of our procedure using the hybrid graft.

Methods: In total, 14 patients who underwent arthroscopically assisted coracoclavicular ligament reconstruction using hybrid graft for acute Rockwood 3 to 5 with minimum 12 months follow-up were included. Two suture tapes were passed through a button, and the tape for conoid ligament side was covered with autologous palmaris longus tendon. One bone tunnel was created in the coracoid process and two in the clavicle, and the grafts were passed through the bone tunnels to reconstruct conoid and trapezoid ligaments. The graft was fixed on the clavicle using two buttons. Additionally, the acromioclavicular ligament and deltotrapezial fascia were repaired or reconstructed. The postoperative shoulder range of motion, American Shoulder and Elbow Surgeons score and pre- and postoperative coracoclavicular distance were evaluated.

Results: The postoperative range of motion, American Shoulder and Elbow Surgeons score, and coracoclavicular distance (17.5 ± 3.2 mm vs. 10.7 ± 3.5 mm, $P < .001$) were significantly improved compared to those preoperatively. Although the average coracoclavicular distance was increased by 12 ± 29 % compared with the unaffected side, no reduction loss was observed in coracoclavicular distance.

Conclusions: Arthroscopically assisted coracoclavicular ligament reconstruction using hybrid-graft demonstrated sufficient joint stability and clinical outcomes. It may be an alternative treatment for acute acromioclavicular joint dislocation with respect to the initial strength and long-term stability.

EP.04.008

MORPHOLOGICAL CHANGES OF THE POSTEROSUPERIOR GLENOID ON ULTRASONOGRAPHY IN ADOLESCENT BASEBALL PLAYERS

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Background: Repetitive throwing applies significant stresses across the posterior glenoid, and adaptive changes that occur in skeletally immature athletes may differ from those in adults. The purpose of this study is to evaluate the ultrasonographic change of the posterosuperior glenoid (PSG) and its clinical characteristics in adolescent baseball players.

Methods: We analyzed 132 consecutive adolescent baseball players (mean age; 13.4 years, mean playing career; 3.2 years) who underwent bilateral sonographic comparison of PSG. Fifty-four players complained about shoulder pain and 79 players displayed posterior tightness of the dominant shoulder. With nondominant shoulder as a control, the bony PSG of dominant shoulder were scanned on horizontal axis view with a linear-array transducer, and physical and demographic factors related with PSG abnormalities were evaluated. All players were divided into groups based on distinctive sonographic abnormalities of the PSG: normal, beak, slope, and round types. In the slope type, the PSG slope angle relative to the glenoid articular surface was measured to verify the relationship between the degree of the slope and related variables including demographics.

Results: Of the 132 players, 123 (93.2%) demonstrated abnormal PSG changes compared to the nondominant shoulder: beak type, 28.8% (38 players); slope type, 50.0% (66 players); and round type, 14.4% (19 players). Significant differences in mean age and length of playing career were identified among the different types: players with the beak type, slope type, and round type were a mean of 12.1, 13.8, and 15.6 years old ($P = 0.002$) and had a mean playing career length of 2.0, 3.5, and 5.4 years ($P = 0.004$), respectively. The mean slope angle of the slope type was 42.7° , and this angle was associated with the length of playing career ($P = 0.029$). Player position ($P = 0.583$), the presence of dominant shoulder pain ($P = 0.739$), and posterior shoulder tightness ($P = 0.203$) were not significantly associated with the type of PSG and slope angle.

Conclusions: Morphological changes of the PSG in the dominant shoulder occur very frequently in adolescent baseball players. Age and length of playing career were significantly associated with this physiologic remodeling process of the premature PSG.

EP.04.009

OSTEOCHONDRITIS DISSECANS OF GLENOID IN ADOLESCENT BASEBALL PLAYERS: COMPUTED TOMOGRAPHY QUANTITATIVE ANALYSIS AND RECOVERY AFTER NONOPERATIVE TREATMENT

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Background: The purpose of this study is to evaluate the characteristics of the osteochondritis dissecans of the glenoid(G-OCD) on computed tomography (CT) scan and the recovery of the lesion after nonoperative rehabilitation.

Methods: We retrospectively analyzed 16 adolescent baseball players (mean age 15.2 years) diagnosed with symptomatic G-OCD. All patients exhibited posterior shoulder tightness and demographic characteristics were compared with 60 players without G-OCD as control. The size (anterior-posterior width and superior-inferior length) and depth of the lesion were measured from axial and coronal CT images. In the 3-dimensional glenoid en face image, the relative proportion of OCD lesions to the total glenoid articular surface and locational differences among the patients were investigated. Nonoperative treatment included refraining from throwing and kinetic chain rehabilitation for a duration lasting 3 to 6 months according to the size of the lesions. Fourteen patients were followed for mean 16 months, and the recovery of the lesions were evaluated on CT.

Results: The average size of the G-OCD lesions was 12.2 mm in width, and 14.9 mm in length, and 3.4 mm in depth, respectively. The mean area of the lesion on the en face view was 176.4 mm² and the proportion was 18.6% of total glenoid area. The location of the lesion was at the same level of the most convex portion of the mid-posterior glenoid and the slopping of posterior glenoid rim, was minimal in all patients. Only one patient showed fragmentation of the lesion. There were no significant demographic differences except for BMI ($p=0.034$), compared to the control players without G-OCD. Twelve patients (85%) returned to throwing at an average of 6 months after rehabilitation and mean recovery rate of the lesion area on CT en face view was 52.5% in 6 months after initial diagnosis.

Conclusions: G-OCD is a different type of internal impingement-induced posterior glenoid lesion in adolescent baseball players. It occurs mainly at the mid-posterior glenoid in overweight players with posterior shoulder tightness and fragmentation of the lesion is rare unlike OCD in other joint. Adaptational change of the posterior glenoid rim is minimal and G-OCD can be successfully treated with nonoperative rehabilitation.

EP.04.010

CHANGES IN PITCHING PERFORMANCE AND PHYSICAL FINDINGS DUE TO FATIGUE

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Background: Baseball pitching motion is performed by the whole kinetic chain, and throwing injuries induced by the repetitive this kinetic chain of pitching. The change of pitching motion due to fatigue is largely unknown, although the pitching motion must change with fatigue. The purpose of this study is to examine how pitching performance and physical findings change with repeated pitching.

Methods: Twenty male baseball players were included this study (height, 171 ± 3 cm; weight, 72 ± 9 kg). Average age was 23.1 years (20-32 years). 18 players were right-handed pitchers, and two were left-handed. We measured pitching performance and physical changes before and after pitching cycles.

Pitching performance was evaluated by performing 6 cycles of 15 pitches followed by a 10-minute rest. We assessed active range of motions of shoulder before and after pitching performance. In addition, we measured ball speed, release point height, RPM, and strike rate using Rapsodo Pitching. We compared the pitching performance between 1st and last cycles.

Results: Active shoulder flexion on throwing side after pitching performance was significantly decreased than that before performance ($p=0.02$), although no significant difference was confirmed in abduction, external rotation, and internal rotation. On the non-throwing side, flexion and abduction were significantly decreased. ($p = 0.04$ and 0.02 , respectively). In the pitching performance, ball speed was significantly decreased in last innings ($p=0.03$). However, there was no significant difference between 1st and last innings in release point height, RPM, and strike rate.

Conclusions: The poor performance and injuries in athletes are thought to be strongly related to decrease muscle strength and joint control due to fatigue. In the change of pitching performance of this study, there was a significant decrease in ball speed, however, no significant decrease in RPM, release point and ball control. On the other hand, active flexion angle was significantly decreased in both shoulders. Therefore, our findings suggest that the active flexion angle of the shoulder joint was more sensitive than the pitching form in the evaluation of fatigue associated with pitching motion.

EP.04.012

BIOMECHANICAL CHARACTERIZATION OF ISOLATED ACROMIOCLAVICULAR JOINT STABILITY

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Background: The purpose of this study was to biomechanically evaluate the isolated AC joint, specifically the contribution of its superior-posterior (SP) and anterior-inferior (AI) ligamentous structures, and the influence of flat or curved morphology translational and rotational stability.

Methods: Sixteen cadaveric shoulders (mean age=67.3±4.4years) were tested on custom shoulder testing system. The Scapula was potted in a metal box and mounted on x-y translator while the clavicle was fixed to the arc at two positions, 0° and 10° clavicle elevation. The scapula and clavicle were dissected while preserving the AC joint, coracoclavicular (CC) ligament, coracoacromial (CA) ligament, and AC ligament. The anatomic neutral positions were digitized using a Microscribe 3DLX, and the CA and CC ligaments were transected afterwards to evaluate the biomechanical and anatomic characteristics of the isolated AC joint. Specimens were tested at 0° and 10° clavicle elevation to simulate glenohumeral abduction for two comparisons: Intact vs SP Tear (n=8), and Intact vs AI Tear (n=8). Clavicle translation and rotation were measured with 5N loading and 0.16Nm of clavicle rotational torque at 5N compression load. Tested specimens were then disarticulated to quantify the AC joint morphology and ligament insertion characteristics.

Results: The joint morphology was characterized as "Flat" or "Curved". Flat joint morphology (n=10) showed higher percent change in all AP and SI translation and Clavicle rotation after either ligamentous tear than curved joint (n=6) morphology. SP tear significantly increased anterior-posterior (AP) and superior-inferior (SI) translation at 10° clavicle elevation ($p = 0.001$ & $p = 0.034$) compared to the intact condition. AP rotation significantly increased with SP tear at 0° and 10° clavicle elevation compared to intact ($p = 0.006$ & 0.001). AI tear did not significantly increase translation or rotation from intact, regardless of clavicle elevation. Clavicle AC ligament insertion area was bigger than acromion AC ligament insertion area.

Conclusions: The Joint morphology of AC joint is as important as, if not greater than, the type of ligamentous tear in isolated AC joint's translational and rotational stability. Furthermore, clavicle side of AC joint's ligament insertion area is bigger than acromion side of AC joint ligament insertion area.

EP.04.013

PROXIMAL BICEPS TENODESIS - BIOMECHANICAL ANALYSIS IN OVINE, COMPARISON BETWEEN METALLIC ANCHOR, BIOABSORBIBLE ONLYAY KNOTLESS ANCHOR AND INTERFERENCE SCREW

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Background: This study aims to biomechanically evaluate different fixation devices for the proximal biceps in the humerus of sheep, comparing their fixation strength to failure, tendon displacement and failure site in each technique.

Methods: Twenty seven humerus tests were performed on sheep, separating them into 3 groups: group A with tenodesis with metallic anchors (n=11), group B with biocomposite knotless devices (n=8) and group C with metallic interference screws (n=8), performing tenodesis with the sheep's own biceps, maintaining its native distal insertion. The 3 methods were submitted to a universal tensile testing machine.

Results: There was no statistically significant difference in the strength of fixation until failure and displacement between the tendons fixed by the different techniques. Regarding the pattern of ruptures, it was observed that most ruptures of the metallic anchors occurred at the level of the myotendinous junction, most of the bioabsorbable knotless anchors failed due to slippage of the wire-screw interface and all interference screws failed via tendon slip.

Conclusions: The three techniques with metal anchor, onlay bioabsorbable knotless anchors and interference screws are largely resistant to tensile loads for Long Head of the Biceps Tenodesis in SheEP. There was no statistical difference summarizing between the three groups. Cyclic load resistance studies can provide more valuable data for comparing groups.

EP.04.014

ARE THE ATHLETES READY TO RETURN TO PLAY AFTER SIX MONTHS FROM SHOULDER STABILIZATION SURGERY

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Background: Although athletes are mostly allowed to return to play after six months from the shoulder stabilization surgery, there is insufficient data about their functional status during this period. The aim this study was to evaluate the functional status of the shoulder after six months from shoulder stabilization surgery.

Methods: Thirty-eight male athletes with arthroscopic anterior capsulolabral repair (AACR) were included to the study (age: 25.4 ± 5.1 years, height: 179.3 ± 8 cm, weight: 78.8 ± 11.6 kg). Shoulder internal and external rotator (IR-ER) strength was assessed using isokinetic dynamometer at $60^\circ/s$ and $180^\circ/s$ angular velocities preoperatively and six months postoperatively. Shoulder function was assessed with Closed Kinetic Chain Upper Extremity Stability Test (CKCUEST), Y-Balance Test-Upper Quarter (YBT-UQ), and Unilateral Seated Shot-Put Test (USSPT) at six months postoperatively. Western Ontario shoulder instability index (WOSI) was also used for the self-assessment of the shoulder function. Limb symmetry index (LSI) was calculated for the IR-ER strength, YBT-UQ, and USSPT scores.

Results: Shoulder IR strength was higher at six months postoperatively compared with preoperatively. The LSI was 77.6% and 78.3% for the ER strength, and 94.6% and 95% for the IR strength at $60^\circ/s$ and $180^\circ/s$ angular velocities respectively, at the postoperative six months. The mean CKCUEST score was 22.2 ± 2.5 touches and the LSI were 94.2% for the YBT-UQ and 102.7% for the USSPT. WOSI ($P < 0.001$) score was significantly lower at six months postoperatively than preoperatively.

Conclusions: Shoulder muscle strength and functional capacity improved considerably six months after the stabilization surgery yet they were not fully recovered. Athletes performing low-risk sports may return to play but athletes performing collision, contact and overhead sports should not return to play.

EP.04.015

HIDDEN PITCHES IN MAJOR LEAGUE BASEBALL: WHAT ARE THE INJURY IMPLICATIONS OF THESE OFTEN OVERLOOKED PITCHES

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Background: Pitch counts are tightly monitored in Major League Baseball (MLB). Hidden pitches, including warm-up pitches before/in-between innings and when relievers are getting warm, are not as closely monitored. The purpose of this study was to report the number of hidden pitches thrown per game and over the course of a season for a single organization, and determine if hidden pitches correlate with injury risk. The hypothesized that players who throw more pitches when getting warm and in-between innings will be at increased risk of injury compared to pitchers who throw fewer hidden pitches.

Methods: All pitchers who played for a single professional baseball organization in 2021 were included. All pitches (hidden and game pitches) thrown during the course of all games for a single MLB organization over the 2021 season were recorded. Injuries to these pitchers were also recorded.

Results: Overall, 137 pitchers were included, 66 (48%) of whom sustained an injury and were placed on the IL during the 2021 season (average time on IL: 53.6 +/- 45.6 days). Of the 66 players who sustained an injury, 18 (27.3%) sustained an elbow injury while 12 (18.2%) sustained a shoulder injury. Of the elbow injuries, only 1 player sustained an ulnar collateral ligament (UCL) tear. When comparing hidden pitches, in game pitches, and total number of pitches between pitchers who sustained an injury and those who did not, there were no significant differences between groups ($p=0.150$, $p=0.830$, $p=0.377$ respectively). On average, hidden pitches made up 45.4% of the total number of pitches thrown during the course of the season. When evaluating the number of hidden pitches as a percentage of the total number of pitches thrown in a season, there was no significant difference between pitchers who sustained an injury and those who did not ($p=0.654$)

Conclusions: Professional baseball pitchers who throw more hidden pitches during the course of the season do not have an increased risk of injury compared to players who throw less hidden pitches. Larger scale studies are needed to confirm the results of this single team study.

EP.04.016

DIAGNOSIS AND TREATMENT OF THORACIC OUTLET SYNDROME FOR SPORTS ATHLETES WITH SHOULDER AND ELBOW PAIN

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Background: Thoracic Outlet Syndrome (TOS) is most commonly seen in sports involving repeated movements at elevated positions. TOS should be suspected if a player complains of upper extremity numbness, weakness, or decreased grip strength during or after competition. However, TOS is difficult to diagnose, refractory to conservative treatment, potentially fatal with surgery, and also difficult to differentially diagnose. In recent years, we have established diagnosis by ultrasound, and 3DCT and angiography are used as supplementary diagnosis to improve the diagnostic rate. In addition, in surgical treatment, we devised a combined use of an endoscope, making it possible to perform the first rib resection and scalene muscle resection more safely and accurately.

In this presentation, we report the diagnosis of TOS, surgical treatment methods, and its outcomes.

Methods: The subjects were 308 sports patients who underwent surgery at our hospital from 2014 to 2020 and were able to be followed up for at least 2 year after the operation. The average age at the time of surgery was 18.7 years old, and there were many sports such as baseball, volleyball, tennis, badminton, and swimming. Patients who resisted conservative treatment for more than 3 months were indicated for surgery. Using an endoscope, the anterior scalene muscle and middle scalene muscle were cut, and the first rib was excised as much as possible.

Results: The postoperative results were excellent in 204 (65.4%) in sports, 76 (24.4%) in good, 26 (8.3%) in fair, and 6 (1.9%) in poor. About 90% were excellent or good.

Conclusions: Ultrasound can measure the degree of neurovascular stenosis at the triangular outlet of the scalenus muscle, making it possible to make objective evaluations in diagnosis. In addition, the merits of endoscopic-assisted first rib resection are that adhesions around the nerve can be treated delicately, scalene muscles attached to the pleura can be cut, nerve entrapment caused by abnormal fiber bundles can be released, etc. Furthermore, in endoscopic surgery, the surgical method is easy for a third party to understand, which will greatly contribute to the handing down of surgical techniques in the future.

EP.04.017

UPPER LIMB INJURIES IN FEMALE VERSUS MALE AUSTRALIAN FOOTBALLERS: A PROSPECTIVE STUDY OF EMERGENCY DEPARTMENT PRESENTATIONS

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Background: Australian Football (AF) is a popular Australian sport with more than 1.7million players nationally. Females now represent one-third of participants. Despite this, the injury profiles of females versus males is largely unknown. The current study investigated upper limb injuries including fractures, sprains, dislocations and tendon ruptures in females versus males presenting to emergency departments (ED) with an AF injury.

Methods: All patients, regardless of age, presenting to one of 10 EDs in Victoria, Australia with an AF injury were included. Data were prospectively collected over a 10-month period, coinciding with a complete AF season. Data were extracted from patient medical records regarding injury-type, -part injured and treatments required. Data for females versus males were compared with chi-squared tests.

Results: Of the 1635 patients presenting with an AF injury, 784 (48.0%) had an upper limb injury, of whom 126 (16.1%) were female, 451 (57.5%) were children, and the average age was 19.2 (SD 8.1). Overall, upper limb injuries were more than twice as prevalent as lower limb injuries (n=368, 22.5%). Fracture was the most common upper limb diagnosis (n=342, 43.6% of patients had a fracture), followed by joint sprain (n=324, 41.3%), dislocation (n=100, 12.8%), lacerations/contusion (37, 4.7%) and finger tendon rupture (n=8, 1.0%). No differences were found between genders for diagnosis ($p>0.05$). Regarding fractures, upper limb fractures were six times more common than lower limb fractures (71.1% v 11.5% of fractures). Fingers were the most common region injured (42.1% of upper limb injuries), usually due to contact with the ball (38.1%), person (23.7%) or ground (20.8%). Females were more likely to injure fingers than males, and it was more likely to be via contact with a ball ($p<0.05$). Most injuries (96.4%) were managed in the ED, with the remainder being admitted, usually for fracture management (GAMP/ORIF).

Conclusions: Upper limb injuries due to Australian Football are common presentations to EDs in Australia, though few require specialist orthopaedic intervention. Injury profiles differed between genders, particularly for finger injuries, suggesting that gender specific injury prevention might enhance the effectiveness of injury prevention programs.

EP.04.018

FREQUENCY OF ISOLATED ROTATOR CUFF TEARS OR THOSE ASSOCIATED WITH SHOULDER INSTABILITY: AN EPIDEMIOLOGICAL STUDY IN ADOLESCENT RUGBY PLAYERS

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Background: Shoulder instability accounts for the majority of surgical cases in adolescent competitive rugby players, while the frequency of isolated rotator cuff tears or those associated with shoulder instability is not well known. This study aimed to investigate the frequency of rotator cuff tears or those associated with shoulder instability in adolescent competitive rugby players who underwent surgical treatment for intraarticular shoulder disorders.

Methods: A total of 423 shoulders of 374 rugby players underwent surgical treatment for intraarticular shoulder disorders between January 2010 and December 2022 were retrospectively investigated. Twenty-four shoulders of revision cases were excluded thus 399 shoulders (mean age 18.2±3.4 years) were finally analyzed by medical record including intraoperative findings. The primary disorders (anterior instability, posterior instability, labral tear, capsular tear, and rotator cuff tear) were tabulated and the frequency of surgical repair for rotator cuff tear was calculated. In addition, based on arthroscopic findings, the frequency of concomitant rotator cuff tears (partial or complete tears) and surgical intervention of them during surgery for shoulder instability were also calculated.

Results: The primary disorder for surgery was anterior instability in 360 (90.2%), posterior instability in 13 (3.3%), anteroposterior instability in 9 (2.3%), labral tear in 8 (2.0%), capsular tear in 3 (0.8%), and rotator cuff tear in 6 (1.5%) shoulders. Of the 393 shoulders with shoulder instability, 26 (6.6%) had concomitant rotator cuff tears, and 6 (1.5%) underwent surgical intervention (two SSP repairs, one SSP+ISP repair, one SSC repair, one SSP debridement, and one SSC debridement) during surgery for shoulder instability.

Conclusions: Surgeons should be noted that rotator cuff tears may occur as an intraarticular shoulder disorder in competitive rugby players, and some cases are associated with shoulder instability and require surgical intervention during surgery for instability.

EP.04.019

RETURNING TO GOLF AFTER ROTATOR CUFF REPAIR

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Background: The prevalence of rotator cuff repair is increasing; however, no study has assessed patients who have returned to golf activity after arthroscopic rotator cuff repair.

Methods: The subjects of the survey were 633 patients who were at least two years postoperative after rotator cuff repair from January 2005 to December 2017. From August 2019 to October 2019, survey responses were collected via an on-line questionnaire or phone calls and a total of 197 patients were reviewed retrospectively to study about returning to golf after rotator cuff repair. The detailed survey included 12 questions specific to the patient's golf career, performance, time of return to play, and symptoms related to golf activity. Depending on the size of the rotator cuff tear, each question was statistically analyzed to determine whether there were differences in the time of return to golf, uncomfortable symptoms when golfing, and distance of the driving.

Results: Of the 197 patients who underwent arthroscopic rotator cuff repair, there were 145 patients (73.6%) returned to golf. In 145 patients, the longer golf career, greater the chance of returning to golf. Sixty (30.5%) people returned to golf at 1 year after surgery. 21 patients (10.7%) improved and 46 patients (23.4%) maintained their driving distance, whereas 78 patients (39.6%) had a worse driving distance after surgery. Ten patients (5.1%) improved and 97 patients (49.2%) maintained their golf score, but 38 patients (19.3%) had worse golf scores after surgery. Men were 6.9 times more likely to return to golf than women ([OR], 6.9). The younger age and shorter the time since surgery, the higher the golfing return rate. The rate of returning to golf was high in the group of patients with good tissue quality during surgery ([OR], 3.9)

Conclusions: The golfing return rate after arthroscopic rotator cuff repair was higher than expected (73.6%) and most players returned at 1 year after surgery. Especially, in the case of young males, their golf scores were maintained or improved and they were able to return to golf earlier after surgery. Better tissue quality in the intraoperative torn tendon was associated with a greater chance of returning to golf.

EP.04.021

ARTHROSCOPIC SUPRASCAPULAR NERVE RELEASE FOR ATYPICAL SCAPULAR DYSKINESIS

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Background: The purpose of this study was to find out whether the SSN entrapment can cause scapular dyskinesis and to assess whether it resolves with arthroscopic suprascapular nerve release

Methods: A total of 15 cases of atypical scapular dyskinesis were included in the study after ruling out all other causes for scapular dyskinesis. Three patients had massive rotator cuff tear, 5 with anterior instability and 1 with multi-directional instability along with scapular dyskinesis. All patients presented with a typical sharp tenderness at the infraspinatus fossa with or without infraspinatus atrophy. All patients had an arthroscopic SSN release with average follow-up of 27 months.

Results: Scapular dyskinesis was visually seen to improve and was completely resolved with significant improvements in the overall shoulder function and pain in 80% (12/15) of the patients. Average time taken for scapular dyskinesis to resolve was 5 weeks (3 -12 weeks). The visual analogue scale (VAS) score decreased from 3.79 (± 2.12) to 0.86 (± 1.10) ($p < 0.0001$). The Range of motion (in degrees) of forward flexion improved from 105.33 (± 34.61) to 148.67 (± 35.02), abduction from 88.33 (± 30.92) to 108.67 (± 30.67), internal rotation from 42.00 (± 19.71) to 59.33 (± 19.35) and external rotation from 45.67 (± 18.79) to 59.00 (± 17.44), which were statistically significant ($p < 0.05$). Motor power (in Kilogram-Force) tested for forward flexion increased from 8.14 (± 4.39) to 14.05 (± 7.43), abduction from 7.15 (± 5.67) to 14.30 (± 8.54), internal rotation from 10.40 (± 5.03) to 17.50 (± 6.06) and external rotation from 8.40 (± 4.14) to 14.53 (± 4.92), all of which had statistical significance ($p < 0.05$). The pain component of the University of California of Los Angeles (UCLA) shoulder score improved from 4.00 (± 1.69) to 7.60 (± 2.56) with $p < 0.0004$ and functional component of the UCLA score also showed a significant improvement from 4.60 (± 1.99) to 7.80 (± 1.70) with $p < 0.0001$

Conclusions: Arthroscopic suprascapular nerve release for atypical scapular dyskinesis with sharp tenderness over infraspinatus fossa, irrespective of EMG proven SSN entrapment or atrophy of the infraspinatus, resulted in improvement in pain, motion, and function. For carefully selected patients, arthroscopic SSN release for atypical scapular dyskinesis can be expected to yield good results

EP.04.022

ANKLE DORSIFLEXION DEFICIT IN THE BACK LEG IS A RISK FACTOR FOR SHOULDER AND ELBOW INJURIES IN YOUNG BASEBALL PLAYERS

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Background: The relationship between ankle joint function and throwing-related injuries has not been demonstrated. We hypothesized that limited ankle joint range of motion (ROM) was related to risk factors for shoulder and elbow injuries in young baseball players.

Methods: This 12-month prospective cohort study evaluated the age, height, weight, playing position, shoulder, elbow, and ankle function of 228 enrolled baseball players. Shoulder and elbow injuries were tracked during the season. Univariate and multivariate analyses were performed to identify risk factors for shoulder and elbow injuries among participants divided into non-injured and injured groups.

Results: Results: Univariate analysis showed that age, height, weight, ROM of elbow flexion in the dominant arm, muscle strength ratio of shoulder abduction, and the likelihood of being a pitcher or a catcher were significantly greater in the injured group than in the non-injured group. ROM of shoulder abduction-external/internal rotation, shoulder total arc on the dominant arm, ankle joint dorsiflexion, and plantar flexion on the back (non-lead) and front (lead) legs were significantly less in the injured group than in the non-injured group.

Conclusions: ROM dorsiflexion deficits in the back leg, shoulder abduction-external rotation in the dominant arm, ROM increase in elbow flexion on the dominant side, older age, and being a pitcher were significant independent risk factors for injury.

EP.04.023

AN ANALYSIS OF PRE-SEASON RISK FACTORS FOR LOW BACK INJURY IN HIGH-SCHOOL BASEBALL PITCHERS: A PROSPECTIVE STUDY

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Background: Pitching motion requires whole- coordination; therefore, poor control of the lower extremities, pelvis and trunk may cause shoulder and elbow injuries. However, few studies have described the relationship between the shoulder joint function and low back injury in high-school baseball pitchers.

Methods: A total of 128 healthy high school pitchers underwent pre-season medical checkups, where their shoulder range of motion and shoulder strength were measured. The participants completed a self-recorded daily questionnaire regarding the presence of low back pain.

Results: Pitchers were divided into injured and non-injured groups. Low back injury was observed in 13 participants (13.4%). In the injured group, horizontal adduction on the dominant shoulder was significantly less than in the non-injured group. A logistic regression analysis showed that horizontal adduction on the dominant side was a significant independent risk factor for low back injury during the season.

Conclusions: It is important to recognize that restriction of the shoulder function not only causes shoulder and elbow injuries but can also risk low back injury.

EP.04.024

ACROMIOCLAVICULAR JOINT DISLOCATION: RETROSPECTIVE STUDY OF NONOPERATIVE AND SURGICAL TREATMENT IN 38 PATIENTS WITH GRADE III OR HIGHER INJURIES AND A MINIMUM FOLLOW-UP OF 1 YEAR

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Background: Acromioclavicular (AC) joint dislocation is a common shoulder injury. When the injury is graded as type III or higher in the Rockwood classification, surgical treatment can be proposed. However, an increasing number of practitioners are shifting back to conservative treatment as it is associated with fewer complications and seemingly close functional outcomes. The aim of our study was to evaluate the functional recovery of operated and non-operated patients with grade III or higher AC joint injuries. Secondly, the reliability and relevance of the Rockwood classification was evaluated within and between raters.

Methods: We did a retrospective two-center study of 38 patients treated between 2014 and 2020. The clinical evaluation involved various functional outcome scores (Constant, QuickDASH, ASES, UCLA, SSV, STT) and a pain assessment (VAS). Return to sports and to work was also documented. The radiological evaluation consisted of Zanca AP and lateral axillary views immediately after the injury and at each radiographic follow-up visit until the final visit. An intra- and inter-rater analysis was also done for the Rockwood classification.

Results: There was no significant difference in the functional scores (Constant score surgery group = 91, nonoperative group = 83; $p = 0.09$) or the pain on VAS at the final assessment. Return to work and to sports was significantly faster in patients treated nonoperatively. No complications were found in the non-operated patients, while nine of the operated patients suffered a complication. The inter-rater reliability of the Rockwood classification was found to be poor ($\kappa = 0.08$) to fair ($\kappa = 0.35$), while the intra-rater reliability was moderate ($\kappa = 0.6$) to good ($\kappa = 0.63$).

Conclusions: No matter which treatment is used, the functional outcomes and patient satisfaction level a minimum of 1 year after the injury appear to be identical. Thus, surgery should be only for patients whose AC joint is painful 7 days after the injury ($VAS > 7$) and whose function has not improved. For young and athletic patients, it is important to remember that the time to return to work and sports is longer with surgical management, and to take into consideration the potential postoperative complications.

EP.04.026

ISOMETRIC EVALUATION OF THE VOLLEYBALL PLAYER IN GAME POSITION: BALANCE BETWEEN EXTRA- AND INTRA-ROTATORS AND BETWEEN SCAPULAR STABILIZERS

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Background: The volleyball player's shoulder requires a fine balance of strength of the intra- and extra-rotator muscles and the periscapular musculature. There is little data in the literature regarding the volleyball player's baseline values, and no study evaluates athletes in a position similar to attack and wall defense.

We tested players from junior categories in positions as to recreate the movements of the game to define the ideal value.

Methods: Each player was divided into 3 categories according to whether he had never missed a practice or game due to shoulder pain, had missed at least one practice or game in the past due to shoulder pain, or could not practice or play at the time of evaluation due to shoulder pain. We tested the players (50, males, age 14-19 y) in a sitting position, with the arm abducted and extrarotated at 75° and the elbow at 90° of flexion. In this position, the players performed 3 extra and 3 intra maximal isometric rotations against resistance from an operator. Force values were obtained using a dynamometer (Activeforce2[®]) and the average value was saved. The extra/intra rotator ratio was then calculated for each player. In quadrupedal position, the scapular retraction test was also performed at 90 (T) and 130 (Y) degrees of humeral abduction using the same method as described above. The ratio of the force measured in the two positions was then calculated.

Results: Among players who never had shoulder pain, the average value of extra/intra rotator ratio was 0.7, and the Y/T ratio was 0.9. Those who had had or had shoulder problems deviated from these values by at least 20%.

Conclusions: Our assessment method allows to study the volleyball player in a position similar to the playing position. We obtained the reference values of extra/intra and Y/T ratios. Most of the players with shoulder problems deviate by at least 20%. The tests performed are easily reproducible, on-field applicable and provide references for prevention and rehabilitation of the volleyball player's shoulder.

EP.04.028

DOES OVERHAND THROWING MOTION CONTRIBUTE TO CHANGES STIFFNESS AROUND SHOULDER MUSCLES MEASURED BY ULTRASOUND SHEAR WAVE ELASTOGRAPHY IN COLLEGE BASEBALL PLAYERS?

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Background: The purpose of this study was to investigate changes of stiffness and muscle strength of shoulder after pitching in college baseball players using shear wave elastography (SWE) with ultrasound.

Methods: Twelve college baseball players were participated. They threw 20 times at 18 m, and SWE value, muscle strength and pitching motion analysis were measured at pre-throwing and post-throwing. SWE values of the supraspinatus, infraspinatus, subscapularis, and teres minor tendons, supraspinatus, infraspinatus, teres minor, lower trapezius, latissimus dorsi, and pectoralis minor muscles, and posterior, and posteroinferior capsules were measured using Aixplorer (Supersonic Imagine). Muscle strength was measured using Dynamometer IsoForceControl EVO2 (Herkules Kunststoff AG). For motion analysis, elbow varus torque, angle of the forearm relative to the ground at ball release, maximal rotational velocity of the forearm, and maximal external rotation of the throwing arm relative to the ground were measured using motus (oneside world).

Muscle strength and SWE were compared between pre-throwing and post-throwing, and correlation coefficients were calculated for the pitching motion and SWE values.

Results: There were no significant changes in all muscle strength parameters by pitching. The SWE values of the teres minor muscle ($p=0.02$) and infraspinatus muscle ($p=0.007$) significantly increased after pitching, and the pectoralis minor muscle ($p=0.02$) significantly decreased. There was a strong positive correlation ($R=0.72$, $P=0.01$) between forearm rotation speed and SWE value of the posterior capsule, and a negative correlation ($R=-0.61$, $P=0.04$) between forearm angle to the ground and SWE value of the pectoralis minor muscle.

Conclusions: SWE value of the teres minor muscle and the posterior capsule increased after pitching, and the posterior capsule increased as maximal rotational velocity of the forearm increased. It may be related to the traction force on the posterior shoulder in deceleration phase. On the other hand, the SWE value of the pectoralis minor muscle increased as the angle of the forearm relative to the ground at ball release decreased. It is suggested that the pectoralis minor muscle elongated as the angle of angle increased in late-cocking phase.

EP.04.029

ROTATOR CUFF TEAR IN HIGH PERFORMANCE ATHLETES

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Background: Rotator Cuff Tears is a challenge for competitive athletes and may stop or delay the participation in competitive sports, and there is a lack in the literature when it comes to return to play or arthroscopic rotator cuff repair in high performance athletes, the purpose of this study to assess the capability of high-performance athletes to return to their competitive sports after transossoues rotator cuff repair.

Methods: between 2014-2020, 35 high performance athletes who participate in national or international tournaments, had been treated through Arthroscopic Transossoues Rotator Cuff Repair, followed by guided Physiotherapy and Rehabilitation Protocol. 29 of the tears were small sized, 3 medium-sized, and 3 large sized tear. Etiology of tears were 92% traumatic and 8% Outlet Impingement. Muscle Test, ROM, and Functional Measurements were done to the patients to see if the injured arm is equal to the non-injured arm following the surgery and physiotherapy. 83% partial and small tears. Average age at surgery 25.8 years. 23 Partial tear (5 Spoon) (66%), 6 complete small tears (17%), 3 medium size complete tear, 3 large tears, All had rotator cuff tear arthroscopic repair surgery, Transosseous in 31, End to End in 4. Acromioplasty was done in only 11 cases (measured subacromial space was less than 12 mm). Etiology of tear in HPA was Contact trauma 14/35 (40%), Balancing/fall Trauma 11/35 (31%), Microtrauma 7/35 (20%), Microtrauma + Outlet Impingement 3/35 (8%).

Results: 94% of the patients had returned to their competitive sports and participated in a national or international tournaments within 4 to 6 months, only 2 patients didn't return to their competitive sports. 92% of the cases were due to direct trauma, only 40% were contact sports athletes, 83% were small tears and Special.

Conclusions: Arthroscopic Transossous Rotator Cuff Repair with guided rehabilitation program results in high probability to return to competitive sports in contact and non-contact sports. rehabilitation program was very effective.

EP.04.030

KEY POINTS OF ARTHROSCOPIC LATARJET SCREW SURGERY

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Background: In the past decades, sports cause has developed rapidly in various countries, and sports injury cases have increased year by year. Especially in recent years, the cases of shoulder joint instability caused by sports injuries have increased significantly. Since 2007, Lafosse et al. first described the Latarjet technique for total arthroscopy. At present, for the treatment of shoulder instability, most doctors have gradually changed from the traditional open surgical treatment to the current minimally invasive surgical treatment under arthroscopy, and have achieved a relatively ideal therapeutic effect. But it is still difficult for young doctors to master the technique, and the learning curve is long.

Methods: Our surgical presentation consisted of five main steps. We put the patient in a beach chair position for a standard shoulder arthroscopy. The first step is to show your organizational skills. The second step is the coracoid process and surrounding tissue processing skills. The third step coracoid process drilling and osteotomy skills. Step 4 Coracoid process transfer technique. step five: Screw the bone block to fix the pelvic bone defect operation skills.

Results: Master and identify the anatomical position of relevant tissues under arthroscopy, and operate freely on each surgical approach. Adept at identifying the relative positions of coracoid processes and peripheral nerves and blood vessels. Master the skills of drilling the coracoid process, osteotomy and splitting the subscapularis muscle. How can the bone graft be rapidly placed in the anterior underside of the glenoid cavity through the subscapularis tear. Technique of bone fixation.

Conclusions: After systematic learning, young doctors can shorten the learning curve of the technique by memorizing the main points of Latarjet surgery under arthroscopy.

EP.04.031

LOW-PROFILE CORACOCLAVICULAR TENOSUSPENSION WITHOUT BUTTONS AND ACROMIOCLAVICULAR CERCLAGE AS TREATMENT IN ACROMIOCLAVICULAR DISLOCATIONS IIIB, IV AND V

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Background: Treatment of acromioclavicular luxations seeks to reduce and control vertical, horizontal and rotational instability. The use of tenosuspension systems with buttons offers good results. Notwithstanding that, there is discomfort and pain in the supraclavicular region, which is a reason for post-surgical consultation and the need for revision for removal.

Objective: To determine the effectiveness of low profile coracoclavicular tenosuspension without buttons and acromioclavicular cerclage as a treatment for IIIb, IV and V acromioclavicular dislocations.

Methods: Explanatory research, experimental design, longitudinal cut, prospective. The population consisted of 14 patients with acromioclavicular dislocation IIIb, IV and V treated with a coracoclavicular tenosuspension based on fibertape sutures in a vertical configuration of 8, holes in the clavicle were do it in 1.5cm and 3cm from lateral to medial, associated with an acromioclavicular cerclage under fluoroscopy guidance, who met the inclusion criteria: patients over 18 years of age, treated acutely no more than 2 weeks, without associated fractures. The Statistical Package for Social Sciences (SPSS) v23 was used and tabulated using descriptive statistics and frequency distribution tables.

Results: The male gender predominated with 79% of the population, with an age of 35 years (57%). 64% of the patients were involved in sports activities (cycling). Acromioclavicular V dislocation according to the Rockwood classification was present in 57%. A Constant Shoulder Score of 80 or more points (excellent) was obtained in 93% of the patients and 7% had a score <30 (poor), which presented a suture dehiscence in the surgical wound in the first three postoperative weeks.

Conclusions: The treatment of acromioclavicular dislocation with low-profile coracoclavicular tenosuspension without buttons with acromioclavicular cerclage provides excellent clinical results, without presenting pain or signs of flogosis in the superior region of the clavicle, which merits surgical revision.

EP.04.032

HIGH SCHOOL AND PROFESSIONAL PITCHERS WITH DECREASED VARIATION IN JOINT AND SEGMENT VELOCITIES DEMONSTRATED SIGNIFICANTLY LOWER OR EQUIVALENT THROWING ARM KINETICS WITH PRESERVED BALL VELOCITY

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Background: Improper sequencing order of maximum joint and segment velocities has been identified as an important predictor for throwing arm kinetics and ball velocity. The purpose of this study was to investigate maximum joint and segment velocities between pitches and the relationship to throwing arm kinetics and ball velocity in high school (HS) and professional (PRO) pitchers.

Methods: HS (n=59) and PRO (n=338) pitchers instructed to throw 8-12 fastball pitches were evaluated with 3D-motion capture (480 Hz). Peak joint and segment velocities were calculated for each pitch and the standard deviation (SD) of the maxima were calculated per pitcher. These SDs were used to classify pitchers as 'Low Variance' for each velocity subcategory, 'Overall Low Variance', 'Overall High Variance', or 'Population,' with any pitcher eligible to be included in multiple subcategories. Maximum velocities and throwing arm kinetics were compared among the various subgroups.

Results: The HS Low Variance Shoulder Internal Rotation Velocity subgroup ($4949 \pm 642^\circ/s$) had significantly lower maximum shoulder internal rotation velocity compared to HS Population ($5774 \pm 1,057^\circ/s$) ($p < 0.001$); similarly observed for PROs (5269 ± 835 vs. $5824 \pm 1,076^\circ/s$ respectively, $p < 0.001$) with an additionally lower shoulder superior force compared to PRO Population (14.8 ± 8.8 vs. $17.8 \pm 8.8\%BW$ respectively, $p = 0.001$). The PRO Low Variance Lead Knee Extension Velocity subgroup had a significantly lower maximum lead knee extension velocity (216 ± 135 vs. $258 \pm 125^\circ/s$ respectively, $p = 0.0010$) and shoulder distractive force (111.5 ± 14.4 vs. $115.6 \pm 15.9\%BW$ respectively, $p = 0.003$) compared to PRO Population. The PRO Overall Low Variance subgroup had significantly lower shoulder distractive force (111.8 ± 14.1 vs. $119.6 \pm 15.5\%BW$ respectively, $p = 0.008$) and elbow anterior force (40.6 ± 5.0 vs. $43.6 \pm 6.2\%BW$ respectively, $p = 0.008$) compared to the PRO Overall High Variance subgroup.

Conclusions: : HS and PRO pitchers with low variance for joint and segment velocities achieved significantly lower maximum velocities in the subgroup of interest, while preserving ball velocity. PRO pitchers with overall low variance among multiple maximum joint and segment velocities demonstrated decreased shoulder distractive and elbow anterior force. Pitchers with repeatability in maximum joint and segment velocities may be viewed as kinetically conservative throwers.

EP.04.033

DO PATIENTS WITH EATING DISORDERS EXPERIENCE WORSE POSTOPERATIVE OUTCOMES AFTER NON-ARTHROPLASTY SHOULDER SURGERIES?

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Background: Studies have shown that mental health disorders adversely impact outcomes of orthopaedic sports medicine surgeries, but no studies, to our knowledge, have examined the impact of eating disorders in this patient population. Given the symptom profile of eating disorders, we hypothesized that patients with eating disorders would have a greater incidence of adverse postoperative outcomes.

Methods: Patients who underwent non-arthroplasty shoulder surgeries between 2010 to 2021 were identified using Common Procedural Terminology codes in the PearlDiver claims database. Two patient cohorts were created: patients diagnosed with an eating disorder within two years prior to undergoing surgery and those without an eating disorder prior to surgery. Patients were matched by age, sex, and Charlson Comorbidity Index using a 1:4 ratio. The incidence of 90-day medical complications, emergency department visits, and readmissions were then analyzed through univariate and subsequent multivariate analysis.

Results: When compared to the control group, patients with a previous diagnosis of eating disorder were more likely to have postoperative medical complications including renal failure (OR=3.38, 95% CI 2.11-5.39, p=0.003), anemia (OR=6.60, 95% CI 3.41-12.75, p=0.06), death (OR=17.41, 95% CI 2.34-129.50, p=0.03), deep vein thrombosis (OR=2.94, 95% CI 1.76-4.89, p=0.02), pneumonia (OR=2.85, 95% CI 2.04-3.99, p<0.001), respiratory failure (OR=4.92, 95% CI 2.60-9.34, p=0.03), urinary tract infection (OR=9.59, 95% CI 6.45-14.24, p<0.001), and acute myocardial infarction (OR=2.37, 95% CI 2.09-2.69, p<0.001). Patients with eating disorders were also more likely to experience an emergency department visit (OR=6.59, 95% CI 5.91-7.35, p<0.001) or readmission (OR=1.45, 95% CI 1.10-1.91, p=0.008).

Conclusions: Patients with eating disorders had a significantly higher incidence of 90-day postoperative medical complications, emergency department visits, and readmissions after non-arthroplasty shoulder surgery. Further work should explore whether this risk is already elevated in this population or if it is exacerbated in the postoperative period, as well as whether any psychiatric or nutritional interventions can be utilized to improve outcomes and reduce resource utilization.

EP.04.034

PROXIMAL BICEPS TENODESIS - CLINICAL OUTCOMES OF DIFFERENT FIXATION TECHNIQUES - A RETROSPECTIVE STUDY

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Background: Pathologies of the proximal biceps are common conditions in the orthopedic environment, commonly associated with rotator cuff injuries, and are rarely isolated. The treatment can vary from conservative to surgical. Tenodesis of the long head of the biceps tendon is one of the most frequently used techniques, and many variations are found in terms of fixation methods, and various types of sutures for tendon tenodesis, each one has its peculiarities, advantages, and disadvantages.

Methods: This study aims to evaluate four distinct surgical techniques for biceps tenodesis: the rocambole technique, arthroscopic technique with SwiveLock device, arthroscopic technique of tenodesis with metallic anchors and fixation with interference screws. In order to identify the clinical advantages and disadvantages of each technique, the evaluation was performed using the ASES score and the Simple Shoulder Test

Results: Ninety-nine patients were evaluated, aged between 37 and 80 years, who underwent surgery in a single center, during the period between 6 months to 5 years after surgery. The rocambole technique and metallic anchor presented lower ASES and SST scores, although it wasn't statistically significant. The chance of having an above-average result according to the ASES score reduces by 9.155 with each year of age.

Conclusions: All techniques demonstrated high rates of patient satisfaction with good to excellent clinical outcomes. Although the results found in the group of patients with arthroscopic technique with SwiveLock anchor and the fixation technique with interference screws presented better clinical outcomes.

EP.04.036

A CLINICAL METHOD OF FUNCTIONAL ASSESSMENT OF THE SHOULDER IN HIGH PERFORMANCE ATHLETES

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Background: Several methods have been devised to estimate shoulder function, none of which is entirely satisfactory to evaluate postoperative condition of the shoulder and determine its condition in high performance athletes. Especially in determining the progress of rehabilitation and when can the patient return to competitive sports and in what level. The method described in this presentation is applicable irrespective of the details of the diagnostic or radiologic abnormalities caused by disease or injury.

Methods: 50 points out of 100 points maximum score is given to strength by measuring 10 groups of muscle in different directions and measure the static strength of each and compare it to the opposite normal side considering a 10% more strength to the dominant side. every muscle group will get 5 points if it has an av. of 95% compared to the opposite normal side and 3 points if it between 85 to 95%. No points for less than 85%.

Pain will be evaluated with 15 points if no pain and 5 points for mild pain. Moderate pain will get no points.

The range of motion is rated by 35 points for full range, 15 elevation, 15 external rotation and 5 internal rotations. More than 95% from opposite side is 15 points, between 80 and 95% only 5 points. Less than that no points.

Results: The scoring of ; 95 to 100 points is rated A level (Excellent), 85-95 points is B level (good), 70 to 85 points is C level (fair) and less than 70 points is rated D level (poor)

The postoperative rehabilitation takes around three to 5 months in our athletes after instability and rotator cuff arthroscopic surgeries. The athlete who reaches the A level after 3 months of rehabilitation or more can go to competitive sport, after 4 months from rehabilitation reaching B level they can start only noncompetitive training. Cases with C level can only start self-fitness and D level are not allowed to go back to sport.

Conclusions: These are the standards used in high performance athletes after shoulder surgery. It reduced the recurrence of injury and fastened the return to sport dramatically.

EP.04.037

WAKEBOARDER'S SHOULDER: COMPLETE TEAR SHORT HEAD OF THE BICEPS BRACHII AND CORACOBRAHIALIS

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Background: Injuries involving conjoint tendon or the short head of biceps (SHB) and coracobrachialis (CB) muscles are extremely rare, especially both muscles simultaneously (SHB and CB). To the best of our knowledge, there are only 5 published reports of SHB/CB injuries, of these, 3 reports with documented completed tear of both muscles and by now, no reports of conservative treatment in cases of complete SHB/CB tear. Here we review the literature on this injury and add a case that is unique in the published literature. Like many reported cases, the mechanism of injury involved a tow-rope while wakeboarding, but unlike the recent cases it was treated non-operatively. The result was acceptable and arguably as good or better than operatively treated cases.

Methods: This study aims to report a case of complete tear of CB and SHB muscles treated non-operatively, unique in the literature. In addition a literature review of reports of SHB/CB injuries.

Results: A 26-year-old male presented with left medial-sided arm pain following an injury while wakeboarding. He had very limited elbow range of motion due to severe pain in the medial arm with attempts at passive extension or active elbow flexion. A MRI of the left elbow and humerus confirmed rupture of the SHB and CB. The patient was told to wear a sling and after 2 weeks starting to remove frequently to slowly begin elbow extension. After 5 weeks post injury, the outcomes were 71.67 for ASES with a VAS of 1. At 6 weeks post injury, the patient was permitted to lift, push, and pull up to 5 pounds and begin active elbow active range of motion.

Conclusions: This case report and literature review describes a rare shoulder injury. This type of injury essentially occurs in sports involving tow lines/ ropes but mainly affects wakeboarders, hence the name wakeboarders shoulder. This is the first time that the nonoperative treatment is described, revealing acceptable outcomes, comparable to current surgical options. We recommend nonoperative treatment be considered, especially in cases where complex intramuscular rupture would require salvage methods to attempt muscular repair.

EP.04.038

A COMPARISON OF THROWING ARM KINETICS AND BALL VELOCITY IN PROFESSIONAL BASEBALL PITCHERS WITH THE FASTEST MAXIMUM JOINT AND SEGMENT VELOCITIES DEPENDENT OF INDEPENDENT OF SEQUENCE ORDER

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Background: Significant associations have been established among individual maximum joint and segment velocities with throwing arm kinetics and ball velocity. Therefore, the purpose of this study was to observe how pitches with the fastest maximum joint and segment velocities, dependent and independent of sequence order, may impact ball velocity and throwing arm kinetics in professional pitchers.

Methods: Professional (n=338) pitchers threw 8-12 fastball pitches while evaluated with 3D-motion capture (480 Hz). Pitches (independent and dependent of sequence order) were classified as 'High Velocity' for each velocity subcategory or 'Population' with any pitch eligible for inclusion in multiple subcategories. Kinematic and kinetic parameters were compared among subgroups with post-hoc regressions.

Results: Population pitches dependent of sequence order (pitches: 71, pitchers=19) had significantly faster ball velocity than Population pitches independent of sequence order (pitches: 3,685, pitchers: 338) (39.0 ± 1.5 vs. 38.2 ± 2.2 m/s respectively, $p < 0.001$). Irrespective of sequence, the Lead knee extension velocity subgroup had faster ball velocity (38.9 ± 1.8 vs. 38.2 ± 2.2 m/s respectively, $p < 0.001$, Cohen D=0.4) compared to Population. For every one standard deviation increase in maximum shoulder internal rotation velocity ($1,091^\circ/s$) for pitches independent of sequence order, shoulder superior force increased by 3.67% Weight (BW). For every one standard deviation increase in maximum shoulder internal rotation velocity ($1414^\circ/s$) for pitches dependent of sequence order, shoulder superior force increased by 4.29%BW, elbow medial force increased by 5.33%BW, and elbow distractive force increased by 9.33%BW.

Conclusions: Sequence order likely plays an important role in maximizing ball velocity with minimal implications for throwing arm kinetics, as a surrogate for joint loading quantifications. Besides potentially maximum lead knee extension velocity, increasing maximum joint and segment velocities appears not to be an optimal means by which to achieve faster ball velocity and has negative implications for pitching arm kinetics. Pitchers and coaching staff should consider the trade-off between faster ball velocity and increased throwing arm kinetics with maximizing specific joint and segment velocities. Sequence order should be emphasized.

EP.04.039

ALL-KNOTLESS REPAIR OF BATTER'S SHOULDER LABRUM TEAR WITH RE-TENSIONABLE ANCHORS

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Background: Batter's shoulder is a unique injury that may be associated with recurrent microtrauma followed by acute subluxation of the humeral head on the posterior glenoid edge leading to posterior labral tears. Early identification of this injury is critical, as it may be treated with conservative non-surgical treatments prior to labral tear onset. If conservative treatment fails and pain persists, surgical options include arthroscopic fixation to re-approximate the posterior labrum to the glenoid. Previous studies have shown the benefit of using knotless suture anchors in arthroscopic shoulder fixation.

Methods: x

Results: x

Conclusions: This technical note demonstrates that Batter's shoulder is a unique injury associated with posterior labral tears of the shoulder and provides a contemporary method of arthroscopic fixation of a posterior labrum tear using all-suture FiberTak (Arthrex) knotless repair.

EP.05.001

REPRODUCIBILITY ANALYSIS OF CLASSIFICATIONS FOR FRACTURES OF THE PROXIMAL HUMERUS WHEN ASSISTED BY ADDITIVE MANUFACTURING (3D MODELS)

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Background: 3D printed bone models are somewhat innovative tools that allows better evaluation of bone deformity by healthcare providers. We aimed to verify, using the Kappa Coefficient, if the reliability of the proximal humerus fracture classifications (Neer, AO, Hertel) increases when 3D printed models are used in the assessment, rather than the digital CT scan alone. Nonetheless, to determine if the treatment indication changes between the two methods (CT scan alone vs CT scan plus the printed model).

Methods: We assessed, retrospectively, charts, x-rays and CT scans of 30 patients. Six evaluators with different levels of expertise (Shoulder and elbows specialists, shoulder and elbow fellows and orthopedic surgeons with no specialization in shoulder and elbow surgery) classified the fractures and proposed a treatment based on the digital CT scans and printed model. After 8 weeks, the evaluation was repeated.

Results: The Kappa Coefficient in the fellow's group was: Neer k:0,417 (CT) and k: 0,620 (Printed); Hertel k:0,379 (CT) and k: 0,524 (Printed); AO k:0,512 (CT) and k:0,603 (Printed). In the orthopedics groups, the Kappa Coefficient was: Neer k:0,378 (CT) and k:0,510 (Printed); Hertel k:0,398 (CT) and k:0,416 (Printed); AO k:0,550 (CT) and k:0,500 (Printed). In the Specialists group, the Kappa Coefficient was: Neer k:0,675 (CT) and k:0,704 (Printed); Hertel k:0,678 (CT) and k:0,721 (Printed); AO k:0,622 (CT) and k: 0,729 (Printed). Therefore, the highest intraobserver agreement was found in the specialists group. It was observed that the change in treatment indication occurred more frequently among the complex fractures (3 and 4-part in the Neer classification), specially in the orthopedics group. In simple fractures (1 and 2 part) there was no change in the proposed treatment that was considered statistically significant.

Conclusions: The evaluation of the printed model resulted in a higher interobserver agreement. We concluded that the use of the printed model not only facilitates the fracture pattern comprehension, but also supports the decision making regarding the type of treatment, specially in complex fractures.

EP.05.003

1-PSI GUIDED SHOULDER REPLACEMENT PROSTHESIS IN THREE TO FOUR PARTS OLD MALUNITED FRACTURE BASED ON A PSI SHOULDER MODEL AND MEASUREMENTS FROM THE NORMAL OPPOSITE SIDE

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Background: The aim of this in vivo study was to assess the accuracy of a new technique of PSI (Patient Specific Instrumentation) of the hemiarthroplasty in old malunited three and four parts fracture using measurements from the normal opposite shoulder and a preoperative PSI planning model of the affected side as well as cutting guides, in a consecutive series at a single center. Based on the fact that the shoulder muscular biomechanics were functioning according to certain bony measures of the glenohumeral joint in respect of size and angles, the outcome of hemiarthroplasty in cases of old four or three parts malunited fractures in the literature are not satisfactory

Methods: The device is patient specific, based on a method comprised of image-based 3D preoperative planning (CT, MRI or computed X-ray) to design the templates (PSI) that are used to perform the shoulder surgery by converting them to physical templates using computer-aided manufacturing.

Eleven consecutive hemiarthroplasties (7 three parts and 4 four parts and two with glenoid prosthesis) were performed using custom-made patient-specific positioning guides for the head component and two for the glenoid component as well as a planning PSI model. Each patient had preoperative computed tomography scans and guides produced to allow head width, height, retroversion, valgus angle, head centre to shaft centre offset, and shaft width.

Results: Eleven head replacements were done for 11 patients. The size of the head, its retroversion, height, valgus angle and head offset were done according to measurements of the normal opposite side. All cases had a range of motion between 170° to 180° elevation and 60 to 70 degrees external rotation. There is 30% reduction in surgical time According to Neer classification the results were excellent in nine cases and one case satisfactory and the other unsatisfactory

Conclusions: This technique of PSI guided shoulder prosthesis in malunited three and four parts proximal humeral fracture using the other normal shoulder measurements increase accuracy in the placement of the humeral component, which improves the likelihood of an optimal outcome

EP.05.004

TREATMENT OF HUMERAL HEAD THREE-PART POSTERIOR FRACTURE-DISLOCATION BY A POSTERIOR REDUCTION AND FIXATION WITH A SYSTEM OF BLOCKED THREADED WIRES. A CONSECUTIVE CASE SERIES

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Background: Posterior fracture dislocations are rare. No uniformity of thought regarding how to manage them. Some treated the posterior fracture dislocations with percutaneous pinning; however, using this system, many configurations can be obtained according to the fracture, bone, and soft tissue condition and surgeon's experience. We evaluated clinical and radiological outcomes of patients with the same pattern of humeral head posterior fracture dislocation treated with a biomechanically validated configuration of blocked threaded wires.

Methods: A rare group of 11 patients with humeral head three-part posterior fracture dislocation with composite tuberosity shield fragment were treated by reduction through a posterior approach and fixed with blocked threaded wires. All patients were clinically (individual relative Constant Murley score: irCS and VAS) and radiographically (a: varus/valgus and impaction/distraction angulation; b: reduction maintenance; c: complications) after a mean follow-up of 50 months. Outcomes were submitted to statistical analysis.

Results: The mean irCS was 86.1% (range: 70.5%-95.3%). No significant difference was found between irCS at 6 and 12 months postoperatively and the final follow-up. Six patients referred their pain intensity as 0/10, 3 as 1/10, and 2 as 2/10. The postoperative reduction was considered as excellent in 8 patients (Bahr's criteria) and good in the remaining 3; at the final follow-up, reduction was excellent and good in 7 and 4 patients, respectively. The mean neck-shaft angles at FU 0 and at the final FU were 137° and 132°, respectively. No signs of avascular necrosis, non-union, and arthritis progression were seen. No recurrence of dislocation or posterior instability symptoms were reported.

Conclusions: We believe that our very satisfactory results depend on: 1) the manual reduction of the dislocation, through a vertical posterior surgical approach, does not produce further osteocartilaginous damage of the humeral head; 2) we don't perform multiple perforations of the humeral head; 3) the threaded wires have a smaller diameter than the screws, therefore they preserve the bone tissue of the humeral head; 4) deperiostization or further detachment of soft tissues are not expected; 5) the adopted and validated system is stable and limits translation, torsion, and the collapse of the humeral head.

EP.05.005

COMPARISON BETWEEN ARTHROSCOPIC SUTURE ANCHOR FIXATION AND OPEN PLATE FIXATION IN THE GREATER TUBEROSITY FRACTURE OF THE PROXIMAL HUMERUS

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Background: Although these techniques have been used to treat displaced GT fractures, techniques (open vs. arthroscopic fixation technique) showing the best results for treating GT fracture are still controversial. Limited data are available to guide the surgeon in selecting the best possible approach. Furthermore, these fractures are rare and therefore a large series to evaluate the results of treatment is difficult to compile.

Our hypothesis was that arthroscopic suture anchor fixation of GT fracture showed better clinical outcomes and less complications than OR/IF of GT fracture. The purpose of this study is to compare the clinical and radiological outcomes of patients undergoing OR/IF using a locking plate or an arthroscopic suture anchor fixation for the GT fracture of the proximal humerus.

Methods: Between January, 2010 and December, 2020, 122 patients with GT fracture underwent operative fixation. Either OR/IF using proximal humeral locking plate (50 patients) or arthroscopic suture anchor (72 patients) fixation was performed. Fourteen patients were lost to follow-up and finally, 108 patients were enrolled in this study. We divided these patients into two groups: (1) OR/IF group (Group I: 44 patients) and arthroscopic anchor fixation group (Group II : 64 patients). The differences in age, sex, BMI, operation time, shoulder dislocation, fracture comminution, AP (anteroposterior), SI (superoinferior) size and displacement, and clinical outcomes including ROM and complications were compared between two groups.

Results: All patients achieved GT union within 3 months. Both groups showed satisfactory clinical and radiological outcomes at mid-term follow-up. Between 2 groups, there were no significant differences in age, sex, BMI, presence of shoulder dislocation or comminution. However, Group II showed significantly better clinical scores and also there were significant differences in operation time, preoperative fracture's size and displacement (all $p < 0.05$). Higher complication rate was found in the OR/IF group ($p=0.049$).

Conclusions: Both arthroscopic anchor fixation and open plate fixation methods showed satisfactory outcomes at mid-term follow-up. However, OR/IF is preferred for larger fracture size and displacement of the GT fracture than arthroscopic anchor fixation. Also, arthroscopy group showed better clinical outcomes and less complication than the OR/IF group.

EP.05.006

LIFE TREATING COMPLICATION FOLLOWING MIGRATION OF TOTAL CLAVICLE REPLACEMENT

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Background: Migration of metallic orthopaedic implants is a recognised complication in orthopaedic surgery. Intra-aortic migration of such devices, is extremely rare, however could be life threatening.

Methods: A 53-year-old male was blue-lighted to our emergency department with chest pain and breathing difficulties. Initial investigations revealed some metal object in the mediastinum. Further investigations revealed that the total clavicle replacement prosthesis that he had following a road traffic accident in 2001, has migrated into the arch of aorta causing aneurysm and cardiovascular symptoms. He was the first patient in the world to receive a total clavicle replacement for clavicle fracture. The titanium prosthesis was manufactured using opposite clavicle and attached with synthetic ligaments to the sternum and to the scapula.

Results: The patient underwent emergency median sternotomy and repair of ascending aorta and proximal arch. The prosthesis was retrieved through a separate clavicular approach. There were no intra-operative or post-operative complications and the patient recovered uneventfully.

Conclusions: This case highlights the fact that extreme migration of prosthetic implants, over a period of number of years is possible, and patients should be adequately counselled on this risk, both as an acute or chronic complication. This report emphasises the role of regulatory bodies in the use of new implant and maintaining a register.

EP.05.007

MINIMAL IMPORTANT DIFFERENCE AND PATIENT ACCEPTABLE SYMPTOM STATE FOR COMMON OUTCOME INSTRUMENTS IN PATIENTS WITH A CLOSED HUMERAL SHAFT FRACTURE - ANALYSIS OF THE FISH RANDOMISED CLINICAL TRIAL DATA

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Background: Two common ways of assessing the clinical relevance of treatment outcomes are the minimal important difference (MID) and the patient acceptable symptom state (PASS). The former represents the smallest change in the given outcome that makes people feel better, while the latter is the symptom level at which patients feel well.

Methods: We recruited 124 patients with a humeral shaft fracture to a randomised controlled trial comparing surgery to nonsurgical care. Outcome instruments included the Disabilities of Arm, Shoulder, and Hand (DASH) score, the Constant-Murley score, and two numerical rating scales (NRS) for pain (at rest and on activities). A reduction in DASH and pain scores, and increase in the Constant-Murley score represents improvement. We used four methods (receiver operating characteristic [ROC] curve, the mean difference of change, the mean change, and predictive modelling methods) to determine the MID, and two methods (the ROC and 75th percentile) for the PASS. As an anchor for the analyses, we assessed patients' satisfaction regarding the injured arm using a 7-item Likert-scale.

Results: The change in the anchor question was strongly correlated with the change in DASH, moderately correlated with the change of the Constant-Murley score and pain on activities, and poorly correlated with the change in pain at rest (Spearman's rho 0.51, 0.40, 0.36, and 0.15, respectively). Depending on the method, the MID estimates for DASH ranged from -6.7 to -11.2, pain on activities from -0.5 to -1.3, and the Constant-Murley score from 6.3 to 13.5. The ROC method provided reliable estimates for DASH (-6.7 points, Area Under Curve [AUC] 0.77), the Constant-Murley Score (7.6 points, AUC 0.71), and pain on activities (0.5 points, AUC 0.68). The PASS estimates were 14 and 10 for DASH, 2.5 and 2 for pain on activities, and 68 and 74 for the Constant-Murley score with the ROC and 75th percentile methods, respectively.

Conclusions: Our study provides credible estimates for the MID and PASS values of DASH, pain on activities and the Constant-Murley score, but not for pain at rest. The suggested cut-offs can be used in future studies and for assessing treatment success in patients with humeral shaft fracture.

EP.05.008

CLINICAL AND RADIOLOGICAL OUTCOMES OF ARTHROSCOPIC SUTURE BUTTON FIXATION FOR ANTERIOR GLENOID RIM FRACTURES: CASE SERIES

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Background: Anterior Glenoid Rim fractures are usually associated with traumatic glenohumeral dislocation and often contribute to recurrent instability. There are several surgical techniques described to fix these fractures, however none has proven to be superior than the others. Suture-button devices have recently been used as fixation method for these fractures, but there are no published studies showing outcomes achieved with this technique.

Methods: Retrospective analysis of prospectively recorded data from a series of patients with anterior glenoid rim fractures, treated at a single Level-1 trauma center between 2020 and 2022. All patients had 3D-CT Scans before surgery; to evaluate fragment size, displacement and comminution; and 3 months after surgery to assess quality of reduction and bony union. Clinical results were measured 3 and 6 months after surgery using ASES, UCLA and Rowe scores.

Results: 20 patients were included, 15 treated with suture-button devices, 3 with arthroscopic reduction and screw fixation and 2 with the Bony Bankart Bridge technique. According to Kim's classification, 8 fragments were medium sized and 12 large, with no small fragments included in the series. In those treated with a Suture-Button device, the reduction was anatomic (less than 2mm step-off) in 12 out of 15 patients (80%) while only in 1 out of 3 (33%) patients treated with Bony Bankart Bridge and 1 out of 2 (50%) treated with screws. Consolidation observed at 3 months after surgery was complete in 14 patients and partial in 6, with no cases of non-union. Those patients with complete union were the same ones in which anatomic reduction was achieved. Average clinical scores at 3 months were ASES 73.4, UCLA 30.1 and Rowe 87.5, and at 6 months ASES 84.7, UCLA 31.0 and Rowe 95.7, with no statistical difference between fixation methods. No recurrent instability events were observed during follow-up.

Conclusions: Use of Suture-Button devices should be considered as an option for fixation of anterior glenoid rim fractures with medium and large fragments, as it achieved anatomic reduction and complete consolidation at 3 months, and good/excellent clinical outcomes at 6 months in most patients.

EP.05.009

SURGICAL TREATMENTS FOR CHRONIC UNREDUCED DISLOCATION OF THE SHOULDER - OUR STRATEGY FOR CHOOSING ORIF, HHA (OR A-TSA), OR RSA -

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Background: The treatment of chronic unreduced dislocation of the shoulder is always challenging. The purpose of this study is to report results of surgical treatments by our strategy for old dislocation.

Methods: 40 shoulders of old dislocation which means the shoulder joint dislocated and unreduced more than 3 weeks, were studied. 40 patients are composed of 14 males and 26 females, anterior dislocation 27 and posterior dislocation 13. We divided these patients into three groups by the treatment methods. Group-1 (22 cases): Open reduction and internal fixation (ORIF), Group-2 (11): hemi shoulder arthroplasty (HHA) or anatomical total shoulder arthroplasty (a-TSA), Group-3 (7): reverse total shoulder arthroplasty (RSA). We investigated surgical approach, operative findings, complications, and postoperative results.

Results: The average age at the time of the surgery was Group-1: 50 (21-73) years old, Group-2: 60 (34-89), and Group-3: 76 (60-88). The period from trauma to surgery ranged Group-1: less than 10 months, Group-2: from 3 months to 34 years, and Group-3: from 6 months to 8 years. Pain decreased and the shoulder joint was reduced in all cases. The averaged JOA Score after surgery was Group-1: 75 (56-97) points, Group-2: 78 (64-97) points, and Group-3: 73 (64-88).

Conclusions: When we treat old dislocation surgically, we must pay much attention to both soft tissues and bones. The combined approach from anterior and posterior is useful for old dislocation. Our strategy is to try ORIF for the first choice. For the second choice, we select HHA (or a-TSA) or RSA depend on the condition of the rotator cuffs and the cartilage of the scapula.

EP.05.010

DOES MULTI-TRAUMATIC INJURY AFFECT RISK OF FIXATION FAILURE AFTER SURGICAL TREATMENT OF MIDSHAFT CLAVICLE FRACTURE? -A RETROSPECTIVE COHORT STUDY-

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Background: Surgical treatment of midshaft clavicle fractures is associated with quick recovery and low risk of non-union. However, fixation failure may occur in case of severe comminution fractures. Moreover, clinical outcomes may be affected when clavicular fractures occur in combination with other injuries, particularly those involving the lower extremities, as the use of crutches or walkers may hinder the process of rehabilitation by adding strain on the acromioclavicular (AC) joint, resulting in possible fixation failure. This study aims to identify risk factors for fixation failure of midshaft clavicle fractures, and elucidate the role of combined fractures in treatment outcomes.

Methods: This study included patients diagnosed with midshaft clavicular fractures who underwent initial surgery between January 2012 and November 2021 at a designate regional trauma center hospital. Retrospective evaluation of fixation failure was carried out in 352 with midshaft clavicular fractures using standard clinical evaluation protocols and conventional radiographs. The prevalence of fixation failure and the effects of several demographic variables on the risk of fixation failure and nonunion were examined. Multivariate logistic regression analysis was carried out to identify independent risk factors for fixation failure.

Results: Fixation failure occurred in 40 patients (11.3%). Multivariate analysis identified comminution [Odd's Ratio (OR): 3.532, p-value=0.003, 95% confidence interval (CI): 1.55–8.05] and fewer number of screws (OR: 0.223, p-value=0.022, 95% CI: 0.06–0.80) as risk factors for fixation failure. Surgical techniques using wire cerclage reduced the chances of fixation failure in comminuted fractures (OR: 0.63, pvalue 0.033, 95% CI: 0.05–0.80). Combined fractures that required rehabilitation using walkers or crutches increased the risk of non-union (OR: 19.043, p-value=0.032, 95% CI: 1.28–282.46).

Conclusions: Additional fixation of comminuted fractures using cerclage and lag screws can reduce the risk of treatment failure, while multiple traumas or rehabilitation for ambulation increases the risk of the same.

EP.05.012

FUNCTIONAL AND RADIOLOGICAL LONG TERM RESULTS AFTER SURGICAL RECONSTRUCTION OF MUTCH TYPE 3 FRACTURE OF THE GREATER TUBEROSITY AFTER FRACTURE DISLOCATION OF THE SHOULDER: A RETROSPECTIVE COHORT

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Background: Fracture involving the greater tuberosity is reported in 15.5-25% of patients presenting with anteroinferior dislocation. It may be classified into 3 groups according to Mutch et al. Type 3 implies a loss of the native offset of the greater tuberosity with potential biomechanical impairment impacting shoulder mobility and risk of osteoarthritis. Restoration of native offset in the acute setting represents a therapeutic challenge. Thus, the purpose of the present study is to present the long-term clinical and radiographic results after surgical management with filling of the Hill-Sachs lesion with bone allograft.

Methods: This study was designed as a monocentric single operator retrospective cohort. Demographic data were collected. Clinical outcomes at final follow-up (FU) with Constant-Murley score (CMS), Subjective Shoulder Value (SSV), Active Range of Motion in Anterior Elevation (AE), Abduction (ABD), External Rotation (ER1), and in Internal Rotation (IR), Visual Analog Pain Scale (VAS) were analyzed. Osteolysis of greater tuberosity and subacromial space at 1 year and final FU were radiologically assessed. Occupational Recovery Rate and Revision Rate were determined.

Results: Fourteen patients were included, 10 men (71.4%) and 4 women (28.6%) with a mean age of 49.57 ± 22.3 years. Mean follow-up was 3 years and 2 months. Total CMS was 80.38 with an age-corrected score of 95.08%; Mean SSV was 87.23%; Amplitudes were AE $156.92^\circ \pm 47.50^\circ$; Mean ABD $155^\circ \pm 41.63^\circ$; Mean ER1 $53.07^\circ \pm 15.62^\circ$; Mean IR Th10; Mean VAS 1.07 ± 1.60 . Revision surgery was indicated in one patient for secondary displacement of the greater tuberosity. Radiological bone lysis occurred in 92.28%. Subacromial space was $<6\text{mm}$ in 14.29%. Occupational recovery rate at 1 year was 88.89%.

Conclusions: Allografting of Hill-Sachs lesion in greater tuberosity fracture dislocation allows for acute management of Hills Sachs lesion in greater tuberosity fracture dislocation with good functional results. Osteolysis is a preponderant finding warranting further studies.

EP.05.013

DISCREPANCY IN THE EVALUATION OF ACUTE SHOULDER-DISLOCATION REDUCTIONS: ORTHOPAEDIC SURGERY VS EMERGENCY MEDICINE

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Background: The shoulder is the most commonly dislocated large joint. An anteroposterior radiograph may appear normal in patients with glen-numeral instability, contributing to a high rate of misdiagnosing a failed reduction, contributing to a delay in treatment. The addition of an axillary radiograph raises the diagnosis rate to 100%. This additional image is inconsistently obtained. This study sought to identify the impact of differences in specialty on the clinical assessment of shoulder joint reduction. We hypothesized that emergency medicine clinicians were significantly less likely to obtain the standard post-reduction axillary radiographs to confirm adequate reduction of the shoulder joint.

Methods: Shoulder dislocation with reductions across 11 emergency departments in a large urban healthcare system over a 4-year-period were identified. We excluded cases that required operative reduction or had associated fractures. The primary outcome was whether an axillary radiograph was obtained post-reduction. Nonparametric-bivariate-analysis was used to determine statistical significance ($p < 0.05$).

Results: We identified 262 patients meeting our study criteria, wherein 157 (59.9%) patients were reduced by emergency department (ED) clinicians, and 105 (40.1%) patients were reduced by orthopedic surgery clinicians. The average age of patients reduced by the ED and orthopedic residents was 38.5 (\pm SD 18.9) and 42.8 (\pm SD 21.7) years old, respectively. Of the 157 patients reduced by the ED staff, 46 (29.3%) were female and 111 (70.7%) were male, versus 41 (39%) female and 64 (61%) male patients reduced by orthopedic surgery. Patients reduced by orthopedic surgery clinicians had a significantly higher BMI than those reduced by the ED staff (28.8, \pm SD 4.5 versus 26.2, \pm SD 26.2, $p = 0.015$, respectively). Post-reduction axillary radiographs were obtained by 87.6% of orthopedic surgery clinicians versus 15.3% of ED clinicians ($p < 0.0001$).

Conclusions: ED clinicians are significantly less likely to obtain a post-reduction axillary radiograph compared to orthopedic clinicians. Axillary radiographs are critical to identify the direction of the dislocation, any associated fractures, and adequacy of reduction. The discrepancy in rate of obtaining an axillary radiograph highlights the need for quality improvement in clinical education, especially with ED colleagues.

EP.05.014

BELANGERO-LIVANI TECHNIQUE (MIPO) IN THE TREATMENT OF HUMERAL SHAFT FRACTURES. A LATIN AMERICAN EXPERIENCE IN THREE MEDICAL CENTERS

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Background: To determine the demographic data of the patients in relation to age, sex, profession, affected side, single or multiple lesions, type of material used, bone healing time and possible complications of the treatment of diaphyseal fractures of the humerus treated using the MIPO technique in a series of patients from three hospital units in Ecuador, Paraguay, and Brazil

Methods: A retrospective, longitudinal, observational study of data from 133 patients collected in 3 services in Ecuador, Paraguay; and Brazil. The distributions between different services were compared using Pearson's chi-square test.

Results: The age of the patients ranged from 17 to 76 years, with a mean of 36 years. The median time to union, which occurred in 126 of the 132 patients, was 11 weeks. Most of the patients were male (70.45%), the right side was the most affected (55.3%), most of the fractures were single (85.61%), consolidation occurred in 95.45 % of cases, complications occurred only in 9.09% of patients, 6.82% of them were severe. In relation to complications, they were divided according to the absence (87.12%) or presence of the following: post-surgical neuropraxia (0.76%), infection (3.03%), and pseudarthrosis (4.55%).

Conclusions: The MIPO technique for the treatment of diaphyseal fractures of the humerus is reliable and presents low rates of complications and morbidity, demonstrating good rates of consolidation in both centers of the current study.

EP.05.016

ARTHROSCOPIC TRANSOSSEOUS SUTURE REDUCTION AND FIXATION OF AVULSED DISPLACED GREATER TUBEROSITY FRACTURE; THREE TECHNIQUES OF FIXATION TRANSVERSE, LONGITUDINAL AND MATTRESS ARE USED ACCORDING TO THE

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Background: In this study we will present the three new techniques of arthroscopic reduction and transosseous suture fixation as well as evaluation of the functional and radiographic results of a series of mostly old patients with posttraumatic displaced two parts greater tuberosity fractures of the proximal humerus. The results of conservative treatment of the proximal humerus fractures are not satisfactory. Open reconstruction and rigid internal fixation as well as arthroscopic-assisted reduction and internal fixation are only possible in selected cases, mostly young patients. Old patients with osteoporotic, comminuted bone accounts for 70% of the cases.

Methods: The arthroscopic transosseous suture fixation technique of avulsed greater tuberosity fracture starts by reduction of the upwards and medially displaced greater tuberosity to its anatomical position and fix it with longitudinal, horizontal and mattress sutures. 23 patients (12 males and 12 females) with a specifically defined displaced fracture of the greater tuberosity underwent arthroscopic reduction and transosseous sutures fixation. The average age was 56 years (between 21 and 79). 66% were above 50 years of age. They were examined with an average follow up of two and a half years (between 12 and 83 months). Follow-up radiographs were assessed for fracture consolidation, malunion, nonunion, heterotrophic ossification, and signs of impingement. All displaced fractures were reduced fixed with number 2 non-absorbable sutures. Rehabilitation exercises were started after a postoperative immobilization period of 3 to 4 weeks.

Results: : Using Neer classification excellent results were present in all cases of the two parts fracture. All fractures were united within four weeks, no nonunion, no heterotrophic ossifications and no osteoarthritis or avascular osteonecrosis was detected. Three men and one women active athletes were able to go back to their previous performance.

Conclusions: The clinical and radiographic result strongly encourage using the arthroscopic transosseous suture fixation techniques to treat displaced greater tuberosity fractures especially in old age patients or patients with osteoporosis. It is the only method with very good results in this group of patients.

EP.05.017

IS ARTHROSCOPIC REDUCTION AND FIXATION APPLICABLE TO THE LARGE-SIZED GREATER TUBEROSITY FRACTURE OF THE HUMERUS?

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Background: Arthroscopic reduction and fixation (ARF) is useful in treating small-sized greater tuberosity (GT) fracture. However, it is unclear whether ARF can be applied to the large-sized GT fracture fixation. The purpose of this study was to evaluate the clinical and radiologic outcome of ARF using double-row suture bridge method for the large-sized GT fracture of the humerus.

Methods: A large-sized GT fracture was defined as a patient with the longest size of 30 mm or more on the preoperative computed tomography (CT). Among patients who underwent ARF with a large-sized GT fracture between February 2014 and February 2021, patients who were evaluated for more than 12 months were included. A total of 15 patients (mean age: 53.2 ± 11.1 years; 8 males and 7 females) were included, and the mean follow-up period was 18.7 ± 19.6 months. The visual analog scale (VAS), the American Shoulder and Elbow Surgery (ASES) score, the University of California at Los Angeles Shoulder (UCLA) score, and the complications were evaluated at each follow-up point.

Results: According to preoperative radiologic classification, avulsion type was 7 cases, split type was 8 cases, and comminuted GT fracture was 7 cases. The mean fracture fragment size on the CT was 32.7 ± 4.4 mm and the mean displacement was 5.32 mm. On the immediate postoperative radiography, 86.7% (13 of 15 cases) had a step-off ≤ 3 mm of the GT fracture. Bone union was achieved within 3 months in all cases. At the final follow-up, the mean VAS was 0.6 ± 0.72 , the mean ASES score was 95.2 ± 8.2 , and the mean UCLA score was 32 ± 2.5 . There were no cases of surgery-related complications.

Conclusions: The ARF for the large-sized (> 30 mm) GT fracture demonstrated a feasible surgical strategy for excellent clinical results.

EP.05.018

DEVELOPMENT AND VALIDATION OF A DEEP LEARNING MODEL FOR PREOPERATIVE VIRTUAL REDUCTION OF A PROXIMAL HUMERUS FRACTURE

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Background: Various deep learning (DL) models have been developed and provide useful information in orthopaedic surgery in terms of diagnosis, classification, and outcome prediction. We developed the DL model for automatic virtual reduction of comminuted fractures. The purpose of this study is to evaluate the performance and accuracy of the DL model applied to proximal humerus fractures (PHF).

Methods: To develop a DL model for automatic virtual reduction, 56,000 computed tomography (CT) images were used (train:70%, test:15%, validation:15%). To evaluate the performance, the combination of two different DL networks (segmentation and reduction algorithms) was used. Nineteen cases of PHF with anatomic reduction after surgery were used to evaluate the accuracy of the DL model. The accuracy between the preoperative automatic virtual reduction image using the DL model and the three-dimensional (3D) CT image after surgery was analyzed using the two-dimensional Dice similarity coefficient (DSC). DSC was used as a statistical validation to evaluate the spatial overlap accuracy of automatic virtual reduction and postoperative 3D CT. According to the Kappa coefficient for DSC, a DSC > 0.6 means substantial agreement, and > 0.8 means almost perfect agreement. The correlation between length of inferomedial support screws in virtual reduction and postoperative 3D CT was analyzed.

Results: In the performance of the DL model, the final training accuracy of the segmentation and reduction algorithms was 98.30% and 97.75%, respectively. The mean Kappa coefficient for DSC of 19 cases was 0.76 ± 0.08 . Among them, 8 cases had almost perfect agreements, and 11 cases had substantial agreements. The Pearson correlation coefficient of length of inferomedial support screws between virtual reduction and postoperative 3D CT was 0.97 (p value < 0.001).

Conclusions: The DL model for automatic virtual reduction of PHF shows high performance and accuracy. Beyond diagnosis and classification, the DL models can also be applied to preoperative planning.

EP.05.022

DOES PRIMARY TREATMENT OF PROXIMAL HUMERUS FRACTURES SHOW FAVORABLE FUNCTIONAL OUTCOMES OVER SECONDARY TREATMENT WITH REVERSE SHOULDER ARTHROPLASTY?

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Background: When conservative or surgical treatment of PHFs fails, treatment with RSA has emerged as preferred secondary treatment. In this study functional outcomes were compared between primary and secondary treatment of patients with a reverse shoulder arthroplasty (RSA) following displaced proximal humerus fractures (PHFs). We hypothesized that primary treatment has better functional outcomes than secondary RSA after failed conservative- or surgical treatment.

Methods: In this retrospective, multicenter study, 85 patients treated with RSA were included (2016 – 2021). 53 Patients with primary RSA and 32 with secondary RSA (17 after conservative-, 15 after surgical treatment). Patient-reported outcome measures (PROMs) were assessed: Constant-Murley Score (CMS), Oxford Shoulder Score (OSS), DASH-score and Visual Analogue Score (VAS). In addition, the range of motion (ROM) was measured.

Results: For PROMs, the following means (SD) for primary versus secondary were, respectively 25.4 (17.7) vs 29.4 (19.2) for DASH 37 (8.6) vs 37 (9.1) for OSS, 63 (19.8) vs 59 (22.0) for CMS and 2 (2.0) vs 3 (2.3) for VAS. For ROM the mean degrees were: forward flexion 113 (33.6), 106 (34.1), abduction 103 (33.4), 96 (37.3) and external rotation 20 (19.1), 20 (17.8). The PROMs and ROM showed no statistically significant differences. However, when the data was corrected for the differences in baseline characteristics (a combination of Neer and anticoagulant use had a confounding effect) significant differences in forward flexion ($p = 0.003$, B 19.85) and abduction ($p = 0.034$, B 17.34) were found in favor of primary treatment.

Conclusions: No differences were found in primary and secondary treatment with RSA concerning PROMs. However, after correction for confounding, statistically significant differences were found regarding forward flexion and abduction in favor of primary treated patients. Therefore, we conclude that in patients with complex displaced PHFs, RSA should be considered as primary treatment.

EP.05.024

PSI GUIDED FRACTURE RECONSTRUCTION USING OPPOSITE NORMAL SHOULDER CT MEASUREMENTS

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Background: arthroscopic reconstruction of proximal humeral fracture is a new emerging technique of treatment which is valuable especially in osteoporotic old patients. To ease the procedure PSI models based on CT measures were used to guide the procedure. The purpose of this paper is to evaluate the surgeries done using this procedure.

Methods: During the last 4 years 13 cases of three to four parts fracture were done using the PSI model. A CT scan is done to the fractured shoulder and a model exactly same as the original fractured proximal humerus in shape and size is made. The model is then studied preoperatively and a fracture reduction plan is made before surgery. During the surgery the sterilized model is used as a guide for closed reduction and percutaneous fixation. Then arthroscopic suturing of the fracture is made to fix the fragments together in the anatomic position followed by removal of the percutaneous wires. The age of the patients were between 52 and 80 years and 80% had osteoporosis.

Results: 9 cases of the of the 13 had a good reconstruction and healing 3 cases had a fairly good refixation of the fragments and one case failed and got a hemiarthroplasty. The range of motion was regained to 90% in half of the cases but all the patients were satisfied with the surgery and were able to use the arm without pain for daily living needs.

Conclusions: Using the PSI model as a guide in arthroscopic reconstruction of the three to four parts proximal humeral fracture of the shoulder can very much ease the arthroscopic reduction and suture transosseous fixation of the fragments.

EP.05.026

NINE CASES OF POSTERIOR FRACTURE-DISLOCATION OF SHOULDER

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Background: Traumatic posterior fracture-dislocation of the shoulder is rare injury. Despite its rarity in daily clinical practice, there is a significant diagnostic and therapeutic interest because age groups of high functional demands are often distressed. In addition, high incidence of missed initial diagnosis makes this problem much more complicated. We are reporting our experience of treating posterior fracture-dislocation of shoulder.

Methods: We reviewed 9 cases (4 fresh, 5 obsolete) of posterior fracture-dislocation of shoulder retrospectively from a viewpoint of diagnosis and treatment. All cases were men, and the cause of injury was traffic accident. The age of patient ranged from 26-68 (mean 42) years old.

Results: Among the four fresh cases, open reduction and internal fixation (ORIF) was performed in two. Of the other two cases, one was treated by closed reduction and the other was treated by open reduction without using any hardware. Among five delayed cases, two were treated in other medical institutions in advance. However, dislocation was overlooked nevertheless treated surgically in both cases. We removed the hardware and performed ORIF after a reduction of dislocation. Synostosis was achieved in these two cases. The other three old cases underwent total shoulder arthroplasty (TSA) because of their age (older than 60 years old) and prolonged period of time (over 10 years) resulting in osteoarthritis of shoulder joint after initial injury. There was no need for revision surgery after shoulder joint replacement.

Conclusions: According to our experience, posterior fracture-dislocation of shoulder can be treated conservatively if diagnosed immediately after injury. In early case, closed reduction under general anesthesia is recommended. When it comes to delayed case, more invasive treatment is needed. Treatment strategy depends on degree of displacement, patient's age, activity, and time after initial injury. Early and accurate diagnosis is the most important element for treatment of posterior fracture-dislocation of shoulder to gain good results.

EP.05.027

PREDICTING FUNCTIONAL OUTCOME FOLLOWING NONOPERATIVE TREATMENT OF PROXIMAL HUMERAL FRACTURES

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Background: Although several risk factors for poor functional outcomes following nonoperative treatment of proximal humeral fractures (PHF) have been described, a practical model for its prediction is still missing. Therefore, it was aimed to identify factors that influence functional outcome following nonoperative treatment of PHF and to develop a predictive model.

Methods: Adults with nonoperatively treated PHF were prospectively followed between 2014-2019. Radiographic parameters included fracture configuration, displacement, bone quality, and the critical shoulder angle (CSA). The neck-shaft-angle and humeral head (HH) offset assessed HH displacement. The greater tuberosity index (GTI) addressed greater tuberosity (GT) displacement while the impingement index addressed GT displacement relative to the acromion. Multivariate regression determined risk factors for poor function. Good functional outcome was defined by flexion $>120^\circ$ and external rotation $>40^\circ$ at 1-year follow-up. Recursive partitioning generated a model with risk factor thresholds to predict good and poor function.

Results: In 185 patients (mean age: 66 years), nonoperative treatment resulted in a mean Constant score (CS) of 75, a mean flexion of 140° , and a mean external rotation of 50° (good function in 72%). Female gender and older age were identified as demographic risk factors for lower CS and poorer flexion ($p < 0.001$). Increasing varus angulation assessed on anteroposterior views in internal rotation, larger GTI assessed on the Y-view and larger CSA were the radiographic parameters associated with lower CS and poorer flexion ($p < 0.001$). The generated model included all risk factors except for gender. When using the radiographic measurements at 1-year follow-up, the model's accuracy in predicting good functional outcome was 87% (sensitivity of 92%, specificity of 73%, positive predictive value [PPV] of 90%, negative predictive value [NPV] of 79%). At <2 weeks, the model's accuracy was 84% (sensitivity of 92%, specificity of 63%, PPV of 87%, NPV of 75%).

Conclusions: Apart from demographic factors, functional outcome was influenced by GT displacement and HH angulation, but also by the surrounding acromial anatomy, as a larger CSA was associated with poor function. The model accurately predicted functional outcome, using two radiographic views in the acute setting, which is useful for patient counselling regarding treatment expectations.

EP.05.028

CLINICAL AND RADIOGRAPHIC RESULTS OF LOCKING PLATE FIXATION OF PROXIMAL HUMERUS FRACTURE ACCORDING TO THE NUMBER OF MEDIAL SUPPORT SCREWS – THE MORE, THE BETTER?

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Background: The calcar of proximal humerus is an important structure for medial column support. The purpose of this study was to assess the outcome of osteosynthesis of unstable proximal humerus fracture (PHF) with medial calcar comminution using Philos locking plate and medial support screw (MSS).

Methods: Between January 2010 to December 2018, we retrospectively analyzed the outcome of 121 cases of osteosynthesis for PHFs with medial column disruption. At least one oblique screw were inserted subchondrally in the inferomedial quadrant of the humeral head to provide medial support. All patients were subdivided into two groups as follows: 26 patients in the single medial MSS group, 95 patients in the multiple MSS group. Follow-up for at least 1 year with clinical and radiographic outcome evaluations including Constant-Murley score, University of California, Los Angeles (UCLA) score, visual analogue scale (VAS), complications, neck-shaft angle (NSA) using the Paavolainen method, humeral head height (HHH) and time to bone union. Risk factors for fixation failure were assessed using the multivariate logistic regression analysis.

Results: Mean age was 64.4 ± 15.4 years, and the mean follow-up duration was 19.5 ± 7.6 months. Between single MSS group and multiple MSS group, there was no significant difference in Constant-Murley score ($p=0.367$), UCLA score ($p=0.558$), VAS ($p=0.571$), time to bone union ($p=0.621$), NSA loss ($p=0.424$), and HHH loss ($p=0.364$) at final follow up. There were no significant differences in the incidence of complications ($p=0.446$) based on the number of MSS. The initial insufficient reduction after surgery ($NSA < 125^\circ$) has been found to be a meaningful risk factor for development of complications.

Conclusions: In the treatment of unstable PHFs with locking plate system, satisfactory outcome could be achieved using at least one MSS. Successful operative treatment with locking plate for PHF is inherent upon anatomical fracture reduction coupled with medial column support.

EP.05.030

VOLUMETRIC MICROSTRUCTURAL IMAGING OF THE FRACTURE MECHANISM OF REVERSE SHOULDER IMPLANTS

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Background: Complications of reverse shoulder arthroplasty include intraoperative and postoperative fracture, loosening, and stress shielding [1]. This study presents a novel time-elapsd microstructural imaging protocol for observing the volumetric deformation of a humerus implanted with a common reverse shoulder implant subjected to a physiological loading configuration, increased up to cause the failure of the implant.

Methods: Ethics clearance was obtained. A humerus from a male donor (age at death: 75 years) was obtained through the institutional Medical Engineering Research Facility (MERF). The diaphysis was cut 220 mm from the superior head. The humerus head was aligned to the vertical axis of a custom-made radio-transparent compressive stage replicating an extreme physiological load configuration and potted 55 mm deep in aluminum cups by using dental cement [2]. The compressive stage and the specimen were mounted in a large-volume micro-CT scanner (Nikon XTH225 ST, Nikon Metrology, UK). The specimen was scanned using a compressive pre-load of 50 N applied followed by a second scan under 650 N. The humerus was then implanted with an Aequalis reversed II stem (Stryker Inc.), using the inlay technique. The implanted specimen was scanned three times under 50 N, 650 N compression, and after a fracture. The 6-component reaction force was recorded during the experiment. Micro-CT cross-section images were reconstructed and examined.

Results: A vertical compression equal to 1.5 mm generated 650 N reaction force. Increasing the displacement to 3 mm, the force reached 2000 N, before dropping to 1000 N (fracture). At 650 N compression, most deformation occurred in the peri-prosthetic bone. A longitudinal fracture, opening proximally, was accompanied by a significant distal migration of the implant stem.

Conclusions: The protocol successfully displayed the displacement of the implant under physiological load and after fracture and a fracture consistent with fracture of the proximal humerus observed in the clinics. The trabecular bone appears to mostly provide support for implant stability, while fracture likely occurred due to increased circumferential strain, caused by the implant migrating distally. Therefore, the protocol can be used to provide micrometric information on the response of the entire implant volume to loading and fracture.

EP.05.031

CLINICAL AND RADIOGRAPHIC OUTCOMES OF CEMENTED VERSUS UNCEMENTED REVERSE SHOULDER ARTHROPLASTY FOR TREATMENT OF PROXIMAL HUMERUS FRACTURE WITH 2-YEAR FOLLOW UP.

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Background: Reverse shoulder arthroplasty (RSA) for treatment of proximal humerus fractures is a well-established treatment. Debate exists on whether cemented or uncemented humeral fixation is utilized. The purpose of this paper is to compare the outcomes of RSA for the treatment of displaced humeral head fractures treated with either a cemented or uncemented humeral component fixation.

Methods: Between 2017 and 2020, a retrospective review was conducted on a consecutive series of patients undergoing RSA for a diagnosis of proximal humerus fracture (PHF). 29 patients were identified that underwent a uncemented RSA for PHF and 23 had a cemented RSA for PHF. Average age was 71 (40-88) and 73 (56-92) years old for the uncemented(UC) and cemented(C) cohorts, respectively. The UC group had 5 males (17%) and 24 females (83%), and the C group had 7 males (30%) and 16 females (70%). Average BMI was 28.5 and 28.6 for the UC and C cohorts, respectively. Distribution of fracture type on Neer's classification were similar between groups with most fractures classified as 3 or 4 part fractures. Outcome data including radiographic assessment of stem stability and tuberosity reconstruction was compared between UC and C cohorts.

Results: Humeral stem stability was seen in all cases reviewed to date and similar rates of tuberosity migration and resorption are seen between groups. Uncemented and cemented cohorts also had similar ASES postoperative scores and pain scores. There was one intraoperative complication of fracture in the UC cohort and was managed successfully with cerclage wire placement.

Conclusions: This study demonstrates that similar outcomes result from UC humeral technique compared to cemented humeral technique in the management of proximal humerus fractures with reverse shoulder arthroplasty. This study provides evidence to support the use of uncemented technique in the treatment of proximal humerus fractures with reverse shoulder arthroplasty.

EP.05.034

SINGLE OR DOUBLE PLATING FOR ACROMIAL TYPE III FRACTURES: BIOMECHANICAL COMPARISON OF LOAD TO FAILURE AND FRAGMENT MOTION

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Background: Acromial Levy III fractures after inverse shoulder arthroplasty occur in up to 7% of patients. To date, it is not clear how these fractures should be treated as clinical outcomes remain unsatisfactory. The aim of this study was to evaluate the biomechanical performance of three different plating methods of type III acromion fractures.

Methods: Levy III fractures in synthetic scapulae were fixed with three different methods. Angular stable locking plates were placed on the spina scapula to bridge the fracture either dorsally, caudally, or on both aspects by double plating. In a biomechanical experiment, the pull of the deltoid muscle at 40° abduction of the arm was simulated by cyclic loading with increasing load levels until failure. Failure load, cycles to failure, and fragment motions were evaluated.

Results: The results showed that double plating (350 ± 63 N) withstood the highest loads until failure, followed by dorsal (292 ± 20 N) and caudal (217 ± 49 N) plating. Similarly, double plating showed significantly smaller fragment movement than the other two groups.

Conclusions: Double plating appeared to provide the largest biomechanical stability in type III acromion fracture under arm abduction. Caudal plating in contract resulted in insufficient fracture stability and early failure and can thus not be recommended from a biomechanical point of view.

EP.05.035

REVERSE TOTAL SHOULDER ARTHROPLASTY FOR COMPLEX PROXIMAL HUMERUS FRACTURE IN THE ELDERLY: CLINICAL AND RADIOLOGICAL RESULTS

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Background: PHF'S are the third most common fragility fracture in patients over 60 years. Most are nondisplaced, lead to little long-term issues, and are treated non-surgically. Furthermore, displaced multi-fragmented fractures may be treated surgically with RSA being an alternative. Studies have shown that RSA is less dependent on GT healing compared to hemiarthroplasty and has several theoretical benefits such as increased external rotation, diminished risk of infection and humeral stem loosening, and improved deltoid wrapping with GT healing.

Methods: Retrospective study including 400 consecutive 3-4 part proximal humerus fractures treated with reverse shoulder arthroplasty with a minimum of 12 months follow-up. In all the cases, the greater tuberosity was reattached with a standardized suture technique and a local bone graft. All the patients were assessed at the 12-month follow-up with Constant-Murley Score (CMS). Radiographic healing of the greater tuberosity was noted. Complications and revision rates were reported.

Results: Mean final CMS for this cohort was 82 points. The greater tuberosity healed in anatomic position in 85% of the cases (N = 340), obtaining an average CMS of 85 in these patients. Healing of the greater tuberosity did not occur in 13% of the cases (N = 52) and displacement more than 5 mm occurred in 2% (N = 8) of the patients for an average CMS of 60. All patients scored above 120° in forward elevation with a mean of 150°. Mean active external rotation was 35°. Lateralized Shoulder Angle (LSA) had a mean of 91° and Distalization Shoulder Angle (DSA) had a mean of 54°. Low-grade scapular notching was reported in < 1% of the cases. A total of 60 patients presented failure of healing or displacement of the greater tuberosity. Major complications were reported in nine patients. Of these nine patients, two acquired superficial wound infections, while two had deep shoulder prosthetic infection. Two other patients developed hematomas, one sustained an acromial stress fracture, and two had a stem loosening. There were 4 reoperations.

Conclusions: Reverse shoulder arthroplasty, with the use of a fracture-specific stem allows an improved rate of greater tuberosity healing and short-term clinical outcomes in the elderly population.

EP.05.036

HIGHER PRIMARY STABILITY OF TUBEROSITY FIXATION IN REVERSE FRACTURE ARTHROPLASTY WITH 135 DEGREES THAN WITH 155 DEGREES OF HUMERAL INCLINATION

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Background: Proximal humeral fractures in elderly patients are frequently treated with reverse total shoulder arthroplasty, and tuberosity healing improves clinical outcome and patient satisfaction. So far reverse prostheses with different humeral inclination (HI) angles have been used. However, it has not been investigated yet if the HI angle affects the primary stability of the tuberosity fixation in primary reverse total shoulder arthroplasty for proximal humeral fractures in a biomechanical setting.

Methods: A 4-part fracture was created in 7 paired human cadaver proximal humeri. After randomization in a pairwise fashion, reverse prostheses with either 135°(n=7) or 155°(n=7) were implanted. The tuberosities were reduced anatomically to the metaphysis of the prostheses and were fixed with 3 suture cerclages in a standardized technique. Tightening was performed with a cerclage tension device with 50 Newton meter (Nm). Before biomechanical testing, the initial vertical and horizontal gap formation was measured. The humeri were placed in a custom-made test setup enabling internal and external rotation. Cyclic loading with a gradually increasing load magnitude was applied with a material testing machine starting with 20 N m and increasing by 5 Nm after each 100th cycle until failure (>15° rotation of the tuberosities). Any motion of the tuberosities was measured with a 3-dimensional camera system.

Results: Overall, the 155° group reached an average of 1460±270 cycles and the 135° group of 1900±271 cycles (P=.048). In contrast to the 135° group, in the 155° group, a mean initial vertical (0.3±0.7 mm) and horizontal (2.7±3.3 mm) gap formation could be observed before cyclic loading. After 1100 cycles, the 155° group showed increased rotation of both lesser and greater tuberosities in all 3 axes around the humeral shaft compared with the 135° group.

Conclusions: Primary stability of the reattached tuberosities is significantly increased, whereas rotational movements are decreased in prostheses with an anatomic HI of 135° compared with a 155° HI according to the original Grammont design. In addition, a 135° HI allows an exact anatomic reposition of the tuberosities, whereas this was not possible for the 155° design. However, transferability and clinical relevance of these biomechanical results have to be verified with clinical studies.

EP.05.039

ACROMIOCLAVICULAR SURGICAL TREATMENT: OUR EXPERIENCE

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Background: Surgical treatment for acromioclavicular dislocations is usually reserved for Rockwood grade IV-V whereas for grade III injuries treatment still remains controversial.

There is a wide range of surgical options reflecting the lack of consensus as to the gold standard. Our goal is to describe the results of the surgical technique using a double-button arthroscopic fixation system followed by acromioclavicular reinsertion with anchors.

Methods: Observational retrospective study of all patients with acromioclavicular dislocations submitted to the aforementioned surgery in our centre from 2019-2022. Demographic, clinical and radiologic data were collected. Pre-op, post-op and last follow-up radiographs were assessed and coracoclavicular and acromioclavicular distances were measured by two orthopaedic surgeons. All patients were operated by the same senior surgeon in a reproducible fashion. Results are presented in mean (\pm standard deviation) and median (Percentile25-Percentile75) according to normality.

Results: Twenty-five patients were included in this study, 23 were male (96%), median age 40 (31-45) and 68% had right side injury. Twenty patients had a Rockwood grade III injury and 5 grade V injury. Patients were admitted for a mean 1,88 (\pm 2,08) days and followed up to a mean 7 (\pm 6,97) months. Coracoclavicular distances decreased significantly from pre-op median 20mm (18-28,76), post-op 9mm (6,45-10,150) and last follow-up 10,5mm (9,2-15.5), ($p < 0,01$). Acromioclavicular distances decreased significantly from pre-op median 11,8mm (10,1-14,5); post-op 4,1mm (3-5) and follow-up 4,2mm (3-6), ($p < 0,01$). We report only two complications: one wound infection and one adhesive capsulitis, both treated conservatively. Full unrestricted range of motion was present in 21 patients (84%) whereas the remaining four have slight limitations in final range of external rotation. All patients returned to work and report no pain in daily activities.

Conclusions: Despite controversy regarding grade III acromioclavicular dislocation treatment, surgical vs. conservative and between the surgical treatment of choice, we report very good outcomes with early return to work, full range of motion and patient satisfaction.

Our surgical technique was effective in maintaining acromioclavicular reduction, with excellent functional outcomes and minimal complications.

EP.05.040

DO PRE-OPERATIVE SCAPULAR FRACTURES AFFECT OUTCOMES AFTER REVERSE SHOULDER ARTHROPLASTY?

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Background: Post-operative scapula stress fractures (SSF) are a formidable problem after reverse shoulder arthroplasty (RSA). Less is known about these fractures pre-operatively. This study will identify the incidence, morphology, and impact on clinical outcomes in patients undergoing primary RSA with an SSF.

Methods: Patients with cuff tear arthropathy (CTA), massive cuff tear (MCT), or rheumatoid arthritis (RA) who underwent RSA between 2000 and 2020 by a single surgeon were reviewed. Patients undergoing primary RSA with existing pre-operative CT and a minimum two-year follow-up were included. Pre-operative CTs were reviewed and identified 525 shoulders that fit inclusion criteria (CTA 337, MCT 153, and RA 35). 72 shoulders had scapula fractures. ASES scores were compared pre- and post-operatively. Fractures were classified by their morphology into three groups 1)os acrominale, 2)multi-fragments (MF), and 3) Levy types. Three observers with a several week washout period was performed to estimate observer error. Of the 72 shoulders there were 73 fractures with 40 Os, 2 Levy, and 31 MF. Inter and intraobserver agreement was 98.6% and 96.7%, respectively.

Results: The total incidence of SSF in all shoulders was 13.6% (CTA with 55 - 16.3% incidence, MCT with 14 - 9.2% incidence, and RA with 3 fractures - 8.6% incidence). The fracture group had an average pre-operative ASES score of 39.4 ± 18.2 and an average final ASES score of 67.7 ± 21.9 ($p < 0.001$). MF factures alone had an average final ASES score of 59.2 ± 22.3 vs the Os and Levy facture group combined had an average final ASES score of 74.5 ± 9.4 ($p = 0.0002$).

Conclusions: This study observed an incidence of SSF of 13.6% compared to 3-8% in the general population. Patients with SSF still see an improvement in ASES after RSA, however the variation of morphology of these fractures with a reproducible classification demonstrates that MF group has inferior outcomes compared to the Os/Levy group.

EP.05.041

THE RADIOGRAPHIC AND CLINICAL OUTCOME OF ORIF USING THE FEMORAL HEAD ALLOGRAFT FOR COMMINUTED PROXIMAL HUMERAL FRACTURES

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Background: In patients with comminuted proximal humeral fractures and epiphyseal fracture void, we performed osteosyntheses by locking plate using an allograft bone augmentation. We aimed to assess the radiographic and clinical outcome after ORIF (open reduction and internal fixation) using the femoral head allograft for comminuted proximal humeral fractures.

Methods: We retrospectively reviewed 12 patients (two male, ten female, mean age, 74.3 years) who underwent ORIF using the femoral head allograft for comminuted proximal humeral fractures, between 2018 and 2021 and completed more than 1year follow up. We assessed the postoperative Japanese Orthopaedic Association (JOA score, a 100-point scoring system), complications as well as radiographic findings using the neck shaft angle (NSA).

Results: An average follow up period were 16.3months (range, 12 to 37weeks). All cases of fractures were healed. The postoperative JOA score was 82.5point (range, 68 to 89) at the latest follow up. Regarding postoperative complications, there were one shoulder stiffness, one screw perforation, and one varus malunion. We had no avascular necrosis of the humeral head, nonunion or post-transplant infection. The correction loss of NSA after surgery was 5.9 degrees (range, 2 to 32degrees). Only one patient had more than 20 degrees of the loss of correction of NSA (varus malunion).

Conclusions: Our results demonstrated good clinical outcomes after ORIF using the femoral head allograft for comminuted proximal humeral fractures. These results suggest that ORIF using the femoral head allograft may be a viable treatment option for comminuted proximal humeral fractures in elder patients.

EP.05.042

OUTCOMES OF PERCUTANEOUS INTRAMEDULLARY NAIL FIXATION FOR 2-, 3- AND 4-PART PROXIMAL HUMERUS FRACTURES

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Background: Percutaneous placement of an intramedullary nail (IMN) for Neer 2, 3- and 4-part proximal humerus fractures (PHFx) can provide stable fixation with limited dissection of the fracture site. The purpose of this study was to evaluate the outcomes and complications in patients who underwent percutaneous IMN for 2-, 3- or 4-part PHFx.

Methods: From August 2009 through March 2020, 75 were treated for Neer 2, 3, or 4-part PHFx using a percutaneous IMN. Criteria for inclusion were a fracture of the proximal humerus without shaft extension and a minimum of 12-month follow-up. Patient reported outcomes evaluated were VAS pain, ASES score, SANE/SSV and patient satisfaction. Active range of motion was measured last available radiographs were reviewed.

Results: 58 subjects met inclusion criteria (49 female, 9 male), 26 had 2-part, 26 had 3-part, and 6 had 4-part fractures. The average age at time of surgery was 63.2 ± 13.8 years (range, 24-85) and average follow-up was 32.0 ± 22.5 months (range, 12 - 102). At final follow-up 80% of the patients were "Satisfied/Very Satisfied" with their function, mean SANE/SSV score was 78 (± 25), and average VAS pain score was 2.0 (± 3). Radiographic healing was noted in 55 subjects (95%) with malunion observed in 3 cases (5%). Patients with 2-part fractures had significantly improved abduction ($p = 0.014$), and internal rotation ($p=0.029$) compared to 3- and 4-part fractures.

Eleven patients (19%) had complications requiring surgical intervention. Four occurred in 2-part, 6 in 3-part and 1 in 4-part fractures. Complications included stiffness requiring arthroscopic debridement ($n=6$), rotator cuff repair ($n=1$), and revision to arthroplasty in 4 due to AVN ($n=3$) or persistent rotator cuff deficiency ($n=1$) resulting in a revision rate of 7%

Conclusions: Percutaneous repair of a PHFx using an IMN can result in acceptable clinical outcomes regardless of fracture type. We observed a low rate of severe complications over a long duration of follow-up (12 - 102 months) with complication and revision rates similar to those reported for locking plate fixation. The limitations of this study are its retrospective nature and the small cohort of 4-part fractures available for analysis.

EP.05.043

REVERSE SHOULDER ARTHROPLASTY IN ACUTE PROXIMAL HUMERAL FRACTURES - THE DFER APPROACH

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Background: Marginal outcomes are seen for fixation of comminuted proximal humeral fractures (PHF) in the elderly. Reverse shoulder arthroplasty (RSA) has been increasingly used in these cases. Literature demonstrates the importance of tuberosity reattachment and healing to ensure satisfactory outcomes postoperatively. The purpose of this study is evaluate outcomes of RSA for comminuted PHF in the elderly using an approach based on 4 important principles: Delayed surgery; Functional tuberosity reattachment; External rotation abduction brace; early Rehabilitation (DFER).

Methods: Consecutive patients with comminuted PHF who underwent RSA following DFER approach performed by fellowship trained shoulder subspecialist from 2016 to May 2022 were included in this prospective study. Clinical and functional outcome measures were recorded preoperatively and at 6, 12 and 24-months postoperatively. These included range of motion, VAS, Constant Score (CMS), and ASES score. Subgroup analysis of outcomes between those who complied vs non-complied with postoperative rehabilitation was carried out. Plain radiographs were performed at 1- and 2-years, whereas CT scan were conducted at 3-months postoperatively as part of standard clinical practice to assess tuberosity healing.

Results: Forty patients were included in the study, mean age 73 (range 53-88). Early, medium, and late outcomes were assessed individually. Clinical and functional improvements were noted (Pre-surgery vs 6-months vs mean final followup = 14 months); VAS (6 vs 1 vs 1), CMS (9 vs 57 vs 62), ASES Score (30 vs 78 vs 84). Range of motion (6-months vs mean final followup) was forward flexion (137 vs 142), lateral elevation (132 vs 134), ER1 (38 vs 42) and IR (49 vs 52). Subgroup analysis (physiotherapy compliant vs noncompliant (n=6)) showed VAS (1 vs 2), CMS (63 vs 51), ASES score (86 vs 73), forward flexion (145 vs 130), lateral elevation (136 vs 122), ER1 (43 vs 33). One- and 2-year radiographs did not demonstrate any tuberosity dehiscence.

Conclusions: The DFER approach results in satisfactory outcome in RSA for acute PHF, ensuring rigid tuberosity fixation and early active mobilization following surgery. Patients who were not able to follow prescribed rehabilitation protocol did not do as well as those who were compliant with physiotherapy.

EP.05.044

ARTHROSCOPIC REDUCTION AND TRANSOSSEOUS FIXATION OF THREE AND FOUR PARTS FRACTURE OF THE PROXIMAL HUMERUS IN OSTEOPOROTIC PATIENTS

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Background: In this study we describe a new technique and evaluate the functional results of arthroscopic transosseous reconstruction of three and four parts of proximal humeral fracture in patients with osteoporosis. To our knowledge no study in the literature describing arthroscopic reduction and suture fixation of three to four parts proximal humeral fractures in patients with osteoporosis is published.

Methods: The surgery is done with arthroscopic reduction of the bony fragments and fixation with temporary K-wires. Intraarticular and extraarticular straight holes will be made in which sutures are placed and the fragment are fixed with sutures. Then the wires are removed and after an immobilization period of 4 weeks exercises will start following radiological control. 29 patients were treated with this technique between March 2014 and December 2020. Three patients were lost and 26 were followed with an average follow up 34 months (between 18 months and 6 years). There were 16 cases of three parts fracture with moderate dislocation, 6 cases of 4 parts and 4 cases with 3 parts and rotator cuff tear. All patients had osteoporosis. All cases were re-examined clinically and radiologically

Results: According to Neer classification excellent results were present in 8 cases (40%) of the 3 parts, satisfactory results were in 8 of the 3 parts (40%) and 3 of the 4 parts (50%) while unsatisfactory results were present in 4 of the 3 parts (20%) and 3 of the 4 parts (50%).

Conclusions: The early result strongly encourage using the arthroscopic techniques to treat proximal humerus fractures especially in cases of osteoporosis and old patients who refuses open surgery or are not suitable for open surgery.

EP.05.045

RADIOLOGICAL AND FUNCTIONAL OUTCOMES OF THE EXTRA-ARTICULAR SCAPULA FRACTURES FIXATION WITH DUAL PLATE

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Background: Displaced extra-articular fractures of the scapula are uncommon, and rarely require operative fixation. When managed operatively, a posterior Judet approach with detachment of the deltoid muscle from the scapular spine and elevation of the infraspinatus from its fossa, is often performed. Our aim is to assess the functional and radiological outcomes of dual plate fixation using Judet approach

Methods: We performed a retrospective cohort study of all patients who underwent operative fixation of their extra-articular scapula fracture (with at least 12 months follow up), using Judet approach. Operative indications included patients with an extra articular scapular neck or fracture, with medial/lateral displacement of more than 20 mm, angulation more than 45°, double disruption of the shoulder suspensory complex, and glenopolar angle (GPA) less than 22°. Functional outcomes were assessed by the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire, the Simple Shoulder Test (SST) score, pain score & return to work. Radiological assessment was done by 2 independent observers

Results: Between January 2017 and December 2020, 12 patients (10 males and 2 female) underwent fixation of their scapula fracture using Judet approach. Mean age was 43.7 years. All fractures had healed at the time of the final follow-up. The scapular neck angulation was corrected from 27.7° pre-operatively (14-52°) to 2.1° post-operatively (0-10°). The mean post-operative GPA was 33.4° (30.3°-38.6°). None of the patients had superficial or deep infections, or post-operative neurovascular injuries. The SST score was 10.8± 0.4 and mean pain score was 0.7 (0-3). The mean DASH score was 9.5± 2.4. All patients returned back to their pre-injury work, with an average return to work of 5.2 months (2 months-8 months).

Conclusions: Dual plating of the of the scapula through the Judet approach is associated with correction of scapular angular deformity, no complications and good clinical results at more than 12 months' follow-up.

EP.05.046

EARLY RESULTS FOR NOVEL USE OF INTRANASAL CALCITONIN FOR TREATMENT OF NON-DISPLACED ACROMIAL AND SCAPULAR SPINE STRESS FRACTURES AFTER REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: Acromial and scapular spine stress fractures (AF/SSF) have remained a persistent complication of the reverse shoulder arthroplasty (RSA) despite advancements in prosthesis design. Currently, there is no consensus on how best to treat AF/SSFs in the nonoperative setting. The purpose of this study is to investigate the use of intranasal calcitonin, a novel off-label non-operative treatment modality, for the treatment of AF/SSF following RSA.

Methods: A retrospective review was conducted at a single institution to identify patients who were treated with intranasal calcitonin for AF/SSF following RSA, performed by one of two providers, from 2018 onwards. Treatment was regimented calcitonin (salmon) 200 unit/actuation nasal spray (1 spray into one nostril per day) for 6 weeks. Each patient was monitored through routine bloodwork. The primary and secondary outcomes of this study are visual analogue scale (VAS) and the American Shoulder and Elbow Surgeons (ASES) scores, as well as functional outcomes via active range of motion (AROM) measurements. Fracture union was evaluated from patient imaging (CT and x-ray) by a musculoskeletal radiologist or board-certified orthopedic surgeon.

Results: Ten patients met inclusion criteria. The primary indication for RSA was rotator cuff arthropathy, and the average time to complication was 6.03 months. Nine of the ten fractures were acromial fractures (Levy I and II), while the remaining fracture was a scapular spine fracture (Levy III). VAS, AROM, and ASES scores all significantly improved preoperatively to postoperative, and subsequently all three parameters significantly worsened from the postoperative time-point to presentation of fracture. Following completion of the intranasal calcitonin treatment, the mean VAS, AROM, and ASES all significantly improved. Patients reported an average improvement in VAS of 5.6 points, a gain of 43.5 degrees of AROM, and a 42 point increase in ASES score following intranasal calcitonin.

Conclusions: Intranasal calcitonin proved safe, and significantly improved the clinical and functional outcomes of patients presenting with non-displaced AF/SSF. Given the early results of this novel, non-operative treatment modality, orthopedic providers may consider the use of intranasal calcitonin in the setting of AF/SSF following RSA. Further investigation on the efficacy of intranasal calcitonin in comparison to other nonoperative treatment modalities is warranted.

EP.05.047

TRENDS IN THE TREATMENT OF PROXIMAL HUMERUS FRACTURES IN THE UNITED STATES MEDICARE POPULATION

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Background: Many factors influence the decision making in the treatment of proximal humerus fractures. With the increasing popularity of reverse total shoulder arthroplasty (RSA), treatment strategies for proximal humerus fractures are evolving. The extent to which expanding indications for reverse total shoulder arthroplasty has impacted the way surgeons treat these fractures is still under question. The purpose of the current study was to determine trends in treatment of proximal humerus fractures in the United States Medicare population from 2010-2019.

Methods: The Mariner subset of the PearlDiver national insurance database, was queried for Medicare patients who sustained a proximal humerus fracture from 2010-2019. Using CPT and ICD 9 and 10 codes we evaluated which were treated nonoperatively versus operatively in the acute setting. Operative interventions included RSA, hemiarthroplasty, or open reduction internal fixation (ORIF). Medicare patients greater than 60 years of age were included for analysis. Poisson regression was used for prevalence trends. Chi square test was used to detect differences in operative treatments. Descriptive statistics were calculated. Statistical significance was set at <0.05 .

Results: In the USA Medicare population, the prevalence of operative management of proximal humerus fractures remained largely unchanged (6.5% of fractures treated operatively in 2010, compared to 6.3% of fractures treated operatively in 2019; $p=0.64$). The utilization of RSA for proximal humerus fractures increased substantially during the last decade (8.9% of operations in 2010, compared to 50.9% of operations in 2019; $p<0.001$). Hemiarthroplasty has continuously decreased (24.6% of operations in 2010, compared to 5.2% of operations in 2019; $p<0.001$). The utilization of ORIF for these fractures has also decreased (69.2% of operations in 2010, compared to 47.7% of operations in 2019; $p<0.001$).

Conclusions: In the USA Medicare population, there was no difference in the overall proportion of proximal humerus fractures treated operatively from 2010-2019. Trends in surgical treatment have been evolving during the last decade with the use of hemiarthroplasty and ORIF for these fractures continuing to decline significantly. Conversely, more surgeons are choosing RSA as their preferred treatment for proximal humerus fractures in this patient population.

EP.05.048

UNDERSTANDING OUTCOMES WITH RSA FOR PROXIMAL HUMERAL MALUNIONS

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Background: Proximal humeral fractures are common in patients over the age of 60 years, but the optimal management remains debated. Reverse shoulder arthroplasty (RSA) has recently emerged as the preferred operative management option for complex proximal humeral fractures in the elderly. Although RSA seemingly provides satisfactory clinical and functional outcomes in patients with complex proximal humeral fractures (PHF), little is known of the clinical and functional outcomes of patients of delayed treatment of proximal humerus fractures treated with RSA. The purpose of this study was to investigate postoperative clinical outcomes in patients with malunions of PHF treated with RSA.

Methods: A retrospective clinical evaluation of 39 patients diagnosed with complex, nonunion or malunion of proximal humeral fractures who underwent RSA performed by a single surgeon in a single institution from 2012 to 2019 was performed. Preoperative and postoperative clinical outcomes including range of motion, Simple Shoulder Test (SST), Constant Score, ASES Shoulder Score, UCLA Score, Shoulder Pain and Disability Index (SPADI), and Shoulder Arthroplasty Smart (SAS) score were recorded and assessed using paired t-test. Clinical outcome measurements were obtained at a minimum 1-year follow up.

Results: The mean age of patients included in this study was 72 years with an average BMI of 24.6 at the time of surgery and average follow up of 12.6 months. The majority of the cohort was Caucasian (92.3%) and female (76.9%). Postoperative measurements of active abduction (96.2°, $p = 0.003$), active forward elevation (103.1°, $p = 0.010$), SST (5.73, $p = 0.011$), Constant Score (63.6, $p = 0.018$), ASES Shoulder Score (51.3, $p = 0.007$), and SPADI (63.3, $p = 0.011$) were significantly improved from preoperative measurements. All other correlations were not statistically significant.

Conclusions: There were significant improvements in clinical outcomes for RSA used to treat malunions or nonunions. While RSA may be a viable option for management of malunion and nonunion of proximal humerus fractures, additional focus on optimizing outcomes with RSA should be considered. Surgeons should educate patients presenting with proximal humeral malunions on their expected outcomes and limited improvements following RSA.

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COMPARATIVE STUDY OF PATIENTS WITH MIDSHAFT CLAVICULAR FRACTURE TREATED WITH A LOCKED PLATE VIA AN OPEN VERSUS PERCUTANEOUS APPROACH

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Background: There are few published studies on OMIP in clavicle fractures, with only 2 comparative, and of these, 1 randomized. Our main objective is to compare the results of surgical treatment of midshaft clavicular fractures, treated with the technique of minimally invasive osteosynthesis with locked plate (OMIP) versus open reduction and internal fixation (ORIF) with locked plate.

Methods: Quasi-randomized comparative study, evaluating displaced fractures of midshaft clavicular fractures treated with OMIP versus ORIF, with procedures performed by a single surgeon. We evaluated patients at 12 months using the UCLA scale and radiographically at 8, 12, 26 and 52 weeks, in addition to describing complications.

Results: We evaluated 44 patients, 22 submitted to OMIP and 22 to RAFI. The median UCLA scale at 12 months was 35 in the RAFI group and 35 in the OMIP group ($p=0.712$). All patients had fracture healing at 3 months ($p>0.999$). The mean surgery time was 87.5 minutes in RAFI and 47.5 in OMIP ($p<0.001$). As complications, 1 suture dehiscence (4.5%), 2 protruding plates (9.1%) and 1 damage of sensitivity around the surgical wound (4.5%) were observed in the OMIP group, while in the RAFI group, 15 sensitivity damages (68.2%) and 3 hypertrophic scars (13.6%). The only complication that showed a difference between the groups was the change in sensitivity ($p<0.001$). No cases of pseudarthrosis and failure of osteosynthesis were identified in either technique.

Conclusions: This study demonstrated that both treatments, both RAFI with locked plate and locked OMIP, are equally effective methods in the treatment of displaced fractures of the middle third of the clavicle. However, surgical time and preservation of supraclavicular nerve sensitivity are factors of superiority in OMIP.

EP.05.051

INTRAMEDULLARY NAILING VERSUS LOCKING PLATE FIXATION FOR PROXIMAL HUMERUS FRACTURES: A RETROSPECTIVE COHORT STUDY

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Background: Representing 4-5% of all fractures, proximal humerus fractures are the third most common fracture in the adult population. The two primary surgical management options are intramedullary nailing and locking plate fixation. There remains no consensus on which fixation method is superior.

Methods: We conducted a retrospective cohort analysis of all proximal humerus fractures managed with intramedullary nailing or locking plate fixation over a 2 year period at our trauma hospital. Participants were all aged 16 years or older. The method of fixation was determined by our treating surgeons. Operative time was recorded. Clinic follow-up of each patient was arranged. Outcome measurements were the American Shoulder and Elbow Standardized Shoulder Assessment (ASES score) and the Shoulder Pain and Disability Index (SPADI). The range of motion deficit was also assessed.

Results: The mean age of our 116 study participants was 59 years. Mean time to clinic follow-up was 9 months. 59 fractures were managed with locking plate fixation, while 57 were managed with intramedullary nailing. We identified a statistically significant improvement in abduction deficit in our intramedullary nail cohort (24.3 degrees; 95% CI 16.0 - 32.6; p=0.003) compared to the locking plate cohort (46.1 degrees; 95% CI 35.1 - 57.1; p=0.04). Furthermore, we identified a statistically significant reduction in operative time in our intramedullary nail cohort (2.03 hours; 95% CI 1.52 - 2.54; p=0.03) compared to the locking plate cohort (3.47 hours; 95% CI 2.67 - 4.28; p=0.03). No statistically significant difference was identified between the two groups on assessment of forward flexion, external rotation, and internal rotation. Additionally, we found no statistically significant difference in ASES or SPADI scores between humeral nail and plate fixation, although all scores trended in favor of humeral nailing.

Conclusions: All of our study outcomes trended in favor of humeral nail fixation. However, only abduction deficit and operative time reached clinical significance. A higher powered study may identify a statistically significant difference across these additional outcome measures. Moreover, further studies are required to confirm this result over a multi-center population.

EP.05.052

TREATMENT OF HUMERAL DIAPHYSIS FRACTURE - RETROSPECTIVE COMPARISON BETWEEN INTRAMEDULLARY NAIL VS MINIMALLY INVASIVE PLATE (MIPO)

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Background: conservative treatment has its proper indications well established in the current literature, there are situations and certain types of fractures in which the surgical treatment is the gold standard with more predictable outcomes. However, the current trend in the use of techniques with relative stability (such as intramedullary nails and MIPO) when technically viable, presents less damage to the soft tissue envelope and has their interest increasing substantially. Therefore, this study aims to compare the treatments of humeral shaft fractures treated with antegrade intramedullary nails and minimally invasive plate (MIPO) to assess significant differences in healing time and the incidence of clinical and radiological complications.

Methods: A retrospective cross-sectional, single-center cohort study, with patients with humeral shaft fractures surgically treated with intramedullary nail and MIPO between 2016 and 2022. We collected functional, clinical, and radiological data.

Results: 65 patients have their data collected, (47 patients with intramedullary nail and 18 with MIPO.) No statistically significant difference was found in consolidation time and incidence of neurological injury secondary to surgery in the 2 groups. The incidence of pseudarthrosis was significantly higher in the MIPO group ($p=0.1083$). No differences were found in the reoperation rate. On the other hand, postoperative stiffness was significantly higher in the group treated with intramedullary nail, with deficits in external rotation and lateral elevation being the most affected. Regarding the incidence of suture dehiscence/ superficial infection, there were no differences between groups.

Conclusions: In our study, no technical superiority was found between intramedullary nail and MIPO, each with its advantages and disadvantages, both techniques being equally valid and composing the arsenal for the treatment of these fractures, and their indication, depending on the fracture pattern, surgeon's experience, and material availability.

EP.05.053

ARTHROSCOPIC RECONSTRUCTION OF COMMINUTED GLENOID FRACTURES USING DISTAL TIBIA ALLOGRAFT RESULTS IN EXCELLENT POST-OPERATIVE OUTCOMES

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Background: Boney Bankart injuries with a fragment from the anterior rim of the glenoid are not the most frequent ones after an anterior shoulder dislocation but can cause severe impairment of the joint and residual instability directly related with the amount of bone avulsed. Different treatment options have been described including fixation or reconstruction of the glenoid bone using distal tibia allograft. The primary objective of this study is to analyze and compare clinical outcomes, Western Ontario Shoulder Instability (WOSI) scores, complication, and re-dislocation rates.

Methods: This study included patients who underwent arthroscopic surgery for glenoid fracture between 2012-2020. Patients were included if they sustained a type Ia glenoid fracture according to Ideberg-Goss classification and if they were treated arthroscopically within three months of injury with one of two surgical techniques; Fixation (including fracture fragment reduction and fixation with screws, buttons, or sutures and anchors), and glenoid reconstruction. Patients were excluded if they had concomitant fractures to ipsilateral humerus or clavicle during injury and history of ipsilateral shoulder instability. Demographic information, WOSI scores, and complications related to the surgery, or new dislocation events were recorded.

Results: Thirty-eight patients were included with both the fixation and reconstruction groups had similar demographics and baseline characteristics, except for the percentage of patients with comminution which was higher in the reconstruction group ($p=0.04$). Both the fixation and reconstruction groups has similar pre- and post-operative glenoid AP measurements. Patient-reported outcomes were similar post-operatively between the two groups ($p=0.546$).

Conclusions: Arthroscopic glenoid fracture fixation has good outcomes but concerns exist regarding cartilage damage. Complex comminuted fracture patterns are suitable for reconstruction with patients achieving comparable outcomes to those who undergo fracture fixation.

EP.05.058

EPIDEMIOLOGY OF 936 HUMERAL SHAFT FRACTURES IN A LARGE FINNISH TRAUMA CENTER

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Background: Humeral shaft fractures are relatively common injuries and are classified according to location and fracture morphology. Epidemiological studies improve understanding of injury patterns and lay foundations for future research. There are only a few published larger epidemiological studies on humeral shaft fractures.

Methods: We retrospectively analyzed the medical records of adult patients having sustained a humeral shaft fracture treated in the Helsinki University Hospital between 2006 and 2016. We recorded patient and fracture characteristics, timing and mechanism of injury, associated injuries, and one-year mortality.

Patient characteristics included age, gender, and chronic illnesses at the time of injury, date of death, and the patient's home municipality. To obtain the most accurate fracture rate and incidence estimates, we calculated the fracture rate and further analyzed incidence using only cases resident to Helsinki.

Results: We identified 914 patients (489 females, median age 61.4 years; 425 males, median age 50.4 years) with 936 fractures. Over 60% of these fractures were sustained from simple falls. The patient age distribution was bimodal, with highest fracture rates in elderly females and young males. We divided the fractures into typical traumatic, periprosthetic, and pathological fractures. Of the 872 typical traumatic fractures, 3.0% were open. In addition, there were 24 (2.6%) periprosthetic and 40 (4.3%) pathological fractures. An associated injury was found in 24% of patients, with primary radial nerve palsy being the most common (10%). Primary radial nerve palsies were more common in distal shaft fractures and high energy injuries. The one-year mortality was 9.2%.

The incidence of humeral shaft fractures in different age groups were as follows:

Age (years) Incidence (cases / 100 000 person-years)

18-29	5.7
30-39	4.7
40-49	6.6
50-59	11.5
60-69	21.3
70-79	26.3
80-89	41.1
90-	42.6
Overall	11.9

Conclusions: In this study on the epidemiology of humeral shaft fractures in Finnish population living in urban area, the most common injury mechanism for humeral shaft fractures was a simple fall. The most common associated injury was a primary radial nerve palsy. The overall incidence of humeral shaft fractures was 11.9 per 100 000 person-years. The observed bimodal fracture rate distribution is consistent with previous literature.

EP.05.059

LOCKED STEM REVERSE TOTAL SHOULDER ARTHROPLASTY FOR COMPLEX PROXIMAL HUMERUS FRACTURE IN THE ELDERLY: CLINICAL AND RADIOLOGICAL SHORT-TERM RESULTS

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Background: PHFs are the third most common upper extremity fracture in the elderly. Up to 90% are treated non-surgically. For multi-fragmented displaced fractures, the treatment could be surgical with RSA as an alternative. Studies have shown that RSA is less dependent on GT healing compared to hemiarthroplasty and has several theoretical benefits including increased external rotation, diminished risk of infection and stem loosening, and improved deltoid wrapping with GT healing. The humeral stem fixation in RSA has historically been cemented in the fracture setting. Recent reports have showed comparable results with uncemented press-fit fixation with dependence on stem coating for stability primarily. Alternatively, the use of uncemented locked stem introduces the ability to stabilize the stem.

Methods: Retrospective study including 40 consecutive 3-4 proximal humerus fractures treated with reverse total shoulder arthroplasty (RSA) with a minimum of 24 months follow-up. In all the cases, the greater tuberosity (GT) was reattached with a standardized suture technique and a local horseshoe bone graft. All the patients were assessed at the 24-month follow-up with Constant-Murley Score (CMS) and Visual Analog Score (VAS). Radiographic healing of the greater tuberosity was noted in addition to stem locking screws radiographic changes. Complications and revision rates were reported.

Results: Mean final CMS for this cohort was of 80 points. GT healed in anatomic position in 90% of the cases. 10% of the GT did not heal. There were significant differences in CMS between patients with (mean = 80) and without (mean = 56) healing of the GT. All patients scored above 100° in forward elevation with a mean of 140°. Mean active external rotation was 30°. Low-grade scapular notching was reported in < 1% of the cases. A total of 4 patients presented failure of healing of the GT. Major complications were reported in one patient with an acromial fracture. No complications or loosening of stem locking screws were noted. There were no reoperations.

Conclusions: Reverse shoulder arthroplasty, with the use of a fracture-specific locking stem, allows an improved rate of greater tuberosity healing and short-term clinical outcomes in the elderly population with no complications regarding stem locking screws.

EP.05.060

TREATMENT OF PROXIMAL HUMERUS FRACTURES IN THE ELDERLY WITH REVERSE SHOULDER ARTHROPLASTY: THE ROLE OF TUBEROSITY REINSERTION

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Background: Complex proximal humerus fractures (cPHFs) represent a very demanding challenge for orthopedic surgeons. Internal fixation can easily fail in elderly patients, due to osteoporosis or poor bone quality, with consequent unsatisfactory clinical and functional outcomes. This justifies the use of prosthetic implants. Recently, the use of hemiarthroplasty has been considerably reduced in favour of reverse shoulder arthroplasty (RSA), thanks to the capability to achieve better and more reproducible results independently from tuberosity's integrity. Tuberosity healing, also in RSA, improves the implant stability and leads to better clinical and functional outcome, especially in internal/external rotation and forward elevation. The aim of this study is to evaluate the role of tuberosity reinsertion in patients suffering from cPHFs, treated with RSA.

Methods: A retrospective cohort study was performed. The inclusion criteria were a displaced 3- and 4- part fractures (according to Neer's classification) in patients older than 65 years; a RSA was implanted using a specific reverse fracture stem that incorporated a cancellous bone autograft (harvested from the fracture head), and a standardized suturing technique for tuberosity fixation, and a clinical (DASH, Constant Score, SF36) and radiographical follow-up of minimum one year. Differences between patients with good tuberosity healing and patients with resorption or mal-union of these parts were then compared.

Results: 32 patients (33 implants) of our cases satisfied the inclusion criteria. 87.9% of the patients (29 of 33 implants) reached the complete recovery of the tuberosities, all of them with excellent functional results. No complications of instability were seen. Tuberosity reconstruction and healing remarkably improves the active range of motion, especially in forward elevation and external rotation, and consequently patient satisfaction.

Conclusions: In our experience with elderly patients suffering from displaced, 3- and 4- part fractures of proximal humerus and treated with RSA, despite their advanced age and poor bone quality, the use of specific reverse fracture humeral stems, bone autograft and a standardized tuberosity reconstruction technique result in a high rate of tuberosity healing and very good functional outcome. We believe that, as described in the literature, the reinsertion of tuberosities plays a fundamental role in this kind of surgery influencing functional outcome.

EP.05.061

ASSESSMENT OF THE MEASUREMENT METHODS IN MIDSHAFT CLAVICLE FRACTURE

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Background: Clavicle fractures account for approximately 5% of all fractures in adults and 75% of clavicle fractures occur in the midshaft. Shortening greater than two centimeters is an indicative of surgical treatment. Radiographic exams are often used to diagnose and evaluate clavicle fractures but computed tomography (CT) scan is currently considered the best method to assess these deformities and shortening.

Goal: 1- To investigate whether different methods of performing the radiographic exam interfere on the measurement of the fractured clavicle length.

2- Compare the clavicle length measurements obtained by the different radiographic exam methods with the CT scan measurements, used as a reference.

Methods: Twenty-five patients with acute (< 3 weeks) midshaft clavicle fracture were evaluated. Patients underwent six radiographic images: PAThorax (standing and lying), APThorax (standing and lying) and at 10° cephalic tilt (standing and lying), and the computed tomography was used as reference.

Results: The mean length (cm) obtained were: 14,930 on CT scan, 14,860 on PAThorax Standing, 14,955 on PAThorax Lying, 14,896 on APThorax Standing, 14,960 APThorax Lying, 15,098 on 10° cephalic tilt Standing and 15,001 on 10° cephalic tilt Lying, ($p > 0,05$).

Conclusions: 1- There is no significant statistical difference in the clavicle fracture length measurement among the variety of radiographic exam performances.

2- The method that comes closest to computed tomography results is the PA thorax incidence, with the patient in the lying position.

EP.05.065

SURGICAL TREATMENT OPTIONS OF DISPLACED MIDSHAFT FRACTURES OF THE CLAVICLE AT YOUNG AGE: PLATE FIXATION VERSUS INTRAMEDULLARY NAILING

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Background: The optimal fixation strategy for unstable mid-shaft clavicle fractures at a young age is plate fixation and intramedullary nails. Therefore, this study aimed to compare outcomes and complications of active young adult populations undergoing open reduction and plate fixation (ORIF) and intramedullary nailing (IMN) for displaced mid-shaft fractures of the clavicle.

Methods: A retrospective review was performed on all patients undergoing ORIF or IMN of complete mid-shaft fractures of the clavicle at a single center between 2018 and 2022. Patients were included if they had no intra-articular or physeal involvement, acromioclavicular injury, age > 65 and radiographic follow-up until union. The mean age was 30.2 years, No differences were demographic data. Outcome measures included achievement of union, time to healing, residual deformity, complications, need for additional procedures. Statistical analysis was performed with alpha set at $P < 0.05$.

Results: Plate fixation provided a faster functional recovery during the first six months compared with IMN, but there was no difference after one year. A total of 58 patients met inclusion, 11 underwent IMN and 47 underwent ORIF. There were no significant differences between demographics or injury variables between groups other than ORIF patients having more distal fragmented fractures (44% vs. 32%; $P = 0.006$). At a mean follow-up of 1 years, 100% of fractures healed at IMN group with statistically difference in healing rates between groups. (100% vs. 92%, $P = 0.08$) The mean time to union was 21 weeks. Higher rates of nonunion complications (0% vs. 8%; $P = 0.10$). Regardless of surgical technique, nearly all patients returned to full activities with no significant deficits.

Conclusions: Both methods return the patients to their pre-injury functional levels, but plate fixation has a faster recovery period in comminuted fractures than IMN. In addition, IMN has a shorter skin incision and lower infection and implant rates of failure when using nails, suggesting that this is the preferred method in mid-shaft fractures with no comminution. In contrast, plate fixation is the superior method in comminuted fractures.

EP.05.066

EARLY POSTOPERATIVE IMPROVEMENT IN PATIENT-REPORTED OUTCOMES FOLLOWING OPERATIVE VERSUS NONOPERATIVE TREATMENT FOR PROXIMAL HUMERUS FRACTURES

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Background: The significance of early improvements in patient-reported outcomes following treatment for proximal humerus fracture (PHF) has not been well established. This study compares early improvement in patient-reported outcomes following PHF between patients who were treated conservatively vs. surgically. The primary outcome was Patient Reported Outcome Measurement Information System (PROMIS) Upper Extremity (-UE) and Pain Interference (-PI) scores at 6-weeks, 3-months, and 6-months from date of injury or date of operation for nonsurgical and surgical patients, respectively.

Methods: This single surgeon, retrospective chart review was conducted on 76 patients treated for PHF between 2/2019 and 7/2021. Exclusion criteria were presentation >4 weeks and follow up <6 weeks from the date of injury, and pathologic fractures. The final cohort included 47 patients treated nonoperatively and 8 treated operatively (3 reverse total shoulder arthroplasty, 5 open reduction and internal fixation). Data points included age, sex, race, smoking status, diagnosis of insulin-dependent diabetes mellitus, Neer classification, glenohumeral dislocation, open fracture, and PROMIS-UE and PROMIS-PI scores.

Results: There was no significant differences in age, gender, race, smoking status, dominant side injury, open fractures, or insulin-dependent diabetes mellitus between the groups. Patients with 1- or 2-part fractures versus 3- or 4-part fractures was not significantly different. Those with glenohumeral dislocation were more likely to be treated operatively, (operative (n=2, 25%), nonoperative (n=2, 4.26%), p=0.037). PROMIS-UE scores were not statistically different between the groups at any time point. PROMIS-PI scores were found to be significantly lower in the operative group at both 3- and 6-months postoperatively (3-months, nonoperative 57.46 ± 7.38, operative 49.25 ± 6.85, p=0.048; 6-months, nonoperative 61.80 ± 9.31, operative 46.33 ± 6.35, p=0.046) but not at 6-weeks postoperatively. Forward flexion and abduction were not found to be significantly different between the two groups.

Conclusions: Patients treated with operative intervention had significantly reduced pain as evaluated on the PROMIS-PI at both 3- and 6-month time points, but no significant differences in either function or range of motion as evaluated on PROMIS-UE. However, Early pain reduction may be a factor to consider when discussing treatment options with patients who sustain a PHF.

EP.05.067

THERAPEUTIC AND PROGNOSTIC PREDICTIVE VALUE OF THE CONTROL VOLUME SEVERITY GRADE ON PROXIMAL HUMERUS FRACTURES DUE TO BONE FRAGILITY

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Background: The treatment of proximal humerus fracture complicated by bone fragility is still controversial. The aim of this study is to compare the Neer classification and the Control Volume severity grade for the accuracy in the selection of the type of treatment and for prognostic evaluation.

Methods: We retrospectively collected the records of all patients admitted at the Emergency Department of our Institute, from 2013 to 2020, for a closed displaced proximal humerus fracture further investigated with a CT scan before treatment decision. We selected all patients with a minimum age of 65 years. The included fractures were retrospectively classified according to Neer, and Control Volume severity grade. The included patients were evaluated with Simple Shoulder Test (SST). A statistical analysis was performed to correlate the type of treatment and the clinical results to the Neer classification and the Control Volume severity grade.

Results: Sixty-four patients (80%), were available for a phone interviewing at a mean follow up of 4 years. According to the Control Volume model, we identified fracture with a low, medium and high severity grade, in 23 (36%), 13 (20%), and, 28 (44%) cases, respectively. Fifteen patients (23,5%) were treated conservatively, whether forty-nine patients (76,5%) underwent surgery. We find a statistical correlation between control volume severity grade and type of treatment. No Therapeutic correlation was detected for the Neer classification. A statistical correlation between the severity grade and clinical outcome could be observed only for patients with the same type of treatment.

Conclusions: The use of Control Volume severity grade is associated with better therapeutic and prognostic informations in confront to the Neer classification.

EP.05.068

THERAPEUTIC RESULTS AND FUNCTION OF CONOID LIGAMENT ON THE BASIS OF POSTOPERATIVE RADIOGRAPHIC FINDINGS OF ARTHROSCOPIC STABILIZATION FOR THE DISTAL CLAVICLE FRACTURES

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Background: Distal clavicle fractures are divided into three types according to Neer's classification. These fractures are usually treated with a sling to immobilize the upper extremity, however, the treatment of type 2 fractures remain controversial. We focused on the anatomical basis of these fractures in which disruptions in the conoid ligament led to the distraction between the two bony fragments. In this study, we report an arthroscopic procedure for conoid ligament reconstruction and its therapeutic outcomes, and discuss the function of the reconstructed conoid ligament.

Methods: A retrospective cohort study was conducted on 27 patients with type 2 distal clavicle fractures. Arthroscopic techniques were performed with the patients in the beach chair position. Dacron artificial ligament was used to reconstruct the conoid ligament, and the internal bone fixation materials included an EndoButton on the coracoid process side and a screw with a spiked washer on the clavicle side. Preoperative assessment was performed via plain radiography or three-dimensional computed tomography to evaluate the displacement of the proximal fragment. Although the displacement was superoposterior in all the cases, the acromioclavicular joint was maintained. The minimum duration of postoperative follow-up was 2 years and one month.

Results: There were no injury-related complications during the surgery, and bony union was achieved within 3 months after surgery. Evaluation using 3DCT also showed that the preoperative superoposterior displacement of the proximal fragment of the clavicle was immediately reduced postoperatively, and this reduced position was maintained until the final follow-up examination

Conclusions: We achieved good results by indirectly reducing fractures of the distal clavicle with conoid ligament damage using the minimally invasive surgical technique of arthroscopic conoid ligament reconstruction. Anatomical reconstruction of the conoid ligament might stabilize not only the superior displacement of the displaced proximal fragment of the clavicle but also its posterior displacement.

EP.05.070

THE UNHAPPY TRIAD AFTER PLATING OF PROXIMAL HUMERUS FRACTURES

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Background: Young patients with displaced proximal humerus fractures (PHFs) are frequently treated with open reduction and internal fixation (ORIF) with plating. However, complications do occur and remain of concern. The senior author described the -Unhappy Triad After Plating (UTP)- which associates 3 complications that may occur following plating and lead to severe shoulder disability: GT posterior migration with humeral head osteonecrosis and glenoid destruction secondary to intra-articular screw penetration. Purpose: The aim of this study is to describe the clinical presentation, functional outcomes and complications related to different treatment strategies after UTP.

Methods: We included all patients tertiary referred and operated at a single institution with complete clinical and radiological record between 2003 and 2018. The interval from index ORIF with plating to revision was 18 months (+ 10; range, 2-36). Patient-specific revision surgery, patient-reported outcomes, complications, and re-operations were assessed. Patients were followed for a mean of 50 months (± 37 , range 13-173).

Results: Thirty-five patients (mean age, 58 years) were seen with UTP; they presented with either a pseudoparalyzed (21%) or stiff shoulder (79%). After after hardware removal and revision surgery, improvement in range of motion was significant but marginal (AFE, 61° to 95°; AER1, -4.6° to 14°; IR, 2.2 to 5.0 points); however, Constant score (20 to 46) and subjective shoulder value (23% to 52%) remained low at last follow-up. Twenty-four patients (68.5%) presented with postoperative complications (mean of 2.0 [1 - 8] complications per patient) and 12 patients (34%) had more than one revision (mean 2.2 [1-6] procedures) after the index procedure.

Conclusions: UTP is an important association of complications following ORIF with plating that leads to severe shoulder disability. Regardless of the revision surgical technique, poor functional and patient-reported outcomes occur with a high complication and re-revision rate.

EP.05.072

DOUBLE RING KNOT(TAG KNOT): A SIMPLE, AND VERSATILE SELF-LOCKING SLIDING KNOT OSTEOSUTURE WITH DOUBLE RING KNOT IN CASE OF TRAUMA SHOULDER PROSTHESIS: PROSPECTIVE MULTICENTER EVALUATION

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Background: Long-term fixation of tuberosities around a humeral implant due to fracture depends mainly on the height of the stem: But osteosuture remains the essential tool for anchoring tuberosities. A new technique for osteosuture (tuberosities) that offers more security is described.

Methods: We prospectively evaluated 93 consecutive hemi and reverse arthroplasties performed for 3 & 4 part fractures which involved reattaching the tuberosities using a polyester suture precisely tied with the double-loop sliding knot. The length of the stem was 15 cm with a proximal coating of HA automatic locking system (2 screws) and 4 different diameter. The Double Ring or double running can be unfastened and retightened in case of premature locking and unintended loop loosening. Cadaver studies (24 shoulders - 12 cadavers) have been carried out with constructed loops to perform tuberosity suturing. For each test, the speed of the technique, its reproducibility, the reliability of the loop and the strength of the mounting were checked. Three systems of 2 looped threads were done in each clinical case and seem valuable to us: The first to anchor and draw the tuberosities, the next to press them onto the implant, and the final group of two threads to create a vertical tie-down system.

Results: In the group of hemi Constant score with ponderation reached 72,3 (31,5-120) and QDash 30,2 (4,5-68,1) with a mean FU of 26 months. In the group of reversed Constant score with ponderation reached 79 (36,4-109,4) and QDash 36,5 (2,27-70,4) with a mean FU of 24 months. Specific complications due to locking system reached 3 % but without reoperation. Other complications were : Capsultis (6%), infection (2%). No complications secondary to the knot have been described.

Conclusions: This fracture is the only one that can be fixed with osteosutures. The main advantage of a loop and such a knot is to create a very simple self-stabilising system, allowing mobilisation of the fracture fixed around the implant, and which is easy to change, undo and and re-tie. This is a well-known knot that has been used for a long time just not in surgery.

EP.05.074

OUTCOME OF FIXED-ANGLE PLATE FIXATION AND REVERSE POLARITY TOTAL SHOULDER REPLACEMENT FOR PROXIMAL HUMERUS FRACTURE

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Background: Proximal humerus fractures are common in the elderly. Surgical treatment is often undertaken to restore function. Open reduction and internal fixation (ORIF) is a widely performed procedure but there is a trend towards managing these fractures with reverse polarity total shoulder replacement (rTSR).

We reviewed and compared the outcomes of patients who underwent ORIF vs rTSR for proximal humeral fractures in our unit.

Methods: All cohort data was collected prospectively, including demographics, pre- and post-operative Oxford Shoulder Score (OSS), Quick DASH, EQ-5D-5L. Radiographic evaluation at latest follow up was performed with standard glenohumeral AP and axial lateral imaging. All complications were recorded. Average FU was 37 months, minimum follow up was 12 months.

Results: There were 71 patients, 54 ORIF and 17 rTSR. Patients who underwent ORIF were younger (average 63 vs 78 yrs, $p < 0.001$), had lower ASA grades (75% vs 49% ASA 1 and 2, NS) and lower frailty scores (74% vs 25% MFI-5 0 and 1, $p < 0.05$). rTSR were used to treat more complex fractures (51% vs 24% Neer 4-part and fracture dislocations, NS).

Functional scores at latest FU were (ORIF vs rTSR): OSS (average 37 vs 35, NS), Quick DASH (average 26 vs 31, NS) and EQ5D (average 0.79 vs 0.75, NS).

There was no re-operation in the rTSR but 6 ORIF patients underwent further surgery.

Conclusions: In our cohort in which decision to undergo ORIF vs rTSR was made by the operating surgeon, both ORIF and rTSR yielded comparable functional outcomes. Older and frailer patients with more complex fracture patterns tended to be treated with rTSR. There were more re-operations in the ORIF group compared with rTSR.

EP.05.075

RETURN TO SPORT AFTER SURGICAL TREATMENT OF PROXIMAL HUMERUS FRACTURE

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Background: There are few data available about how patients resume sport activity after proximal humerus fracture. The aim of this study was to evaluate return to sport after surgical treatment of proximal humerus fracture.

Methods: This retrospective monocentric study included 108 patients (mean age 67 ± 11.8 years), operated on for a traumatic proximal humerus fracture. Among them, 59% were treated by ORIF with nail, 24% by ORIF with plate and 17% by a reverse shoulder arthroplasty. All patients practiced a sport activity preoperatively on a regular basis. Modalities for resuming sport after surgery were collected by a telephone questionnaire at last follow-up. Primary endpoint was the postoperative delay to return to sport. Secondary endpoints were: return to sport rates at 3, 6, 12, 24 months, the return to same level rate at last follow-up. Influence of different potential factors on the primary endpoint was evaluated with multivariate analysis. A p-value of less than 0.05 was considered significant.

Results: Postoperative delay to return to sport was 23.9 ± 10.0 weeks. At 2 years follow-up, 67% of patients had resumed sport activity, for 41% of them at same level. In multivariate analysis, the occurrence of a postoperative complication was associated with a delayed return to sport (by 10.5 weeks, $p=0.044$). We did not find any statistical correlation between delay to return to sport and the other potential factors evaluated: age ($p=0.676$), Neer classification ($p=0.223$), surgical treatment ($p=0.884$), preoperative weekly volume of sport practice (0.5), professional activity ($p=0.885$).

Conclusions: After surgical treatment of proximal humerus fracture, 67% of patients were able to resume sport activity, at 2 years follow-up. Mean delay to return to sport was 23.9 weeks.

EP.05.076

MORTALITY AFTER SURGICAL TREATMENT OF PROXIMAL HUMERUS FRACTURES IN OLDER PATIENTS

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Background: Mortality of patients after of proximal humeral fractures (PHF) has been poorly studied in contrast to fractures of the proximal femur. Objective: To evaluate the mortality of older patients with PHF undergoing surgical treatment.

Methods: We conducted a retrospective study with analysis of medical records of patients undergoing surgical treatment of proximal humeral fractures in the period between 2009-2019 .

Demographic data such as gender age, comorbidities and Neer classification of the fracture were evaluated. The inclusion criteria were: patients undergoing surgical treatment of PHF aged 60 years or older; medical records containing all demographic and radiological data. Exclusion criteria were: cases without information about death and patients with 2 or more associated fractures. Non-categorical variables were tested using the Kolmogorov-Smirnov test to define the normality of the sample. In the study of these variables, unpaired t-test (parametric variables) was used. Categorical variables were analyzed using the Fisher exact test. The Kaplan-Meier mortality curve was constructed. A significance level of $p < 0.05$ was considered

Results: A total of 131 surgeries were performed in patients with PHF between 2009-2019. At the end, 59 patients met all the inclusion criteria. There was a predominance of females in the sixth decade of life. The most prevalent fractures were Neer type III. Osteosynthesis with Locking plate was the treatment of choice in most cases. A small number of patients were treated with arthroplasty. Most patients (69.4%) had at least one comorbidity. The most prevalent comorbidity was Hypertension followed by Diabetes Mellitus (DM). Six patients (11.3%) died during the maximum follow-up period of 11 years. The highest mortality occurred in the first 4 postoperative years (4.1 ± 3.2 years). The presence of DM influenced mortality and increased the chance of death by 7.6 times. Other comorbidities, fracture classification, sex and age did not change mortality. The only comorbidity capable of changing the survival curve was DM ($p = 0.03$), which led to earlier mortality

Conclusions: The overall mortality after surgical treatment of proximal humeral fracture was 11.3% at the first 4 years of follow-up. Diabetic patients evolve with earlier mortality and are 7 times more likely to die than non-diabetic patients.

EP.05.077

PREVALENCE AND RISK FACTORS FOR PSEUDARTHROSIS IN HUMERAL SHAFT FRACTURES TREATED BY MINIMALLY INVASIVE PLATE OSTEOSYNTHESIS: A 10-YEAR REVIEW

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Background: Fractures of the humeral shaft account for about 3% to 5% of all fractures. Although conservative treatment remains the first choice, there are a number of surgical indications. Minimally invasive plate osteosynthesis shows good functional results. However, complications have been reported, such as non-union.

Objective: To assess the prevalence and risk factors for non-union after treatment of humeral shaft fractures using minimally invasive plate osteosynthesis.

Methods: This retrospective study was carried out in patients treated by minimally invasive plate osteosynthesis between 2009 and 2019. Demographic data and variables related to the fracture that could influence bone healing were analysed. The radiographs were interpreted by an orthopaedist who did not participate in the surgeries. On anteroposterior radiographs, the distance between the fracture line and Heim's square was measured. On lateral radiographs, the plate working length was also calculated. The associations of demographic and radiological data with non-union were examined. Non-categorical variables were assessed for normality using the Kolmogorov-Smirnov test. The unpaired t-test (for parametric variables) and Mann-Whitney test (for non-parametric variables) were used for the statistical analyses. Categorical variables were analysed using the chi-square test or Fisher's exact test

Results: During the 10-year study period, 146 patients with humeral shaft fractures underwent MIPO treatment. Of these, 75 were included in the study because they fulfilled the inclusion criteria. The study population showed a male predominance (53 of 75, 70.7%).

Seven patients developed non-union. Factors that could influence the prevalence of non-union were evaluated. There were no significant differences in sex, fracture classification or presence of radial nerve injury between cases that did and did not progress to non-union. However, open fractures showed a 6.5-fold higher likelihood of progressing to non-union than closed fractures (odds ratio (OR) 6.53; $p=0.046$).

Conclusions: The prevalence of non-union in patients with humeral shaft fractures treated by MIPO was 9.3%. Patients with open fractures were six times more likely to progress to non-union than those with closed fractures. Fracture characteristics (AO classification, fracture location and plate working length) did not influence progression to non-union.

EP.05.078

CLINICAL AND RADIOGRAPHIC OUTCOMES IN OPERATIVE VS NONOPERATIVE TREATMENT OF HUMERAL SHAFT FRACTURES

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Background: Humeral shaft fractures represent 1-5% of all fractures and are increasing in incidence. There is conflicting literature regarding the superiority of operative versus nonoperative treatment of these fractures. We hypothesized that patients treated operatively would have a faster time to radiographic union and improved functional outcomes relative to patients treated nonoperatively.

Methods: This was a retrospective cohort study performed at a single healthcare system. All humeral shaft fractures treated between 2010-2020 were identified using ICD-9, -10, and CPT codes. Information on demographics, fracture, treatment, and outcomes was collected through chart and radiograph review. These measures were compared between patients treated operatively and nonoperatively.

Results: A total of 517 adult patients with unilateral humeral shaft fractures were identified, 233 were treated nonoperatively and 284 were treated operatively. Patients treated operatively had a mean age of 50.2 years relative to 59.9 years in patients treated nonoperatively ($p < 0.001$). A higher proportion of the nonoperative group were female and unemployed than the operative group ($p = 0.007$ and $p < 0.001$ respectively). Operatively treated patients had significantly faster time to radiographic union at a median of 113 days versus a median of 161 days in nonoperatively-treated patients ($p = 0.001$). The operative group was made weight-bearing as tolerated at a median of 84 days, significantly less time than the nonoperative group at a median of 98 days ($p = 0.002$). There was no difference in complication rates between groups. There were no differences in range of motion at time of radiographic union. However, at time of last follow-up, patients treated operatively were up to two times more likely to achieve full shoulder forward elevation than those treated nonoperatively ($p = 0.011$).

Conclusions: Operative treatment of humeral shaft fractures leads to faster time to union and earlier weight bearing without increased rate of complications.

EP.05.081

HIGHER TWO-YEAR REVISION RATES OF HEMIARTHROPLASTY COMPARED TO REVERSE TOTAL SHOULDER ARTHROPLASTY FOR PROXIMAL HUMERAL FRACTURES

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Background: Proximal humerus fracture (PHF) may impart substantial loss of function in elderly patients with poor bone quality. While hemiarthroplasty (HEMI) and reverse total shoulder arthroplasty (rTSA) can be used for displaced, multi-part fractures; rTSA is becoming increasingly more common, especially in the setting of rotator cuff compromise. In this study, we compare post-surgical complications, revision rates, and costs between these two surgeries.

Methods: We identified 2,648 geriatric patients (age>64) who underwent either rTSA (N=2202) or HEMI (N=446) for PHF using a national claims database (PearlDiverTechnologies) using Current Procedural Terminology and International Classification of Disease Codes. Patients with prior surgery or pre-existing malignancy were excluded. After matching patients by age, sex, Charlson Comorbidity index, smoking status and obesity, we used multivariate analysis to compare rates of 90-day post-operative complication, mortality, and risk of revision within two years from index procedure. Secondary outcomes included costs of the index surgery and the 90-day postoperative period.

Results: Patients undergoing HEMI were more likely to undergo revision surgery compared to the rTSA group (OR 3.14, P<0.001). In contrast, they were less likely to experience 90-day postoperative anemia or atrial fibrillation (OR 0.56, P<0.001 and OR 0.65, P=0.042, respectively). Despite this, patients receiving HEMI were more likely to undergo blood transfusion (OR 5.02, P<0.001). Mortality did not differ between both groups (P>0.05). rTSA was more expensive for both the index surgery (\$5,198 vs. 1,599, P<0.001) and 90-day post operative period (\$9,581 vs \$5,090, P<0.001).

Conclusions: Our results are consistent among other studies showing higher revision surgery rates for patients undergoing HEMI for PHF compared to those receiving rTSA. However, rTSA is a more expensive surgery and further study is needed to determine whether the net healthcare cost is reduced when factoring the need for revision surgery following HEMI.

EP.05.082

IS GENERAL ANESTHESIA OR LOCAL ANESTHESIA PREFERABLE FOR PLATE REMOVAL AFTER CLAVICLE FRACTURE SURGERY? A PATIENT QUESTIONNAIRE SURVEY

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Background: Although implant removal after clavicle fracture is usually conducted under general anesthesia, local anesthesia has mostly been used in our hospital.

Hypothesis: Plate removal following clavicle fracture surgery is painful and distressing for patients if conducted under local anesthesia, and whether patients who have undergone this procedure would prefer it to be performed under general anesthesia should they require similar surgery in the future was conducted.

Methods: The study participants were 56 patients who had undergone plate fixation of a distal clavicle fracture or clavicular shaft fracture in whom plate removal was conducted under local anesthesia at a university hospital, and 183 patients in whom plate removal was conducted under general anesthesia at an acute general hospital. The participants were asked to complete a questionnaire including a question on which method of anesthesia they would prefer should they have to undergo similar surgery in the future.

Results: The patients of both groups responded that they would prefer the same method of anesthesia as before to be used (87.0% of the patients who underwent plate removal under local anesthesia, 78.9 % of the patients underwent plate removal under general anesthesia), with no significant difference between the groups ($p > 0.33$).

Discussion: Patients who underwent surgery under local anesthesia preferred local anesthesia if they were to undergo it next, even though most of them felt some pain. While surgeons tend to focus only on the patient's distress during surgery, they also find that patients are often dissatisfied during the perioperative period, including bed rest and urinary catheters.

Conclusions: Plate removal under local anesthesia, which was just as acceptable as general anesthesia for the patients.

EP.05.083

EVALUATION THE GREATER TUBEROSITY FRAGMENT OF PROXIMAL HUMERAL FRACTURE USING 3DCT

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Background: Now a days , three dimensional CT scan(3DCT) is useful and widely performed for proximal humeral fracture. But, the reports of CT evaluation are very few. We report the evaluation of greater tuberosity(GT) fragment using 3DCT. 166 shoulders , which are diagnosed in our hospital as proximal humeral fracture and performed CT scan are involved to this study.

Methods: The average age is 64.7 years old, and male were 69, and female were 97 shoulders. Fracture type was 60 surgical neck fractures of Neer classification, 42 greater tuberosity 2 part, 51 of 3 part, and 13 of 4 part fractures. We classified these fractures into 5 groups with 3DCT. The fragment which has no fracture lines is grouped as none. The fragment which has fracture line in 1/3 anterior part is grouped as anterior. Grouped as middle when the fracture line exists in 1/3 middle part, and grouped as posterior when the line exists in 1/3 posterior part . And if the fragment is communed, we call group as communed

Results: 43 % of surgical neck fracture were obtaining the fracture line in their tuberosity fragment(anterior 4, middle 5, posterior 9, communed 8). 25 % of GT 2 part(anterior 2, middle 5, communed 4), 55% of GT 3 part(anterior 10, middle 5, posterior 6 communed 7), 62% of GT 4 part(middle 1, communed 7) have any fractures in the fragment.

Conclusions: We evaluate the greater tuberosity fragment of proximal humeral fracture using 3DCT. More than 25 % of GT fragment involve the fracture.

EP.05.084

TRENDS IN THE SURGICAL TREATMENT OF PROXIMAL HUMERUS FRACTURES 2010-2019: IS RTSA REPLACING ORIF IN THE ELDERLY POPULATION?

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Background: Proximal humerus fractures are becoming more common with an aging, increasingly fragile population. Patient age, functional status, bone quality and fracture pattern all influence decision making. When they meet operative indications, surgical options including open reduction internal fixation (ORIF), hemiarthroplasty (HA) and reverse total shoulder arthroplasty (RTSA). However, recent modifications in indications and knowledge of the complication profile may have changed implant selection trends. This study aimed to report U.S. national volume and incidence estimates and to analyze differences in volume and incidence among age groups, and gender.

Methods: Using IBM MarketScan national database, all patients that underwent ORIF, HA, or RTSA between 2010-2019 were identified using CPT codes. The dataset was further stratified to identify patients with a diagnosis code for proximal humerus fractures. Volume and incidence were adjusted per 1,000,000 persons and calculated for subgroups according to age group and sex. The U.S. Census Bureau annual population data was used for all incidence calculations.

Results: During the study period, 136,093 surgically treated proximal humerus fractures were identified. The total procedure volume and incidence increased by 29% and 20%, respectively. Total volume and incidence of RTSA increased by over 300%. Both volume and incidence of RTSA markedly increased across all age groups. Although the overall incidence of ORIF decreased, it remained the most common surgical treatment performed during our study period. The greatest decrease in volume and incidence of ORIF occurred in patients 75 and older. Total volume and incidence of HA decreased between 2010-2019.

Conclusions: Surgical management trends of proximal humerus fractures have changed greatly over the past decade. RTSA is likely growing in popularity over ORIF due to the benefits of immediate motion, tolerance of poor bone quality and lower reoperation rate. ORIF remains the mainstay in patients with good bone quality and a viable humeral head. Although once the standard for complex fractures, hemiarthroplasty has fallen out of favor.

EP.05.086

LONG HEAD OF BICEPS IN PROXIMAL HUMERAL FRACTURES: SHOULD WE CHANGE OUR APPROACH

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Background: Proximal humerus fracture represents around 5-10% of fractures in the adult.

In the majority of patients, conservative treatment is effective, with only around 20% requiring surgery. In the middle aged patient, osteosynthesis is commonly the first attempt.

The long head of the biceps (LHB) is scarcely referenced in the treatment of these fractures.

The present a retrospective study of 20 patients which received minimally invasive plate osteosynthesis, 14 without approach of the LHB through transdeltoid approach and 6 patients with approach of the LHB through the McKenzie approach.

Methods: The reviewed the results of 20 patients treated for proximal humerus fracture (2, 3 or 4 parts of Neer).

The patients were divided in two groups, the group with LHB tenotomy/tenodesis and the group without LHB approach.

The following data were gathered from each case: age and gender, fracture classification, surgical approach and LHB treatment, follow up time, active range of motion, pain score and need for reintervention.

Results: The patients had a minimum follow up of 9 months.

The transdeltoid without LHB approach group had 14 patients, with average pain score of 5, the mean active flexion was 90 degrees and abduction 80 degrees, 35% of patients required implant removal. Arthroscopy in 3 of these patients revealed 2 of them with LHB tendinopathy and one with adhesive capsulitis.

The McKenzie approach with LHB treatment had 6 patients, 4 submitted to tenodesis and 2 submitted to tenotomy. The average pain score was 4, the mean active flexion was 100 degrees and abduction 90 degrees. One patient was submitted to implant removal due to impingement.

No neurovascular injuries were reported.

Conclusions: LHB post traumatic tendinopathy is a possible source of pain after fracture fixation. Schai et al reported an incidence of 35% LHB injury in preoperative arthroscopic assessment.

The McKenzie approach is a more anterior transdeltoid approach, which combines the better assessment of the tuberosities with the possibility of treatment of the LHB.

We believe that the LHB is a very important factor in proximal humerus fractures and should be addressed in the primary intervention.

EP.05.087

CONSERVATIVE TREATMENT OF 3- AND 4-PART PROXIMAL HUMERAL FRACTURES: CAN POOR OUTCOMES BE PREDICTED?

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Background: Patients presenting with 3 and 4-part proximal humeral fractures are frequently treated conservatively following the PROFHER trial. This study aims to assess radiographic and PROMS data to identify factors leading to poor outcomes following conservative treatment.

Methods: Retrospective local database analysis identified patients sustaining 3 or 4-part proximal humeral fractures. Radiographic and functional outcome measures were collected including Oxford Shoulder Score (OSS), QuickDash (QD), Subjective Shoulder Score (SSV) and VAS pain scores.

Results: We included 104 patients (84F:20M) at mean follow-up of 55 months, with a mean age of 69 at time of injury. Analysis highlighted significant OSS differences in 3 vs 4-part fractures ($p=0.027$), dominant vs non-dominant side injured ($p=0.046$), age at injury >65 vs younger ($p=0.006$), varus coronal neck shaft angle <115 vs $115-155$ degree ($p=0.002$), apex anterior sagittal neck shaft angle >155 vs $115-155$ degree ($p=0.024$), GT displacement >5 mm vs less ($p=0.001$), GT comminution ($p=0.02$) and medial hinge displacement >3 mm or less ($p=0.002$). Each variable achieved a minimally important clinical difference (MCID) of 5 points.

QD scores showed significant differences with age ($p=0.012$), varus neck shaft angle ($p=0.01$), apex anterior fractures ($p=0.019$), GT displacement >5 mm ($p=0.001$), GT comminution ($p=0.022$), medial hinge displacement >3 mm ($p<0.001$). QD difference according to age was only 9.1, below the MCID threshold of 10 seen in all the remaining variables.

VAS pain was significant in varus neck shaft angle ($p=0.011$), GT displacement >5 mm ($p=0.027$), medial hinge displacement >3 mm ($p=0.045$).

SSV varied significantly with 3 vs 4-part fractures ($p=0.005$), age >65 ($p=0.04$), varus angulation ($p=0.001$), apex anterior angulation ($p=0.001$), GT displacement >5 mm ($p=0.001$), GT comminution ($p=0.008$), medial hinge displacement >3 mm ($p<0.001$). Each variable showed a MCID of 12.

Conclusions: Patients with a 4-part fracture showed poorer functional outcome on both OSS and SVV. Injury to the dominant side showed poorer clinical outcome than to the non-dominant side. Over age 65 reported poorer clinical outcomes than younger. Varus type fractures, posterior head angulation, GT displacement >5 mm, GT comminution and medial hinge >3 mm displacement are further predictors of poorer clinical outcomes. These results allow for improved shared decision-making regarding treatment options and patient expectation management.

EP.05.089

ROTATOR CUFF INTEGRITY AND FUNCTION AFTER ANTEGRADE HUMERUS NAILING FOR PROXIMAL AND SHAFT FRACTURES

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Background: Antegrade humerus nail insertion requires violation of the rotator cuff. Older lateral entry nails violated the footprint of the cuff on the greater tuberosity. Straight humerus nails use an entry point just medial to the footprint of the cuff within the rotator cable. The aim of this study was to study the integrity and function of the rotator cuff after humerus nailing using the cuff splitting approach

Methods: 103 consecutive cases of humerus fractures treated with an intra-medullary humerus nail between 2005 and 2021 were enrolled for this study with one lost to follow-up. 32 proximal humerus and 70 shaft fractures were included. Short and long nails were used as indicated. Nails were inserted using a central entry point medial to the cuff footprint by a simple linear split in line with the cuff fibres, lateral to the rotator cable. The cuff was repaired with a simple appositional stitch. Any pre-existing tear was not repaired. Shoulder elevation, and Oxford Shoulder and Constant scores were documented at 6 and 12 weeks and 6, 12 months. All shoulders had an ultrasound examination at 12 months. We compared the scores between proximal and humerus shaft fractures.

Results: A long nail was used for all 70 shaft fractures and 11/32 proximal humerus fractures. A small pre-existing cuff tear was seen in 14 cases. 12-month ultrasound showed an intact cuff in 85/88 cases where the cuff was split for nail entry. The Oxford shoulder score was 30, 34, 40 and 44 for shaft fractures and 22, 28, 38 and 40 for the proximal humerus fractures at 6, 12 weeks and 6, 12 months ($p < 0.05$). Shoulder elevation was 80, 134, 158 and 166 for shaft fractures and 68, 122, 144 and 158 at the same time points ($p < 0.05$). The Constant scores were lower in the proximal humerus fracture group at each point. Delayed union was seen in 3/70 shaft fractures.

Conclusions: Rotator cuffs split for humerus nailing results in reliable cuff healing at 12 months. Shoulder function following humerus nail insertion is related to the site of the fracture with more shoulder stiffness seen in proximal humerus fractures.

EP.05.091

SHOULDER CLINICAL FUNCTION AFTER POSTTRAUMATIC AVASCULAR NECROSIS OF THE PROXIMAL HUMERUS

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Background: Avascular necrosis of the proximal humerus may be present after open reduction of three and four-part proximal humerus fractures and fracture-dislocations. It is not clear which is the functional sequelae of the shoulder with this pathology and how urgent is the need to address it from an orthopedic point of view.

Methods: We followed all patients who underwent surgical treatment for three and four-part fractures and fracture-dislocation at our institution from March 2017 to December 2021 who developed posttraumatic avascular necrosis of the proximal humerus according to Crues classification. We analyzed demographic variables, and applied SANE and DASH scores to evaluate shoulder function.

Results: We identified 27 patients who fulfilled the criteria. The average age at the time of presenting avascular necrosis was 66.4 +/- 8.5 years. Patients who developed avascular necrosis, presented it at least one year after the index surgery. According to gender, 81.5% of the patients were female and 18.5% were male. According to Neer classification at the time of injury, the patients who presented with avascular necrosis had the following diagnosis: 44.5% 3-part, fracture, 40.5% 4-part and 15% two part fracture-dislocation. According to Crues classification 55.6% presented Crues type II, 25.9% Crues type III, and 18.5% Crues type IV. According to DASH score 81.5% of our patients had 18 points or less which means good to excellent function regardless the avascular necrosis stage. According to SANE score 81.5% had score of 80 points or more regardless the avascular necrosis stage.

Conclusions: Although posttraumatic avascular necrosis of the proximal humerus distorts the anatomy, the clinical function of the shoulder is almost recovered in the vast majority of cases with minimal or no pain.

EP.05.092

EXPERIENCE OF REVERSE SHOULDER ARTHROPLASTY FOR COMMUNATED PROXIMAL HUMERUS FRACTURES

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Background: Although humeral head replacement (HHR) has been performed in the past for highly comminuted fractures of the proximal humerus, there were many cases in which a satisfactory range of motion could not be obtained after surgery, and the treatment results were not good. Recently, reverse shoulder arthroplasty (RSA) has become available, and many good postoperative results have been reported overseas. In Japan, however, there have been few reports because of the short period of time since its introduction. In this report, we report 8 cases of proximal humerus fractures treated with RSA and discuss their progress in the literature.

Methods: We compared the outcomes of 8 cases of proximal humerus fractures treated with RSA and 8 cases treated with HHR between January 2019 and January 2021.

Results: The average time of pain relief was 1.5 months after surgery for both HHR and RSA. At 3 months postoperatively, the HHR group had an average range of motion of 50 degrees in automatic flexion (AF) and 40 degrees in automatic abduction (AA), while the RSA group had an average of 70 degrees in AF and 80 degrees in AA. At 6 months postoperatively, the HHR group averaged 50 degrees AF and 50 degrees AA, while the RSA group averaged 115 degrees AF and 115 degrees AA. There was no significant change at 1 year postoperatively compared to 6 months postoperatively in the HHR and RSA groups, respectively. In the RSA group, there were three cases in which patients who had not undergone active rehabilitation due to advanced age or comorbidities were able to raise their arms to 90 degrees. 70% of patients in the RSA group were able to perform essential daily activities such as washing their face and eating on the affected side 3 to 6 months after surgery.

Conclusions: RSA may be a useful initial surgical treatment for crush fractures of the proximal humerus in the elderly.

EP.05.093

MANAGING RECURRENT CLAVICLE NONUNION AND CONSTRUCT FAILURE: A CASE REPORT

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Background: Numerous studies have evaluated optimal fixation for open reduction internal fixation (ORIF) of clavicle fractures. Although nonunion rates have been well described for nonoperative treatment, few studies examine fixation failures and factors associated with increased incidence of nonunion. This study reviews the literature and a complex case of three-time revision surgery for a standard midshaft clavicle fracture which ultimately was successfully treated with dual plating, autograft bone from tibial harvest, and risk optimization.

Methods: This study provides an extensive review of risk factors and fixation considerations for clavicle nonunions, with a detailed case example of multi failure ORIF midshaft clavicle for a 36-year-old male smoker who presented from a mountain bike accident. He underwent an initial ORIF after which the plate failed and broke at mid aspect, he subsequently underwent a revision ORIF which again failed with repeat plate breakage at the fracture site and nonunion.

Results: Follow-up radiographs at 7 months post initial operation showed plate failure from broken plate. Diagnostic workup at 8 months post initial operation revealed low vitamin-D and alkaline phosphatase, discussion on noncompliance, and continued smoking. Smoking cessation and management of hypovitaminosis was attempted. Patient then underwent a hardware removal and revision ORIF with dual plating and cancellous bone autograft. Treatment continued with electromagnetic bone growth stimulator, oral vitamin D, restricted activities with graduated physical therapy, and continued abstinence from smoking. Follow-up radiographs taken at 12 months from the initial surgery showed intact hardware and full bone healing.

Conclusions: Successful management of clavicle nonunion can be optimized through optimal plate selection and construct biomechanics and screening of patients with high preoperative risk. Efforts to minimize controllable risk factors for nonunion preoperatively such as smoking cessation or vitamin D supplementation advice should be given to patients both preoperatively and postoperatively. The optimal construct fixation in terms of type of plates, plate positioning, biologic augmentation needs further investigation to understand the causative relationship between nonunion and construct failure following ORIF for clavicle fractures.

EP.05.094

ARTHROPLASTY AS PRIMARY TREATMENT FOR METADIAPHYSEAL PROXIMAL HUMERUS FRACTURES: A VIABLE ALTERNATIVE TO OSTEOSYNTHESIS FOR THE ELDERLY

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Background: In elderly patient populations, fracture comminution, osteoporotic fractures and associated arthritis or rotator cuff pathologies dominate—precluding acceptable fracture alignment, stable surgical fixation, or restoration of pre-injury function. Metadiaphyseal proximal humeral fracture is a challenging subset of fractures with no consensus on standard surgical treatment. This study reports on the use of cementless long-stem reverse total shoulder arthroplasty (RTSA) for the primary treatment of metadiaphyseal proximal humeral fractures in the elderly population.

Methods: Between 2018-2021, 22 consecutive patients sustained proximal humerus fractures with metadiaphyseal extension and underwent surgery with cementless long-stem RTSA. Cerclage wires and tibial allograft strut were used to augment stability of fracture fragments. Patients older than 60 years and with minimum 1-year of clinical and radiographic follow-up were included. Patient demographics, range of motion, and patient reported outcomes [Visual Analog Scale (VAS) pain scale, Simple Shoulder Test (SST), Subjective Shoulder Value (SSV) and American Shoulder Elbow Surgeon (ASES) scores] were retrospectively collected. Postoperative X-rays were reviewed for fracture and tuberosity union.

Results: There were 14 eligible patients with median age of 71 years (range 61-91 years) and median 13 months follow-up. There were 8 acute and 6 chronic fractures. At final follow-up, the median active elevation was 120° (range 80°-150°), external rotation was 40° (range 0°-50°), and internal rotation was 40° (range 0°-80°). The median VAS was 2 (range 0-8), SST was 71% (range 33%-92%), SSV was 78% (range 20-90%), and ASES was 73 (range 17-90).

All patients exhibited radiographic union. In 7 patients who required additional tuberosity osteosynthesis, 5 (71%) achieved tuberosity union. One patient (7%) had a postoperative fall leading to a periprosthetic fracture and required revision surgery. There were 5 minor complications in 3 patients, not requiring surgery: postoperative neuropathy, tuberosity nonunion, scapula notching, and proximal humeral bone stress shielding. Two patients with postoperative neuropathic symptoms demonstrated poor ASES and SST scores <40.

Conclusions: Cementless long-stem RTSA is a viable alternative to primary fracture fixation in the elderly patient population with metadiaphyseal proximal humerus fractures. The surgical technique produced consistent radiographic healing rate, improvement in pain, return of shoulder function, and acceptable complication rate.

EP.05.097

EVALUATION THE GREATER TUBEROSITY FRAGMENT OF PROXIMAL HUMERAL FRACTURE USING 3DCT

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Background: In proximal humeral fractures, the AO classification and the Neer classification are widely known. Lately, CT scans are performed for proximal humeral fractures for pre-operational planning, and we can see the fractures more clearly than we see in x-rays. Especially when the greater tubercle is broken into multiple pieces, we would have to choose operating methods and place the screws carefully, but the reports of CT evaluation are very few.

Methods: 210 shoulders, which were diagnosed in our hospital as proximal humeral fracture and performed CT scanner from Jan. 2013 to Nov.2022, are involved to this study. We took x-rays and classified them according to Neer classification, and then evaluated the greater tubercle fragment with 3DCT.

Results: The average age is 66.7 years old, and 82 were male, and 128 were female shoulders.

According to Neer classification, 75 were surgical neck fractures, 55 were greater tubercle 2 part, 61 were of 3 part, and 19 were of 4 part fractures. 45 % of surgical neck fracture had a fracture line in the tubercle fragment. 28 % of 2 part, 56% of 3 part, 63% of 4 part have any fracture in the fragment.

Conclusions: We evaluated the greater tubercle fragment of proximal humeral fracture using 3DCT. There were some that had a fracture line the greater tubercle.

EP.05.098

AUGMENTED VERSUS NOT AUGMENTED GLENOID IN REVERSE SHOULDER ARTHROPLASTY FOR PROXIMAL HUMERUS FRACTURES

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Background: Indications for Reverse Shoulder Arthroplasty (RSA) in Proximal Humerus Fractures (PHFs) have been extended over the last 25 years, and RSA has become one of the leading treatments. In our Study we compare PHFs treated with RSA and Standard Glenoid with Not-Augment metal back (SG) and Glenoid with Augmented metal back (AG).

Methods: We enrolled 95 patients, with mean age of 76 ys, affected by severe PHFs, who underwent to RSA. All surgery were performed at our Surgical Unit, by same surgeon. We implanted the same type of prosthesis in all pts, the only variant was the metal back, Standard or Augmented. We noted age, gender, side, type of fracture, surgical times, perioperative and medium-term complications. Post-op X-Rays were performed at 7 days, 1-3-6-12 months. All patients underwent a minimum follow-up of 12 months and at the last control they were evaluated by the Constant-Murley Score (CMS) and a subjective satisfaction index.

Results: Sample consisted of 61 pts with type 7 and 34 type 12 PHFs according to Hertel. The average surgery's time was 70 minutes. In all pts the surgical wound had healed without complications. We had 1 periprosthetic infection. In 18 cases the tuberosities did not consolidate or were reabsorbed. 6 pts reported chronic pain and/or paraesthesia to the treated upper limb at the last follow-up. At 1 year, two-thirds of patients reported being satisfied or very satisfied of the treatment. 52 pts were treated with a SG and 43 with a AG. Despite higher mean values in term of forward elevation, internal and external rotations in pts underwent to RSA with AG, no statistical difference was found between the two groups, according to Range of motion and CMS.

Conclusions: RSA is one of the main treatments for severe proximal humerus fractures in the elderly pts. Despite some complications, most of our pts reported being satisfied with the treatment. We did not find significant differences in the subjects underwent to RSA with Standard and Augmented glenoid, even if the latter showed higher values in term of forward elevation, internal and external rotations.

EP.05.100

COMPARATIVE BIOMECHANICAL STUDY OF TWO CONFIGURATIONS OF CEMENTED SCREWS IN A SIMULATED PROXIMAL HUMERUS FRACTURE FIXED WITH LOCKING PLATE

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Background: Screw tip augmentation with bone cement for fixation of osteoporotic proximal humerus fractures seems to improve stability and to decrease the rate of complications related to implant failure. However, the optimal augmentation combinations are unknown and some complications have been reported in clinical studies related with cement augmentation of more proximal screws and the calcar screws (screws A and E, respectively). The aim of this study was to assess the relative stability of two augmentations combinations under axial compression load in a simulated proximal humerus fractures fixed with locking plate.

Methods: A surgical neck osteotomy was created in five pairs of embalmed humeri (three males and two females) with a mean age of 74 years (range 46-93 years), secured with a stainless-steel locking-compression plate. In each pair of humeri, on the right humerus were cemented screws A and E, and in the contralateral side were cemented the central screws (B and D) of the locking plate. The specimens were first tested cyclically in axial compression for 6000 cycles to evaluate interfragmentary motion (dynamic study). At the end of the cycling test, the specimens were loaded in compression force simulating varus bending with increasing load magnitude until failure of the construct (static study).

Results: There were no significant differences in interfragmentary motion between the two configurations of cemented screws in the dynamic study ($p=0.463$). When tested to failure, the configuration of cemented screws in lines B and D demonstrated higher compression load to failure (2218N vs 2105, $p= 0.901$) and higher stiffness (125 N/mm vs 106 N/mm, $p 0.672$). The configuration of cemented screws in lines A and E tolerated on average 6mm more in axial compression before failure ($p=0.447$) and longer time to failure (84s vs 56s, $p=0.342$). However, no statistically significant differences were reported in any of these variables.

Conclusions: In simulated proximal humerus fractures, the configuration of the cemented screws does not influence the implant stability when a low-energy cyclical load is applied. Cementing the screws in rows B and D provides similar strength to the previously proposed cemented screws configuration and could avoid complications observed in clinical studies.

EP.05.101

REVERSE SHOULDER PROSTHESIS ON FRACTURE, 1 YEAR FOLLOW-UP IN THE DIFFERENT ANGLES OF INCLINATION OF THE HUMERAL NECK PROSTHESIS 135°-145° AND 155°

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Background: The case series under study consists of 18 patients, from January 2021 to December 2021: 6 males and 12 females, with an age ranging between 58 and 86 years. The diagnosis was 3-fragment fracture in 8 cases (of which 2 cases of fracture-dislocation) and 4-fragment fracture in 6 cases (of which 1 case of fracture-dislocation).

The results were evaluated by standard X-ray, Constant score, DASH score and VAS score at 1, 3, 6 months and 1 year

Methods: The purpose of this study is to analyze the clinical-functional results and complications encountered following treatment with reverse total prosthesis (RTSA) with humeral stem with neck inclination at 135°-145° and 155° following fractures at 3 and 4 according to Neer fragments of the proximal humerus.

Results: From a functional point of view, at an average follow-up of 1 year (with a range from 1 month to 3 months, 6 months and 1 year) the patients reported an average score of the Constant score of 59.7/100 and a DASH score of 43.1/100. Eight reverse prostheses were implanted with a humeral stem with a 155° neck angle, 8 with a 145° neck angle and 2 with a 135° neck angle. The prostheses used were of two modular types, both with a fixed angle of 155° in a design and variable angle 135°-145° and 155° in other design. There were 5 cases of complications: 1 case of scapular notching with humeral stem implant with 155° neck angle, 1 case of circumflex nerve deficit, 2 cases of implant dislocation with a 155° neck angle, and 1 case of infection.

Conclusions: RTSA configures the best reconstructive option in case of complex fractures of the proximal humerus, The clinical results point to a faster recovery in terms of recovery of functionality in the first 3 months with implants at 135° and 145°, adaptation of the functional results after 6 months with prostheses with a 155° neck angle. In terms of pain, the prosthesis with a 155° neck angle was on average more painful up to 6 months after surgery.

EP.05.102

THE HERTEL CLASSIFICATION CAN'T PREDICT THE RISK OF HUMERAL HEAD OSTEONECROSIS AFTER OSTEOSYNTHESIS USING AN ANTEROLATERAL APPROACH

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Background: Proximal humeral fractures can progress to osteonecrosis of the humeral head. Hertel developed a binary classification system (12 subtypes) and demonstrated that some patterns have more risk to develop osteonecrosis. Hertel described the prevalence and the risk factors for Humeral head osteonecrosis after osteosynthesis using a Deltpectoral approach. Few studies have evaluated the prevalence and the capacity of Hertel's classification to predict Humeral Head osteonecrosis following osteosynthesis of proximal Humeral fractures through the anterolateral approach.

The objectives of this study were to correlate osteonecrosis predictors established by the Hertel classification with the risk for developing osteonecrosis and its prevalence after osteosynthesis using the anterolateral approach.

Methods: This was a retrospective study of patients who underwent osteosynthesis of proximal humerus fractures using an anterolateral approach. Patients were divided into two groups: high risk for necrosis (group 1) and low risk for necrosis (group 2) according to Hertel's criteria. The overall prevalence of osteonecrosis and the prevalence in each group were calculated. A radiological examination was performed in the true anteroposterior (Grashey) , scapular, and axillary views, before and after the operation (minimum 1 year after surgery). A Kaplan-Meier curve was used to assess the pattern of the temporal evolution of osteonecrosis. The groups were compared using the Chi-square test or Fisher's exact test. The unpaired t-test (parametric variables - age) and the Mann-Whitney test (non-parametric -time between trauma and surgery) were used.

Results: In total, 39 patients were evaluated. The postoperative follow-up time was 14.5 ± 3.3 months. Time to onset of necrosis was 14.1 ± 3.9 months. Sex, age, and time between trauma and surgery did not influence the risk of necrosis. Type 2, 9, 10, 11, and 12, or fractures with posteromedial head extension less than or equal to 8 mm, or diaphysis deviation greater than 2 mm, as well as grouping did not influence the risk for osteonecrosis.

Conclusions: Hertel's criteria were not able to predict the risk for Humeral Head Osteonecrosis after osteosynthesis of proximal humeral fractures performed through the anterolateral approach. The overall prevalence of osteonecrosis was 17.9%.

EP.05.103

REVERSE SHOULDER ARTHROPLASTY FOR FRACTURE SEQUELAE

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Background: It is very difficult to treat the fracture sequelae. We have experienced three cases which we treat using reverse shoulder arthroplasty (RSA) and we report it.

Methods: The first case is 69 year-old-female. After injured rt proximal humeral fracture, her general condition turned severe and couldn't take a surgery. After 2 months passed, the condition got better and she had the RSA because of severe right shoulder pain and limitation of ROM. The second case is 74 year-old-female. She had injured the right proximal humeral fracture, and was treated conservatively. But, because of delaying bone union, she had been operated the RSA after 3 months. The third case is 78 year-old-female, she had been operated the open reduction and internal fixation for proximal humeral fracture. But because of humeral head collapse, she suffered the severe pain and operated the RSA.

Results: One year after surgery, the first case was reduced pain and the flexion increased 10 to 70 degree. the second case was also increased the flexion 20 to 100 degree. The third case improved the flexion 70 to 140 degree.

Conclusions: The RSA for fracture sequelae can improve the pain and ROM limitation, so we think it is very useful treatment.

EP.05.104

HEMIARTHROPLASTY VERSUS LOCKING PLATE OSTEOSYNTHESIS FOR COMPLEX PROXIMAL HUMERUS FRACTURES IN NON-GERIATRIC ADULTS

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Background: The optimal treatment is still unknown in patients with complex proximal humerus fractures (PHFs). In minimally displaced fractures, conservative treatment is the gold standard, and in very complex fractures in elderly, reverse shoulder arthroplasty is becoming more popular. However, for younger patients with complex fractures, sound evidence for treatment is missing. Treatment with open reduction and internal fixation (ORIF) can be challenging, and literature opts for hemiarthroplasty (HA) as a viable treatment option. Therefore, we hypothesized that in patients with a complex PHF in the intermediate age group, a hemiarthroplasty has better functional outcomes than ORIF.

Methods: In this retrospective study, 10 patients with complex PHFs treated with an HA were included and matched to 20 patients treated with ORIF. The matches were based on fracture characteristics, sex and age. The patients are between 40-70 years and have a 3- or 4- part fracture with either a fracture of the anatomical neck, fracture-dislocation or head-split fracture. Patient-reported outcome measures (PROMs) were assessed: Constant-Murley Score (CMS), Oxford Shoulder Score (OSS), Disabilities of the Arm, Shoulder, and Hand (DASH) score, and Visual Analogue Score (VAS). In addition, the range of motion (ROM) and complications were assessed.

Results: Mean age for patients treated with HA and ORIF was 55.4 (6.7) vs. 56.3 (7.2) years. For PROMs, the following means (SD) for HA versus ORIF were, respectively, 26.8 (28.8) vs. 28.6 (13.9) for DASH 37.3 (12.4) vs. 37.4 (6.9) for OSS, 64.2 (27.2) vs. 68.7 (19.8) for CMS and 2.7 (2.7) vs. 2.8 (2.1) for VAS. No statistically significant differences were found. For ROM, forward flexion 110.5 (41.7), 116.9 (37.8), abduction 107.4 (46.8), 105.3 (46.3), and external rotation 26.3 (33.4), 27.4 (18.0) also showed no statistically significant differences as well as the complication rate. However, both groups had a high revision rate (HA 50% and ORIF 30%).

Conclusion: This study shows that there are no differences between an HA or ORIF. However, in both groups, high revision rates were found. Therefore, we conclude that the choice between HA and ORIF should be based on factors other than expected clinical outcomes, e.g., surgical experience and preference.

EP.05.105

REVERSE SHOULDER ARTHROPLASTY IN YOUNG ADULT AS A SALVAGE TREATMENT AFTER MULTI-SURGICAL PROCEDURES, A CASE PRESENTATION

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Background: Reverse shoulder arthroplasty is an established treatment for elderly patients with selected fractures of the proximal part of the humerus. However, in young adult population it is not a preferred option except as a salvage procedure.

Methods: Thirty six years old right handed blind male had dislocation right shoulder. Underwent trial of closed reduction elsewhere resulting in 3 parts fracture dislocation right shoulder. Underwent open reduction and K wires fixation in the same hospital. The patient had severe pain after surgery and was not able to move his shoulder with no forward flexion. The patient did a revision surgery elsewhere by cemented hemiarthroplasty shoulder replacement. The patient presented to our institute by pseudoparalytic shoulder, so we operated a reverse shoulder arthroplasty using cement on cement technique. We used Simple shoulder test (SST) and constant score (CS) also to evaluate the ROM preoperative and postoperative. Patient was reviewed at two and six weeks, and three, six and 12 months.

Results: Patient experienced improvements in his preoperative to postoperative pain and shoulder range of motion. He has type II functional internal rotation lumbar sliding in the last follow up with SST score of 12 points and CS of 78 points.

Conclusions: The patient experiences pain relief and improved shoulder function. Reverse shoulder arthroplasty is a stable implant for revision of failed hemiarthroplasty in young population and shows a satisfactory early results as a salvage procedure in post-traumatic sequale while the tuberosities are resorbed. However, the complication rate is considerable, Long-term follow up is needed.

EP.05.106

NOVEL ALL-SUTURE TECHNIQUE FOR FIXATION OF UNSTABLE DISPLACED DISTAL CLAVICLE FRACTURES

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Background: Displaced Neer type II and V clavicle fractures are usually treated surgically in active patients. Distal fragment fixation however remains a challenge and no consensus has been established regarding the optimal surgical treatment. Osteosuture techniques have been popularized over the last decade and multiple techniques have been described. The aim of this pilot study was to propose a novel all-suture technique combining biomechanically proven concepts for the treatment of displaced type II and V clavicle fractures and report its clinical and radiological outcomes in a prospective case series.

Methods: Between 2017 and 2019, 15 consecutive patients (9 males and 6 females; mean age of 44.7 years) with displaced acute distal clavicle fractures (9 left, 6 right) were treated with an all-suture open technique performed by one shoulder specialized surgeon, with a minimum follow-up of 1 year. Osteosuture repair consisted in a coraco-clavicular cerclage with four n°6 Ethibonds and a figure-of-0 and figure-of-8 fracture cerclage with two n°2 Suturetapes. Single assessment numerical evaluation (SANE) and adjusted Constant score were recorded at 6 months and 1 year. Radiologic union was assessed on plain radiographs.

Results: At 12 months, all patients reported excellent clinical results, with a mean SANE of 98.2 [\pm 5.2, range 80 to 100] and a mean adjusted Constant score of 99.0 [\pm 1.9, range 94 to 100]. One patient developed shoulder stiffness that resolved before final follow-up. Fractures consolidated in 93% of the cases, with a mean time to union of 6 months [range 3 to 12 months]. One patient developed an asymptomatic malunion.

Conclusions: Excellent clinical and radiological outcomes can be achieved with this novel minimally invasive all-suture fixation technique for displaced distal clavicle fractures which allows for an anatomic reduction and stable fixation. This pilot study showed low complications and a high level of union after a follow up of 1 year. Among the numerous advantages are a small exposure, avoidance of hardware-related complications such as screw failure, coracoid fracture from drilling, or rotator cuff damage caused by hook-plates and avoids a second operation for implant removal.

EP.05.110

TREATMENT OF PSEUDOARTHROSIS AFTER A HUMERAL DIAPHYSEAL FRACTURE: A CASE REPORT

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Background: Humeral diaphyseal fracture is a common injury, accounting for 3-5% of all fractures. The nonunion rates of humeral diaphyseal fractures treated nonoperatively range from 0% to 13%. Numerous techniques and fixation constructs have been described to treat humeral diaphyseal nonunions with mostly good to excellent rates of fracture healing.

Methods: We report a case of a 55-year-old patient with a history of surgery for insufficient pseudoarthrosis after a humeral diaphyseal fracture from a gunshot wound, presenting pain and deformity in his right upper arm. The humeral diaphyseal fracture had been previously treated elsewhere with open reduction and internal fixation, 4 years ago he suffers an accident in Venezuela refracturing the humerus, due to a conservative treatment a pseudoarthrosis of the humeral shaft is formed. After a complete physical examination, symptoms of infection and any neurovascular deficit were ruled out. Radiographic examination revealed a pseudoarthrosis of the middle third of the humeral shaft associated with disuse osteopenia. A 3D impression of the radiographic study was made since he presented a complicated neurovascular anatomy at the focus of the nonunion.

Results: An open reduction and internal fixation (ORIF) with a posterior plate and autologous iliac crest graft was performed, along with platelet-rich plasma and bone matrix. During the immediate postoperative period, he was treated with a custom-made thermoplastic brachio-antebrachial orthosis. A postoperative evaluation by Neurophysiology showed a partial acute axonal lesion of the motor and sensory branch of the radial nerve with muscle denervation. A second intervention was decided. We performed a revision surgery with nerve exploration, neurolysis and radial nerve reparation under control by neurophysiology. 3 months after surgery, the patient's bone has healed and he has recovered flexion (90°) and extension (30°), with complete pronosupination but the limitation for the active extension of the wrist persists.

Conclusions: An orthopedic surgeon should be aware of these complications when choosing open reduction and internal fixation for the treatment of a history of insufficient pseudoarthrosis. An extensive preoperative study is always needed to avoid neurovascular complications. Fracture fixation in patients with pseudoarthrosis requires strategies to overcome the technical difficulties during the procedure.

EP.05.111

PERI-IMPLANT DISTAL CLAVICLE FRACTURE: CASE REPORT (OVERLAYING PLATE FIXATION: SOLUTION FOR PERI-IMPLANT CLAVICLE FRACTURES)

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Background: Surgical treatment for clavicle injuries is indicated for displaced and shortened fractures. Osteosyntheses with plate fixation may present with complications in 6.3% to 8.5% of patients. Peri- implant clavicle fractures (PIF) are rare, and we have not found any previous cases in our literature search.

Methods: A 25-year-old male with previously (six years earlier) surgically treated clavicle fracture presented with a peri-implant clavicle fracture requiring surgical treatment. The management involved over- laying an implant to fix the lateral clavicle fracture without removing the previous plate. Complete bone healing was observed without any further complication.

Results: Despite the low rate of implant failure in clavicle fractures, this complication occurs mainly in elderly patients with poor bone quality. No PIF have been described in the literature prior to this. This case report demonstrates a young patient with good bone quality and previous fracture fixation presenting with PIF which has now shown complete bone healing.

Conclusions: In this case, overlying an additional plate on the lateral clavicle portion without removing the previous plate increased the stability of the fracture. It demonstrates the value of overlaying plate osteosyntheses for patients with clavicle PIF.

EP.06.001

THE INFLUENCE OF POSTURE ON THE CLINICAL OUTCOME AFTER REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: Studies with preoperative planning software have shown that scapulothoracic orientation and posture have a significant effect on the simulated range of motion after implantation of a reverse total shoulder arthroplasty (RTSA). However, we currently do not know how these findings translate to clinical practice. Goal of this study was to analyze the effect of scapulothoracic orientation and Posture Types on the clinical outcome after RTSA implantation.

Methods: 681 patients with a minimum clinical and radiological follow-up of 2 years after RTSA implantation were extracted from our institutional shoulder arthroplasty registry. Patients with revision surgery and without available preoperative cross-sectional imaging were excluded. The Posture Types (A, B, and C) were determined according to a previously published method based on the scapula internal rotation determined by two independent raters on preoperative cross-sectional imaging. Differences in clinical outcome between Posture Types were analyzed including range of motion, strength, clinical outcome scores (Subjective Shoulder Value, Constant Score, SPADI, EQ5D5L), pain and notching.

Results: The group comparability analysis showed no relevant differences between the three Posture Types (A: n= 225; B: n=326; C: n=130) including patient characteristics, diagnosis, preoperative range of motion, implants used and clinical scores except for a higher percentage of female patients in Group C ($p<0.001$) resulting in lower abduction strength ($p=0.014$). The Posture Types showed a significant difference in terms of active flexion (A: $137\pm 21^\circ$; B: $136\pm 20^\circ$; C: $131\pm 19^\circ$; $p=0.039$), passive flexion (A: $140\pm 19^\circ$; B: $138\pm 19^\circ$; C: $134\pm 18^\circ$; $p=0.041$), active abduction (A: $127\pm 26^\circ$; B: $125\pm 26^\circ$; C: $117\pm 27^\circ$; $p=0.004$), passive abduction (A: $129\pm 24^\circ$; B: $128\pm 25^\circ$; C: $121\pm 25^\circ$; $p=0.013$), SPADI (A: 81 ± 18 ; B: 79 ± 20 ; C: 73 ± 23 ; $p=0.003$) and pain level (A: 1 ± 2 ; B: 2 ± 2 ; C: 2 ± 2 ; $p=0.025$) at 2 year follow-up. Abduction strength continued to show a significant difference between groups (A: 5.3 ± 2.6 kg; B: 5.1 ± 2.5 kg; C: 4.4 ± 2.5 kg; $p=0.007$).

Conclusions: The theoretical concept of the influence of scapulothoracic orientation and posture on the achievable outcome after RTSA implantation has been confirmed in this large-scale clinical study. Patients with Posture Type C experience a worse flexion, abduction, SPADI, and pain level regardless of initial diagnosis, implant design, configuration, and implantation.

EP.06.002

RELATIONSHIP BETWEEN THE PREOPERATIVE GRIP STRENGTH AND POSTOPERATIVE SHOULDER STRENGTH OF PATIENTS TREATED WITH REVERSE SHOULDER ARTHROPLASTY

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Background: Systemic disorders including diabetes mellitus, obesity, and depression affect the outcomes of reverse shoulder arthroplasty (RSA). Sarcopenia (a general skeletal muscle disorder) is common in elderly people, but its effect on patients after RSA is not clear. We hypothesized that the preoperative sarcopenia indices of grip strength and general skeletal muscle mass would correlate with the clinical outcomes of RSA.

Methods: Grip strength and general skeletal muscle mass were measured in patients scheduled (between 2016 and 2020) for primary RSA to treat cuff tear arthropathy, an unreparable cuff tear, or osteoarthritis with a large cuff tear. Before surgery, grip strength was measured using a hydraulic dynamometer with the patient seated and the elbow flexed at 90° and general skeletal muscle mass was calculated from the appendicular relative skeletal muscle mass index (aRSMI) using dual-energy X-ray absorptiometry. In all, 58 patients were included; the minimal follow-up duration was 12 months. The postoperative clinical results (pain, active range of motion, shoulder strength, and functional scores) were evaluated during scheduled outpatient visits. We calculated correlations between the preoperative sarcopenia indices, and the clinical results at the final follow-up.

Results: The mean preoperative grip strength and aRSMI were 21.6 ± 4.0 kg and 5.98 ± 0.84 kg/m² in females, and 30.6 ± 7.5 kg and 7.21 ± 0.94 kg/m² in males, respectively; the grip strength and aRSMI were not associated with each other ($P = 0.083$). Ten females (25%) and 10 males (56%) met the criteria for sarcopenia. The postoperative abduction shoulder strength and Constant-Murley shoulder score increased significantly with higher preoperative grip strength ($R = 0.420$ and $P = 0.001$; and $R = 0.497$ and $P < 0.001$, respectively) and the American Shoulder and Elbow Surgeons Score was related to the preoperative aRSMI ($R = 0.320$, $P = 0.039$).

Conclusions: The clinical features after RSA correlated positively with the preoperative grip strength and general skeletal muscle mass. Measuring grip strength before RSA allows the surgeon to predict shoulder strength after RSA. Interventions to manage sarcopenia, such as nutrition, supplements, or anaerobic exercise, might improve shoulder function after RSA.

EP.06.003

ASSESSING APPROPRIATENESS FOR SHOULDER ARTHROPLASTY USING A SHARED DECISION-MAKING PROCESS

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Background: Shoulder arthroplasty is usually recommended based on clinical examination and radiographic criteria. Patient expectations and perspectives about surgery have direct impacts on the success of surgery. Thus, increasing engagement of patients in their care through active participation and shared decision-making is desirable and should be considered. The primary purpose of this study was to validate an appropriateness decision-aid tool as a part of engaging patients with glenohumeral arthritis in their surgical management. The associations between the final decision to have surgery and patient characteristics were examined.

Methods: This was an observational study of patients assessed at an academic centre. The demographics, overall health, patient-specific risk profile, expectations, and health related quality of life were documented. Visual Analogue Scale and the American Shoulder & Elbow Surgeon (ASES) measured pain and functional disability respectively. Clinical and imaging examination documented clinical findings and extent of degenerative arthritis and cuff tear arthropathy. Appropriateness for arthroplasty surgery was documented by a 5-item Likert response survey and the final decision was documented as ready, not-ready and would like to further discuss.

Results: Eighty patients, 35 men (44%), mean age: 72(8) participated in the study. The appropriateness decision aid showed excellent discriminate validity (AUC value of 0.93) in differentiating between patients who were "ready" and those who were "not-ready" to have surgery. Gender ($p=0.037$), overall health ($p=0.024$), strength in external rotation ($p=0.002$), pain severity ($p=0.001$), ASES score ($p<0.0001$), and expectations ($p=0.024$) were contributing factors to the decision to have surgery. Imaging findings did not play a significant role in the final decision to have surgery.

Conclusions: A decision aid assisted patients in evaluating their status and making an informed decision for having shoulder arthroplasty surgery. Patient's gender, expectations, strength, and self-reported outcomes are important factors in reaching the final decision.

EP.06.004

CLINICAL OUTCOMES OF ANATOMIC VERSUS REVERSE TOTAL SHOULDER ARTHROPLASTY FOR PRIMARY OSTEOARTHRITIS WITH AN INTACT ROTATOR CUFF AND PREOPERATIVE EXTERNAL ROTATION WEAKNESS

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Background: Anatomic and reverse total shoulder arthroplasty (aTSA and rTSA) are well-established modalities for patients with primary osteoarthritis and an intact cuff. However, it is unclear whether aTSA or rTSA provide superior outcomes in patients with preoperative external rotation (ER) weakness.

Methods: A retrospective review of a single-institution prospectively-collected shoulder arthroplasty database was performed between 2007-2020. Patients were excluded for preoperative diagnosis of nerve injury, infection, or fracture. Analysis included 403 aTSAs and 213 rTSAs performed for primary cuff-intact osteoarthritis with 2-year minimum follow-up. Defining preoperative ER weakness as strength less than 10 pounds, 3 cohorts were matched 1:1: (1) non-weak aTSAs (n=79) to weak aTSAs, (2) non-weak rTSAs (n=44) to weak rTSAs, and (3) weak rTSAs (n=95) to weak aTSAs. We compared ROM, outcome scores, strength, complications, and revision rates at latest follow-up.

Results: Weak aTSAs had significantly greater pre- to postoperative improvements in active internal rotation (IR) score and ER strength compared to non-weak aTSAs; no differences in postoperative outcomes nor complication and revision rates were found. Non-weak rTSAs had significantly better postoperative SPADI, SST, ASES, Constant, and ER strength compared to weak rTSAs. Pre- to postoperative improvement was significantly greater for weak rTSAs compared to non-weak rTSAs for SST, active forward elevation (FE), ER strength, and FE strength. There was no difference in complications or revision rates between non-weak and weak rTSAs. Weak rTSA had greater postoperative SPADI, ASES, UCLA, Constant, active ER, and active FE compared to weak aTSAs. Pre- to postoperative improvement was greater for weak rTSA for SPADI, ASES, UCLA, Constant, active FE, passive FE, active abduction, and FE strength. There was no difference in complications for weak rTSA and aTSA, but weak rTSA had a lower revision rate (1% vs. 9%, P=.015). Additionally, a greater proportion of weak rTSAs achieved minimal clinically important difference and substantial clinical benefit compared to weak aTSAs.

Conclusions: In preoperatively weak patients with primary osteoarthritis and an intact cuff, rTSA appears to lead to greater improvements in functional and clinical outcomes than aTSA.

EP.06.005

PRIOR BARIATRIC SURGERY IS ASSOCIATED WITH AN INCREASED RATE OF COMPLICATIONS AFTER PRIMARY SHOULDER ARTHROPLASTY INDEPENDENT OF MASS INDEX

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Background: Despite recent advances in bariatric surgery (BS) techniques, there is limited data on the impact of prior BS in patients undergoing shoulder arthroplasty (SA). This investigation evaluated the outcomes of primary SA in patients with prior BS compared to matched controls.

Methods: Over a 31-year period (1989 – 2020), 183 primary SA (12 hemiarthroplasties [HA], 59 anatomic total SA [aTSA], and 112 reverse SA [rTSA]) in patients with prior BS and a minimum of 2-year follow-up had been performed at a single institution. This cohort was matched 1:1:1 according to age, sex, diagnosis, implant, American Society of Anesthesiologists score, Charlson Comorbidity Index, and surgical year to two separate control groups of patients who had undergone SA and had no history of BS with a BMI of either < 40 kg/m² (Low BMI group) or ≥ 40 kg/m² (High BMI group). The mean follow-up time was 6.8 years (range, 2 to 21 years).

Results: The BS cohort had a higher rate of any complication (29.5% vs. 14.8% vs. 14.2%; $P < .001$), surgical complications (25.1% vs. 12.6% vs. 12.6%; $P = .002$), and non-infectious complications (20.2% vs. 10.4% vs. 9.8%; Low $P = .009$ and High $P = .005$) relative to both low and high BMI groups. For BS patients, the 15-year survivorship free of any complication was 55.6 (95% confidence interval [CI], 43.8% – 70.5%) compared to 80.3% (95% CI, 72.3% – 89.3%) in the low BMI group and 75.8% (65.6% – 87.7%) in the high BMI group ($P < .001$). Comparisons of the bariatric and matched groups demonstrated no statistical differences between the risk of reoperation or revision surgery. When SA was performed within 2 years of BS, higher rates of complications (50% vs. 27.0%; $P = .040$), reoperations (35.0% vs. 8.0%; $P = .002$), and revisions (30.0% vs. 5.5%; $P = .002$) were observed.

Conclusions: Primary SA in patients with prior BS demonstrated an elevated complication profile when compared to matched cohorts of patients with no history of BS and either low or high BMI. These risks were more pronounced when shoulder arthroplasty was performed within 2 years of bariatric surgery.

EP.06.006

PATIENT PERCEPTIONS OF EMERGING TECHNOLOGIES IN SHOULDER ARTHROPLASTY

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Background: Intraoperative navigation (NAV) and augmented reality (AR) have emerged as promising new technologies in shoulder arthroplasty. Previous research in these areas have focused on the use of these technologies by surgeons, but not around improved understanding of patient knowledge and perceptions. The aim of this study was to characterize patient's baseline understanding and perceptions of AR, NAV, and robotic technology in shoulder arthroplasty and then see if educational content in this area enhances or changes their perceptions.

Methods: A 37-item survey to assess base knowledge and perception of NAV, AR, and robotic surgery technologies was administered to adult patients. Subjects were recruited from local public areas (e.g., golf clubs, and grocery stores) and orthopedic clinics across Palm Beach County to provide a broad array of demographics. Baseline assessments were performed and then educational materials were provided about each of the technologies. Perception and understanding questions were then repeated. Categorical variables were reported as frequencies with percentages and bivariate analyses using the Pearson chi-square test were performed.

Results: Of the 85 responders, a majority were not familiar with NAV (56.5%) or AR (67.4%). Patients were most familiar with robotics 52.9%, but this technology is currently not available in shoulder arthroplasty. Responders perceived NAV and robotic surgery to lead to better results (52%) and AR to have no specific benefit (52.4%) after shoulder surgery. After reading educational materials of AR, NAV and robotic technologies, most patients expected faster recovery (56.5%) and fewer complications (52.9%) with NAV. In contrast, with AR and robotics, most patients (>50%) expected no specific benefits. Most respondents did not see these technologies helpful for pain relief. The primary reported concerns of respondents were lack of surgeon experience with the technology and increased cost. Overall, < 50% of participants have a preference for surgeons who use these technologies, and most (69.8%) thought surgeons using these technologies are of similar skill.

Conclusions: The public's perception of superior outcomes with technology-assisted surgery may contribute to misinformed decisions in some patients. Brief descriptions of these technologies does not dispel these misperceptions. Technology-assisted surgery appears to be a powerful marketing tool for surgeons and hospitals.

EP.06.007

CANNABIS USE DISORDER IS NOT A RISK FACTOR FOR MEDICAL OR SURGICAL COMPLICATIONS FOLLOWING TOTAL SHOULDER ARTHROPLASTY

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Background: In recent years, there has been an increase in utilization of cannabis. Existing studies have found Cannabis Use Disorder (CUD) to be associated with increased incidence of perioperative complications in lower extremity arthroplasty. However, studies examining CUD following total shoulder arthroplasty (TSA) are limited. The aim of this study was to evaluate the effect of comorbid CUD on 2-year revision and 90-day postoperative outcomes in primary TSA for osteoarthritis.

Methods: A retrospective cohort analysis was conducted using the PearlDiver database. CPT, ICD-9, and ICD-10 codes were used to identify patients undergoing TSA for the indication of osteoarthritis and were divided into a CUD and control group. The primary outcomes of interest were 2-year all-cause revision, 90-day hospital readmission, and 90-day emergency department visit. Surgical perioperative complications included PJI, periprosthetic fracture, aseptic loosening, articular bearing surface wear, broken prosthesis, and prosthetic dislocation. Univariate analysis and multivariable logistic regression were conducted to analyze the data.

Results: A total of 115,457 patients undergoing TSA were identified. The CUD cohort contained 510 patients and the control cohort contained 114,947 patients. After controlling for comorbidities, there were no statistically significant differences in 2-year revision outcomes. Multivariable results also showed no association with 90-day medical or surgical complications, with the exception of 90-day presentation to an Emergency Department (ED).

Conclusions: Our results showed that CUD is not an independent risk factor for 2-year revision surgery, nor is it independently associated with adverse 90-day medical or surgical complications. The results of this research expand the literature on TSA and comorbid substance use. Further, our findings can assist orthopedic surgeons in counseling patients regarding CUD as a risk factor for complications of TSA

EP.06.008

CLINICAL OUTCOMES SIMILAR AFTER SHOULDER ARTHROPLASTY IN PATIENTS REGARDLESS OF UNEXPECTED POSITIVE CULTURE AND PRIOR SURGERY

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Background: Unexpected positive cultures (UPC) at the time of primary shoulder arthroplasty (SA) are reported near 31.3% in patients with prior surgery, with unknown clinical significance. The effect on clinical outcomes and the impact of UPC at the time of primary SA is unclear. The purpose of this study was to evaluate the impact of UPC in patients with prior surgery on outcomes after primary SA.

Methods: A retrospective cohort study reviewed all patients who underwent primary SA January 2015 – December 2019 by one surgeon at one institution. Prior surgery was defined as open or arthroscopic, and number of prior surgeries was quantified. All patients received appropriate preoperative antibiotics. One set of synovial fluid cultures (aerobic and anaerobic) was obtained and cultured for a minimum of 14 days. Outcome measures including visual analog scale for pain (VAS), American Shoulder and Elbow Surgeons score (ASES), the simple shoulder test (SST) and single assessment numeric evaluation (SANE) scores were compared between cohorts with and without positive cultures. Minimal clinically important difference (MCID) and substantial clinical benefit (SCB) were evaluated for the UPC cohort.

Results: 514 shoulder arthroplasty cases met study inclusion criteria: 141 patients had ipsilateral prior surgery; no cultures were obtained in 5 patients, leaving 136 primary anatomic or reverse arthroplasty patients who had at least one prior surgery and were cultured at the time of primary shoulder arthroplasty. 14 (10.3%) of 136 patients had UPC, with 11/14 growing *C. acnes* (78.5%). No patients subsequently developed prosthetic joint infection (PJI). Patients with UPC had similar improvements in clinical scores as patients with negative cultures (VAS: 4.3 ± 3.0 versus 4.6 ± 2.5 , $p=0.877$; ASES: 37.9 ± 22.7 versus 41.0 ± 21.7 , $p=0.659$; SST: 4.0 ± 3.2 versus 4.4 ± 3.3 , $p=0.737$; and SANE: 49.5 ± 28.8 versus 31.6 ± 22.9 , $p=0.246$). Patients with UPC achieved MCID and SCB for all outcome measures.

Conclusions: Patients with UPC at time of primary shoulder arthroplasty have a low risk of PJI and achieve similar clinical outcomes as patients with negative cultures. The primary organism identified in patients with prior surgery was *C. acnes*.

EP.06.011

AMBULATORY SHOULDER ARTHROPLASTY, COMPARED TO SAME-DAY HOSPITAL-BASED SHOULDER ARTHROPLASTY, DOES NOT MINIMIZE COST: TIME-DRIVEN ACTIVITY-BASED COSTING ANALYSIS

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Background: The utilization of ambulatory shoulder arthroplasty has grown rapidly in recent years. Reduced cost to the patient, hospital and healthcare system may be a theoretical advantage of ambulatory shoulder arthroplasty. Herein, we analyze the cost of shoulder arthroplasty via time-driven activity-based costing (TDABC) across various surgical settings.

Methods: Consecutive cases were retrospectively analyzed via TDABC to describe the cost of shoulder arthroplasty (primary total shoulder arthroplasty [TSA] and reverse shoulder arthroplasty [RSA]). Cases performed at an ambulatory surgery center (Ambulatory), main hospital with discharge on postoperative day 0 (Outpatient), main hospital with discharge on postoperative day 1 (Hospital POD1) and main hospital with discharge postoperative day 2 or later (Hospital POD2+) were analyzed for total episode of care costs, including preoperative, intraoperative and postoperative costs. Patient demographics and surgical characteristics were recorded. All costs were normalized by dividing them by the mean ambulatory episode of care cost.

Results: Included in the analysis were 355 cases (90 TSA, 265 RSA). The relative proportion of RSA increased significantly in hospital-based settings. Case complexity, determined by the Favard and Walch classifications, was not significantly different between surgical settings. The cost of shoulder arthroplasty was minimized in the ambulatory setting, though cost savings were nominal and not significant when compared to outpatient surgery (1.00 vs 1.04, $p = 0.36$). For patients who underwent shoulder arthroplasty and were hospitalized overnight, each subsequent day of hospitalization increased total episode of care costs by approximately 10%: Total costs for Hospital POD1 was 11% costlier ($p = 0.006$) and Hospital POD2+ was 21% costlier ($p < 0.0001$). Across all phases of care, intraoperative costs drove the total episode of care costs (84.0% - 96.7%). When intraoperative costs were analyzed, implant costs accounted for 64.0% to 71.8% of the total episode of care costs, varying by surgical setting.

Conclusions: Hospital-based surgical setting has a nominal effect on the total cost of shoulder arthroplasty. Intraoperative costs, particularly implant costs, drive episode of care costs. Each day of hospitalization after shoulder arthroplasty increases the total cost by approximately 10%.

EP.06.012

THE TRENDS AND OUTCOMES OF OUTPATIENT SHOULDER ARTHROPLASTIES IN THE UNITED STATES

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Background: In January 2021, the US Medicare program approved reimbursement of outpatient shoulder arthroplasties (SA), including total and reverse shoulder arthroplasties. It remains unclear whether shifting SAs from the inpatient to outpatient setting has affected clinical outcomes. Herein, we describe the rate of outpatient SA growth and compare inpatient and outpatient SA complications, readmissions, and mortality.

Methods: We analyzed 100% of 2019-2022Q1 Medicare fee-for-service claims to evaluate the trends in outpatient SAs and to compare the rates of surgical complications, 90-day hospital readmissions, and 90-day mortality between outpatients and inpatients. Outpatient cases were defined as those discharged on the same day of the surgery. To reduce the COVID-19 pandemic's impact, we excluded 2020Q2-Q4 data. To reduce selection bias, we used propensity scores to match 2021-2022Q1 outpatients with 2019-2020Q1 inpatients. We performed both propensity score-matched and -weighted multivariate analyses to compare outcomes between the two groups. Covariates included socio-demographics, preoperative diagnosis, comorbid conditions, the Hierarchical Condition Category risk score, prior year hospital/skilled nursing home admissions, surgeon volume, and hospital characteristics.

Results: A total of 88,099 cases were identified (14,540 outpatients and 73,559 inpatients). Outpatient SA volume increased from 1% (1,841) in 2019Q1 to 22% (3,456) in 2021Q1 and 38% (6,778) in 2022Q1. Glenohumeral osteoarthritis was the most common indication (70.20%), followed by rotator cuff pathology (14.47%). The unadjusted rates of complications (0.21 vs. 1.24%, $p < 0.001$), readmissions (3.67 vs. 6.86%, $p < 0.001$), and mortality (0.25 vs. 0.40%, $p = 0.005$) were significantly lower among outpatient SAs than inpatient SAs. Using 1:1 nearest matching, 14,487 patient pairs were identified. Propensity score-matched multivariate analyses showed among outpatients lower rates of complications (Odds Ratio [OR]=0.21, $p < 0.001$) and 90-day hospital readmissions (OR=0.76, $p < 0.001$) but similar rates of 90-day mortality (OR=1.18, $p > 0.05$). Propensity score-weighted multivariate analyses resulted in similar conclusions.

Conclusions: There has been exponential growth in outpatient SAs since 2019. Outpatient SAs demonstrate better clinical outcomes than inpatient SAs; more research is warranted to understand the differences in these outcomes.

EP.06.013

ACROMION FRACTURES IN REVERSE SHOULDER ARTHROPLASTY - A BIOMECHANICAL CLASSIFICATION GUIDING FIXATION TECHNIQUES AND OUTCOMES

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Background: Acromion stress fractures are increasingly seen with reverse total shoulder arthroplasty. Literature is sparse, consisting of mainly case series. We found both the Levi and Crosby classifications to be poor guides for management. We propose a new biomechanical classification based on the forces through different parts of the acromion and site specific fixation techniques.

Methods: Two practice EMRs were reviewed and 26 acromion stress fractures were identified over a 21 year period from 2002 to 2022.

Fracture patterns were identified per 3-D CT scans and treatment documented. A new biomechanical classification was devised. Our CT based classification has 3 main types 1,2,3 similar to the Levy classification with subtypes 1a (anterior tip, inferior sagittal flexion displacement force), 1 b (cantilever force), 2 (interzone), 3a (inferior sagittal displacement), 3 b (base of spine, inferior coronal flexion). Fixation techniques were directed to neutralization of the forces with hook plates, locking plates and allograft. All cases had the Oxford Shoulder Score and Constant Score prospectively documented pre-injury (if available, post-injury and post fixation).

Results: All fractures were seen within 5 years of the index surgery. 17 cases were in females and 9 in males (2:1 ratio). All but one case reported a sudden loss of function and or onset of pain.

Fracture classification: 1a-9, 1b- 6, 2-4, 3a-2, 3b-5.

5/26 were non-unions.

The average OSS at presentation with the fracture was 21 and Constant score 23. Of the cases that had pre-fracture scores available (8/21) the OSS fell from 41 to 23 and Constant score from 76 to 22, after the fracture.

22 cases had operative fixation with union achieved in 21 cases. Of the cases that achieved union the OSS 6 mo. post fixation was 38 and Constant score 71. All cases treated non-operatively had persistent symptomatic non union with poor function (OSS 21, Constant 22).

Conclusions: A new biomechanical classification guides fixation modalities. Surgical fixation of acromion stress fractures results in improved functional outcomes.

EP.06.014

USE OF PATIENT-SPECIFIC INSTRUMENTATION FOR HUMERAL OSTEOTOMY DURING ANATOMIC SHOULDER ARTHROPLASTY LEADS TO ACCURATE RECREATION OF THE CENTER OF ROTATION

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Background: Restoration of the proximal humeral anatomy after anatomic total shoulder arthroplasty (aTSA) has been shown to lead to better clinical outcomes and survival rates. Recent study showed that using three-dimensional planning with standard cutting guides leads to high deviation of the center of rotation (COR) in 65% of the cases. The purpose of the study is to radiographically measure the deviation of the COR after implantation of aTSA using PSI for the humeral osteotomy. The second aim is to analyze the deviation between planned and postoperative parameters.

Methods: Twenty-six consecutive patients who underwent aTSA using PSI for the humeral osteotomy were radiographically assessed using pre- and postoperative standardized AP radiographs. The pre-morbid COR was established using the circle method described by Youderian et al. and a deviation of < 3mm of the COR was considered a correct RPHA. Based on this two groups were created (group 1: <3 mm, group 2: >3 mm). Additionally, the deviation between the planned- and postoperative values of neck shaft angle (NSA), humeral head height (HHH) and humeral diameter (HD) were assessed. Outliers were defined as cases with one or more of the following deviations: >10° NSA, >5 mm HHH and >5mm HD. With normal distribution in Shapiro-Wilk testing the comparison between groups was performed using t-tests. Comparison between group 1 and 2 was performed using Mann Whitney U-test.

Results: Mean age was 60 years, 13(50%) male, 11(42%) left shoulders. In 17(65%) patients a short stem and in 9 (35%) a stemless implant was used. All humeral components were cementless. The mean deviation of COR was 2mm with 3 (11.5%) cases being > 3 mm. The deviation between planned and postoperative values of NSA, HHH and HD was $3.6^{\circ} \pm 5.8$, $1.8\text{mm} \pm 1.7$ and $1.0\text{mm} \pm 1.7$. There were 4 (15%) outliers (3 due to NSA and 1 due to HHH). A dichotomized group analysis between group 1 and 2 showed no significant difference in NSA, HHH or HD.

Conclusions: The use of PSI for humeral osteotomy leads to an accurate RPHA with low deviation of the COR. Additionally, PSI is associated with low deviation between planned and postoperative result.

EP.06.015

SCAPULAR AND HUMERAL CONTRIBUTIONS TO SHOULDER INTERNAL ROTATION FOLLOWING PRIMARY REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: The cause of internal rotation (IR) deficits following reverse total shoulder arthroplasty (rTSA) is likely multifactorial – limitations in power (e.g. subscapularis), intrinsic restrictions (impingement or capsular tightness), and extrinsic limitations (scapulothoracic motion) – but the relative contribution of each remains unknown. This study utilizes a novel radiographic assessment to understand the scapulothoracic and glenohumeral contributions to IR following rTSA.

Methods: Patients presenting for routine follow-up at least 1 year following primary rTSA (Tornier Perform Reversed [Stryker; Kalamazoo, MI], Trabecular Metal Reverse [Zimmer-Biomet; Warsaw, IN]) were approached for inclusion. Three anteroposterior radiographs of the shoulder were obtained: elbow at side in neutral rotation, hand on abdomen, maximal IR behind back. Radiographs were imported into FreeCAD three-dimensional (3D) modeler software and the 3D location of the implants was utilized to determine positional changes of the scapula and humerus for each pose. This technique was validated with digitally reconstructed radiographs of post-operative CT scans from a separate cohort ($p < 0.001$).

Results: Thirty-nine cases in 38 patients with an average age of 69.6 years (range: 44-82) with 19 females (48.7%) were included in this analysis. Relative to neutral position, IR to the abdomen resulted in upward scapular rotation (mean=5.9deg [95% CI=3.0-8.8]; $p < 0.001$) and internal scapular rotation (9.7deg [5.8-13.6]; $p < 0.001$) plus humeral abduction (8.1deg [5.2-10.9]; $p < 0.001$) and humeral internal rotation (26.9deg [18.9-34.9]; $p < 0.001$). Comparatively, IR behind the back resulted in downward scapular rotation (13.3deg [10.3-16.3]; $p < 0.001$) with humeral abduction (21.0deg [18.2-23.9]; $p < 0.001$), internal rotation (76.9deg [71.1-82.7]; $p < 0.001$), and extension (28.8deg [25.0-32.4]; $p < 0.001$). The scapula contributed to 34% (30-41%) of total motion to achieve internal rotation to the abdomen and 19% (79-83%) of total motion required to achieve internal rotation from the abdomen to maximum behind-the-back. Increased glenohumeral internal rotation (OR=1.07 [1.0-1.1]; $p = 0.04$) was the sole independent predictor of acceptable IR following rTSA.

Conclusions: This analysis demonstrates that scapulothoracic and glenohumeral motion both contribute to IR to the abdomen and behind-the-back following rTSA. However, in this cohort, patients' ability to achieve sufficient IR most substantially depended upon glenohumeral internal rotation. Improving behind-the-back function following rTSA may benefit from a more discerning assessment of impingement-free glenohumeral range-of-motion.

EP.06.016

TRENDS OF VENOUS THROMBOEMBOLISM AFTER TOTAL SHOULDER ARTHROPLASTY IN THE UNITED STATES: ANALYSIS FROM 2011 TO 2019

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Background: In 2009, the American Academy of Orthopedic Surgeons (AAOS) released a consensus recommending venous thromboembolism (VTE) prophylaxis after total shoulder arthroplasty (TSA). The purpose of this study was to examine the (1) change in incidence of 90-day VTE, deep venous thrombosis (DVT), and pulmonary embolism (PE); (2) change in utilization of chemoprophylaxis; and (3) change in the economic burden associated with VTE following TSA from 2010 to 2019.

Methods: Using the PearlDiver database, national data from 2010 to 2019 was used to identify patients who underwent primary TSA for osteoarthritis and/or rotator cuff arthropathy. Exclusions entailed liver pathology, coagulopathy, or those on prior prescribed blood thinners before TSA. Multivariable regression was used controlling for age and Charlson Comorbidity Index for all years with 2010 as the reference year.

Results: From 2010-2019, there was a reduction in VTE rates from 0.89% in 2010 to 0.78% in 2019. In terms of implant type, there was no significant change in incidence of VTE, DVT, and PE within 90-days after anatomic TSA. There were significant reductions in both VTE and DVT after reverse TSA from 2010-2019. Prescribed chemical VTE prophylaxis utilization after TSA significantly increased from 4.41% in 2010 to 11.70% utilization in 2019. The utilization of aspirin significantly increased from 17.27% in 2010 to 65.17% in 2019. Among anticoagulants, the utilization of direct factor Xa inhibitors increased from 0.0% utilization in 2010 to 66.09% utilization in 2019. The added reimbursements associated with VTE following TSA significantly decreased from \$14,122 in 2010 to \$4,348 in 2019.

Conclusions: The incidence and economic burden associated with VTE after TSA have significantly declined following the 2010 AAOS CPG guidelines. This reduction can be attributed to both an increase in VTE prevention via increased utilization of prescribed chemoprophylaxis as well as improvement in VTE treatment strategies.

EP.06.020

GLENOID COMPONENT PLACEMENT ACCURACY IN TOTAL SHOULDER ARTHROPLASTY WITH PREOPERATIVE PLANNING AND STANDARD INSTRUMENTATION IS NOT INFLUENCED BY SUPERO-INFERIOR GLENOID EROSION

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Background: Accurate glenoid component placement in total shoulder arthroplasty (TSA) is often difficult even with the use of preoperative planning. Computer navigation and patient-specific guides increase component placement accuracy, but which patients benefit most is unknown. We assessed surgeons' accuracy in placing a glenoid component in-vivo using 3-dimensional preoperative planning with standard instrumentation for different glenoid erosion patterns.

Methods: We retrospectively reviewed of 170 primary TSAs performed at a single institution. Commercially-available preoperative planning software was used in all arthroplasties with multiplanar 2-dimensional computed tomography and a 3-dimensional implant overlay. After registration of intraoperative bony landmarks to the navigation system, participating surgeons with knowledge of the preoperative plan were blinded to the navigation screen and attempted to implement their preoperative plan by simulating placement of a central-axis guide pin. 230 screenshots of surgeon's simulated guide pin placement were included (aTSA=66, rTSA=164). Displacement, error in version and inclination, and overall malposition from the preoperatively-planned target point were stratified by the Favard classification describing superior-inferior glenoid wear: E0(n=89)=superior humeral migration with no glenoid erosion; E1(n=81)=concentric glenoid erosion; E2(n=29)=glenoid erosion predominantly in the superior pole; E3(n=29)=global glenoid erosion more severe in the superior pole; E4(n=2)=glenoid erosion predominantly in the inferior pole. Components were considered malpositioned for version/inclination errors >10° or displacement from the starting point >4 mm.

Results: Overall, the mean displacement error was 3.5±2.7mm (aTSA=2.7±2.3mm, rTSA=3.8±2.9mm), version error was 5.7±4.7° (aTSA = 5.8±4.4°, rTSA = 5.7±4.8°), inclination error was 7.1±5.6 (aTSA = 4.8±4.8°, rTSA = 8.1±5.7°), and malposition rate was 53% (aTSA=38%, rTSA=59%). None of our outcomes differ based on Favard classification: displacement error (P=0.829; E0=3.5±3.0mm, E1=3.4±2.8mm, E2=3.2±1.9mm, E3=3.8±2.4mm, E4=2.0±0.4mm), version error (P=0.297; E0=6.0±4.9°, E1=6.2±5.0°, E2=4.6±3.7°, E3=4.6±3.7°, E4=4.5±4.9°), inclination error (P=0.764; E0=7.2±5.6°, E1=6.6±5.7°, E2=7.4±5.6°, E3=8.2±5.7°, E4=6.0±5.7°), and malposition rate (P=0.381; E0=53%, E1=51%, E2=48%, E3=66%, E4=0%). Additionally, outcomes did not differ when stratified by type of TSA.

Conclusions: Glenoid component displacement, version error, inclination error, and overall malposition did not differ based on supero-inferior glenoid morphology as defined by the Favard classification. Malposition was relatively high in our cohort, suggesting that surgeons should consider alternate techniques beyond preoperative planning and standard instrumentation when performing shoulder arthroplasty.

EP.06.021

RETURN TO SPORT AFTER REVERSE TOTAL SHOULDER ARTHROPLASTY : ASIAN PERSPECTIVE

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Background: Many patients who undergo reverse total shoulder arthroplasty (RSA) are willing to return to sport after surgery. There are few literatures reporting return to sport after RSA. The aim of the study is to survey patients who underwent RSA who participated in sport activity preoperatively and determine 1) rate and timing of return to sport 2) factors that may prevent from return to sports after RSA.

Methods: We performed a retrospective review of consecutive patients who underwent RSA. All patients who were playing sports preoperatively within 3 years with minimum 2-year follow-up were included. Clinical outcome, radiological outcome, and patient-reported questionnaire regarding sport activities after RSA was examined. Sub-group analysis was done between Group A (Returned to sport after RSA) and Group B (Not participated in sport after RSA).

Results: Of the 213 patients who underwent RSA, 43 patients (Group A : n = 27, Group B : n = 18) were eligible for this study. Mean age was 72.5 years for Group A and 73.7 for Group B ($p > 0.05$). Mean follow up duration was 41.2 months. Average time to return to sport was 9.1 months. Swimming was the most common sport played preoperatively and only 25% of patients returned to swimming after RSA. The most patients stopped sport activity after RSA because they are worried about postoperative complications after surgery. Both groups had significant improvement of range of motion and functional scores after surgery. There were no significant differences in clinical, radiological outcome, and complications between two groups.

Conclusions: Return to sport rate after RSA was 62.8%, and time to return to sport was 9.1 months. Patients could return to sport activity without significant complication. This study could not find any predictable factor which was relevant to return to sports.

EP.06.022

INFLUENCE OF ACROMIOCLAVICULAR JOINT ARTHRITIS ON OUTCOMES AFTER REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: Although substantial motion at the acromioclavicular joint (ACJ) occurs during overhead shoulder motion, the influence of ACJ arthritis on postoperative outcomes of patients undergoing rTSA is unclear. We assessed the influence of the presence and severity of ACJ arthritis on clinical outcomes after primary rTSA.

Methods: We conducted a retrospective review of a prospectively-collected shoulder arthroplasty database of patients that underwent primary rTSA with a minimum 2-year clinical follow-up. Imaging studies of included patients were evaluated to assess the ACJ for pathology; severity was based upon size and location of osteophytes. Severe ACJ arthritis was characterized by large osteophytes (≥ 2 mm). When available, computed tomography and magnetic resonance imaging were used to assess the ACJ. Range of motion (ROM) and clinical outcome scores (ASES, Constant, SPADI, SST, UCL scores) were assessed both preoperatively and at latest follow-up and compared between patients with varying severity of ACJ arthritis. Multivariable linear regression models were used to determine whether increasing severity of ACJ arthritis was associated with poorer outcomes.

Results: The mean age at surgery was 70.9 ± 7.7 years. 55% were female. The mean follow-up was 4.1 ± 3.3 years. Preoperatively, there were no difference in ROM and scores based on the severity of ACJ pathology. There were no differences in ROM postoperatively based upon the severity of ACJ arthritis, except for greater improvement in active internal rotation in patients with normal or grade 1 ACJ arthritis versus grade 2 and 3 (3 ± 2 vs. 1 ± 2 and 1 ± 3 , $P=0.029$). Patients with ACJ arthritis and osteophytes ≥ 2 mm had less favorable SPADI scores, which corresponds to greater pain in these patients (-49.3 ± 21.5 vs -41.3 ± 26.8 , $P=0.015$). On multivariable analysis, increased severity of ACJ arthritis was not independently associated with poorer postoperative ROM or outcome scores.

Conclusions: Overall, our results demonstrate that greater ACJ arthritis severity is not associated with poorer ROM and outcome scores following primary rTSA. Therefore, patients with high grade ACJ arthritis can safely undergo rTSA and expect similar outcomes to patients without ACJ arthritis. However, patients with large ACJ osteophytes (≥ 2 mm) may have greater pain postoperatively.

EP.06.023

REVERSE SHOULDER ARTHROPLASTY WITH OR WITHOUT STEM : COMPARISON OF FUNCTIONAL AND RADIOLOGICAL OUTCOMES WITH A MINIMUM FOLLOW-UP OF 5 YEARS

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Background: The main advantage of a stemless reverse arthroplasty is to reduce the operating time and to simplify the management of stem complications (periprosthetic fracture, removal for infection, stress shielding). The objective of this work was to report the functional and radiological outcomes of 2 cohorts of patients who had received implants with and without stem.

Methods: This is a retrospective, non-randomized case-control evaluation involving 42 patients with a minimum of 60 months of follow-up : 16 stemless reverse prostheses (EasyTech™ - FX) with an age of 69 years (+/- 7) and 26 stemmed reverse prostheses (24 Humelock & 2 Humeris™) with an age of 73 years (+/- 8) operated for eccentric omarthrosis or cuff tear arthroplasty during 7 years. The humeral stemless implant is an corolla with Retentive periphereal discontinuous pegs and Symmetric Onlay cup. A delto-pectoral approach allowed for a 145° humeral cut for each arthroplasty. The data collected at more than 5 years included a functional evaluation of the operated shoulder (measurement of joint amplitudes, Constant score (CSS), QuickDash, ASES) as well as a radiological evaluation with measurement of distalization, lateralization and complications.

Results: At a mean follow-up of 76 months (+/- 15) functional outcomes of the S- and S+ respectively reported a Constant score at 98 (+/- 27) vs. 83 (+/- 25), a Quick DASH at 24 (+/- 9) vs. 31 (+/- 7), an ASES at 74 (+/- 20) vs. 65 (+/- 16). The postoperative radiological study revealed an NSA at 144° (+/- 10) vs. 147° (+/- 11), a DSA at 42° (+/- 18) vs. 49° (+/- 14), LSA at 79° (+/- 26) vs. 74° (+/- 20), lowering is measured at 30 mm (+/- 8) vs. 36 mm (+/- 6), glenoid inclination is 98° (+/- 7) vs. 99° (+/- 7) and a similar inferior overhang of 3 mm . In S- group, no scapular notching were reported, but 3 patients (18.7%) had radiolucency without loosening. In S+ there were 8 patients (30.8%) with a scapular notching and 13 patients (50%) with periprosthetic radiolucency with no loosening.

Conclusions: Only 2 series have already been published. Stemless reverse implant are reliable

EP.06.024

ANALYSIS OF THE ASSOCIATION BETWEEN THE DEGREE OF TYPE II ACROMION FRACTURE IN REVERSE TOTAL SHOULDER ARTHROPLASTY AND THE BIOMECHANICAL DETERIORATION OF THE SHOULDER FUNCTION

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Background: It is known that conservative treatment for type I and surgical treatment for type III are suitable for maintaining shoulder function. However, the biomechanical changes and treatment guideline which is derived by type II acromion fracture in RSA are still not well understood. The purpose of our study was to analyze the biomechanical changes according to the degree of tilting of the fracture when an acromion fracture occurred at the type II position in the shoulder undergoing RSA.

Methods: RSA was performed on a total of 9 cadaveric shoulders, and osteotomy was performed at the position where the plane extending to the flattened glenoid surface after reaming and meeting the acromion, and a hypothetical type II acromion fracture was created. The measured values in the normal state before fracture (group A) and the values in each group (10° tilted; group B, 20° tilted; group C, 30° tilted; group D) were compared.

Results: There was no significant difference in the impingement free angle of shoulder abduction between groups A and B, but group C showed a significant difference from group A, and group D demonstrated a significant difference between groups A and B. In the forward flexion, all groups B, C, and D had significantly decreased impingement angle than group A. In group D, the impingement angle was significantly decreased than in group B. In the analysis of glenohumeral abduction capability, significant differences between group A and group C, and D were continuously observed from 12.5N. And in the capability of forward flexion, group D showed a significantly smaller value than group A from 15N to 20N ($P < 0.01$, respectively). At 17.5 and 20N loading, group D also showed significantly lower ability than group B.

Conclusions: In Type II fractures that occurred after RSA, when tilting progressed by 10° compared to before fracture, range of motion was deteriorated in proportion to the degree of tilting. In the capability of shoulder movement, acromion fracture had a greater effect on abduction, and in particular, it was confirmed that the ability was significantly reduced when the acromion was tilted by 30°.

EP.06.025

STEMLESS METAPHYSEAL REVERSE SHOULDER ARTHROPLASTY - LONG TERM CLINICAL AND RADIOLOGIC OUTCOME IN PROSPECTIVE 10 TO 17 YEARS FOLLOW-UP STUDY

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Background: Stemless metaphyseal humeral components were developed to minimize bone resection and preserve bone. The aim of this study is to evaluate the long-term clinical and radiologic outcomes (10 to 17 years follow-up) using a stemless metaphyseal reverse total shoulder arthroplasty (rTSA).

Methods: Between 2005 - 2012, 207 consecutive patients underwent rTSA with stemless metaphyseal rTSA (51M/156F). 121 cuff arthropathy, 19 fracture sequelae, 26 rheumatoid arthritis, 16 massive rotator cuff tear & failed repair, 7 anatomic prosthesis with cuff deficiency, 7 osteoarthritis and 11 acute trauma. 49 of these were revision TSA. 95 patients died before 10y from surgery but were pleased with their shoulder at their last FU, 9 patients were lost to FU. 103 patients were available for long term FU of more than 10 years (10 -17 years; 120 - 193 months).

Results: Mean age at surgery was 74.8 years (range, 38-93 years). Subjective Shoulder Value (SSV) improved from 14/100 to 89/100. Mean Constant score (CS) improved from 17.5 to 66 points, age/sex adjusted CS improved to 107 (P < .0001). Range of motion improved from 58° to 145° elevation, 22° to 38° external rotation, and 32° to 83° internal rotation. 98/103 patients felt much better or better since the operation (84 much better), 4 same and 1 worse. Radiographic analysis showed no lucencies, subsidence, or stress shielding around the humeral or glenoid components. Glenoid notching was found in 21% of the patients (mainly grade 1-2). 18 cases had to be re-operated: 3 for dislocation, 4 plating of scapular spine fracture, 7 revised due to traumatic periprosthetic fracture (3 humeral, 3 glenoid and one both) and 2 revised for infection.

Conclusions: The stemless metaphyseal rTSA design shows good long-term results in 10 to 17 years FU, with excellent pain relief and shoulder function, restoration of good active range of motion, and high patient satisfaction scores. The unique design of this implant seems to result in improved rotational movements, low incidence of glenoid notching, and no implant loosening, subsidence, or stress shielding. The good clinical, functional and radiographic outcome was maintained throughout the long-term follow-up with no deterioration.

EP.06.026

PYROCARBON HEMIARTHROPLASTY WITH CORRECTIVE GLENOID REAMING FOR GLENO-HUMERAL OSTEOARTHRITIS WITH POSTERIOR HUMERAL SUBLUXATION: A CT-SCAN STUDY

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Background: Glenohumeral osteoarthritis (OA) with posterior humeral head subluxation and posterior glenoid erosion in young patients remain an unsolved problem in shoulder arthroplasty. Total shoulder arthroplasty (TSA) and hemiarthroplasty (HA) presents unpredictable results. Reverse shoulder arthroplasty (RSA) is a more reliable solution, but caution is suggested in young or very active patients. The aim of the study is to present the radiological and clinical results of HA with Pyrocarbon head (HA-PYC) combined with glenoid reaming at short- to mid-term follow-up. The main outcome was the correction of the version and subluxation on the CT scan.

Methods: A monocentric retrospective study was performed including patients who underwent primary HA-PYC + glenoid reaming for primary OA with B2/B3 glenoid or instability arthropathy with posterior subluxation and posterior glenoid erosion. A CT scan was performed preoperatively, immediate postoperative and at minimum follow-up of 2 years assessing glenoid version, subluxation with scapula (SM) and mediatrix method (MM), and glenoid medialization as coracoid-glenoid distance on the multiplanar reconstruction. Clinical examination and X-ray were performed preoperatively and at last follow-up.

Results: At a mean follow-up 53 ± 19 months 37 shoulders (31 patients) were evaluated. All the patients presented a mono-concave glenoid on axial images at last follow-up. Glenoid version changed significantly from 17.2 ± 7.6 to 10.7 ± 8.1 to 8.6 ± 8.1 ($P < 0.001$). With the SM, 25 (68%) cases had a subluxation $< 60\%$, while using the MM 36 (97%) cases had a subluxation $< 55\%$. Coracoid-glenoid distance varied significantly from -5.1 ± 3.4 mm to -6.9 ± 4.2 mm ($p=0.002$), to -8.7 ± 5.4 mm at last follow-up ($p=0.051$).

Two (5,4%) patients underwent revision to RSA: one for a traumatic subscapularis rupture and one for pain and clinical subscapularis insufficiency. At last follow-up Constant Score, Subjective shoulder value, pain and forward flexion, external internal rotation improved significantly ($P < 0.05$)

Conclusions: HA-PYC combined with asymmetrical anterior and concentric reaming allows to correct retroversion and posterior subluxation. Two mm of medialization due to the glenoid reaming and 2 mm due to glenoid remodeling and erosion were measured. Clinical results and revision rate are promising at short-to mid-term follow-up.

EP.06.027

DOES IMPLANT INNOVATION OPTIMIZE THE RATES OF RECOVERY AFTER REVERSE SHOULDER ARTHROPLASTY?

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Background: Reverse shoulder arthroplasty (RSA) has seen an increase in utilization, however, glenoid wear is a common obstacle for patients that undergo shoulder arthroplasty, resulting in higher failure rates and poor outcomes. To address this issue, augmented RSA glenoid components were introduced to treat patients with glenoid wear. Despite the increase in use of augmented RSA (aRSA), there has been limited literature on these new implants. The purpose of this study was to quantify the rate of recovery after aRSA compared to standard RSA.

Methods: A retrospective review of 2089 patients who were treated with primary RSA from 2007 - 2020 with both augmented and standard RSA was performed. The demographic variables, Constant-Murley score (CMS), and range of motion were collected preoperatively and at latest follow-up appointment. Change (delta) in clinical and functional outcomes were calculated from the pre- to postoperative period and compared. Time to recovery was compared between groups and recovery was defined as a Constant-Murley Score 70 or greater. Statistical analysis included t-test with significance defined as $p < 0.05$.

Results: The augmented group had less males (341) than standard group (381) ($p = 0.002$). All other demographic variables and preoperative patient reported outcome metrics were comparable ($p > 0.05$). Patients who underwent augmented RSA experienced significantly greater postoperative Constant score ((63) ($p < 0.001$) compared to Constant score of 59 in standard RSA, greater active forward elevation improvements (73 in aRSA versus 58 in RSA), improvements in active abduction (aRSA=63 in AG versus 51 for RSA), and improvement in active external rotation (aRSA=20 compared to 14 in RSA) ($p < 0.05$). The rate of recovery for patients that had fully recovered was significantly shorter in the augmented RSA group with an average of 13 (+ 16) months following surgery compared to an average of 15 (+ 18) months for standard RSA patients ($p = 0.03$).

Conclusions: Our results demonstrate that augmented baseplates more reliably improve rate of recovery, outcome scores and range of motion for RSA patients. This study is helpful for patients and orthopedic surgeons to understand that implant selection may significantly impact a patient's rate of recovery and outcome after RSA.

EP.06.028

CLINICAL OUTCOMES BETWEEN 1ST AND 2ND TSA IN PATIENTS UNDERGOING BILATERAL TSA

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Background: With rise in bilateral total shoulder arthroplasty (TSA), we compared outcomes of first versus second TSA in patients who underwent bilateral TSA.

Methods: A single-institution prospectively-collected shoulder arthroplasty database was reviewed. Patients undergoing bilateral primary anatomic or reverse TSA (aTSA or rTSA) since January 2000 with minimum 2-year follow-up on both shoulders were identified. Outcomes included outcome scores (SPADI, SST, ASES, UCLA, Constant), active range of motion (abduction, forward elevation[FE], external and internal rotation[ER and IR]), and shoulder strength (ER and FE). Clinically-relevant benchmarks were adopted from prior literature and included minimal clinically important difference (MCID), substantial clinical benefit (SCB), and patient acceptable symptomatic state (PASS). Incidence of surgical complications and revision rates were examined for combinations of 1st and 2nd TSA.

Results: We identified 134 bilateral TSA patients; variations were aTSA/aTSA(n=68), aTSA/rTSA(n=29), rTSA/aTSA(n=3), and rTSA/rTSA(n=80). At the time of second TSA, the mean age was 70.3±7.1 years; patients undergoing rTSA were older than aTSA (71.8±7.0 vs. 67.8±6.6, P=.001). The average BMI was 30.8±7.7kg/m², 50% were female, and 17% had prior surgery; these characteristics did not differ between patients undergoing second aTSA versus second rTSA. Mean time between TSAs was 2.6±2.8 years (aTSA/aTSA=2.2±2.5, aTSA/rTSA=4.6±3.4, rTSA/aTSA=0.9±0.2, rTSA/rTSA=2.3±1.9).

In patients undergoing aTSA/rTSA, 2nd rTSA had superior postoperative SPADI score (19.7±17.9 vs. 31.1±27.6, P=.003), SST score (8.6±3.9 vs. 10.0±2.4, P=.015), ASES score (69.3±25.7 vs. 80.8±6.7, P=.010), and FE strength (12±6 vs. 13±7 lbs., P=.036). For rTSA/rTSA, 1st rTSA had superior postoperative UCLA (27.7±8.0 vs. 25.1±9.8, P=.010), Constant (70.0±22.9 vs. 61.8±28.8, P=.009), FE (120±35° vs. 109±44°, P=.017), abduction (112±36° vs. 99±45°, P=.005), ER strength (11±6 lbs. vs. 9±5 lbs., P=.004) and FE strength (10±5 lbs. vs. 9±6 lbs., P=.040). The only clinically-important difference in all cohort comparisons was a lower proportion of patients achieving the SCB for ER after 2nd rTSA versus 1st aTSA (58% vs. 24%, P=0.016). Overall, there was no difference in incidence of surgical complications or revision rates between any bilateral TSA variations.

Conclusions: All bilateral TSA combinations demonstrated excellent outcomes with most patients achieving clinically-relevant benchmarks. rTSA after aTSA was associated with superior outcomes compared to rTSA after rTSA.

EP.06.029

THE FUNCTIONAL AND RADIOGRAPHIC OUTCOMES OF NON-AUGMENTED ANATOMIC TOTAL SHOULDER ARTHROPLASTY IN PATIENTS WITH WALCH B3 GLENOID DEFORMITIES

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Background: Achieving a durable result with anatomic total shoulder arthroplasty (aTSA) in shoulders with glenoid retroversion deformities, specifically Walch B3 glenoid deformities, can be a challenge. In this retrospective series, we report the mid-term clinical and radiographic follow-up of aTSA in patients with B3 glenoids with nonaugmented polyethylene implants.

Methods: Patients that had undergone aTSA with a non-augmented all-polyethylene glenoid at a single institution by a fellowship-trained surgeon between January, 2013 and August, 2017 with a pre-operative CT scan demonstrating a B3 glenoid were identified. Eccentric reaming was performed to achieve near complete seating of the glenoid component. Patients were contacted to complete patient-reported outcome scores (ASES, WOOS, SST) and radiographic review. Final radiographs were reviewed for glenoid loosening using Lazarus rating.

Results: Twenty-five subjects with a mean age of 65.1 (range: 55-81) years and 6 females (24%; 6/25) met inclusion and had a mean follow-up of 6.2 years (range: 3.9-8.4). ASES improved from 38.2 ± 13.2 to 90.0 ± 16.9 ($p < 0.001$). Three-quarters (20/25) of these patients were available for radiographic follow-up and had an average Lazarus grade of 1.9 (range: 0-5). There was no change in mean posterior glenohumeral subluxation (4.6% vs. 2.3%; $p = 0.15$) relative to their immediate post-operative films. The 12 patients with a Lazarus grade less than two had a greater WOOS (96.9 ± 1.3 vs. 67.4 ± 12.8 ; $p < 0.001$), ASES (94.0 ± 5 vs. 76.3 ± 16 ; $p = 0.03$), SANE ($88.2 \pm 8.7\%$ vs. $66.7 \pm 15\%$; $p = 0.02$), and satisfaction ($98.5 \pm 0.7\%$ vs. $79.9 \pm 13.2\%$; $p = 0.002$) compared to the 8 patients with a Lazarus grade greater than or equal to two. These 8 patients were more likely to have had severe pre-operative biplanar deformity (retroversion > 25 deg and inclination > 10 deg) than the 12 without early glenoid radiolucency (63% [5/8] versus 17%; $p = 0.04$).

Conclusions: At mid-term follow-up, aTSA with standard implants for B3 glenoid deformity provides a reliable treatment option for restoration of function and improvement in pain. Mid-term radiographic review demonstrated development of early glenoid component lucencies in shoulders with severe biplanar deformities with associated deterioration in their clinical function. Long-term follow-up is needed to understand the clinical and radiographic outcome durability after aTSA in the setting of a B3 glenoid.

EP.06.032

PATIENTS WITH RENAL DISEASE HAVE HIGHER COMPLICATION RISK AFTER SHOULDER ARTHROPLASTY BUT EXPERIENCE SIMILAR CLINICAL IMPROVEMENT TO PATIENTS WITHOUT RENAL INSUFFICIENCY

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Background: Chronic kidney disease (CKD) is associated with negative outcomes after hip or knee arthroplasty due to higher rates of complications. The purpose of this study was to describe clinical outcomes and complications after shoulder arthroplasty (SA) for patients with or without CKD.

Methods: We conducted a retrospective cohort study of prospectively-collected data for all primary shoulder arthroplasty patients January 2015 – December 2019 by one surgeon at one institution. We evaluated results from patients with CKD (GFR <60) or without CKD (GFR >60). Outcome measures including visual analog scale for pain (VAS), American Shoulder and Elbow Surgeons score (ASES), simple shoulder test (SST) and single assessment numeric evaluation (SANE) scores were compared between cohorts. Minimal clinically important difference (MCID) and substantial clinical benefit (SCB) was evaluated. Univariate regression was performed to assess the influence of CKD on outcome measures and risk of complications.

Results: 514 patients met study inclusion criteria; 389 patients had normal GFR; 125 had CKD. Patients with CKD were older (73.2 ± 8.9 versus 68.1 ± 9.4 , $p < 0.001$); had lower preoperative Hg (12.4 ± 1.5 g/dL versus 13.4 ± 1.5 g/dL; $p < 0.001$); higher ASA score ($p < 0.001$); more preoperative comorbidities (5.9 ± 2.9 versus 5.0 ± 3.1 , $p < 0.001$); and were more likely to use preoperative opioids ($p = 0.043$). Patients with CKD were at higher risk for transfusion (OR 16.2 (1.9, 139.7), $p = 0.011$) despite similar intraoperative estimated blood loss (156.9 ± 132.5 mL versus 153.8 ± 89.7 mL, $p = 0.768$). CKD patients also were at higher risk for intraoperative fracture (OR 5.4 (1.3, 23.0), $p = 0.022$). CKD patients were not at increased risk for prosthetic joint infection (OR 3.2 (0.2, 50.8), $p = 0.418$), medical complications (OR 0.9 (0.2, 4.4), $p = 0.890$), or revision (1.9 (0.7, 4.9), $p = 0.195$). Patients with CKD had lower ASES, SST, and SANE scores, but similar clinical improvement from preoperative to postoperative (Δ ASES 41.4 ± 21.8 versus 42.9 ± 21.4 , $p = 0.550$), (Δ SST 4.8 ± 3.4 versus 4.9 ± 3.3 , $p = 0.0837$), (Δ SANE 40.7 ± 29.1 versus 42.4 ± 26.5 , $p = 0.766$). Both cohorts achieved MCID and SCB for ASES, SANE, and SST.

Conclusions: Patients with CKD see similar gains in clinical outcomes after shoulder arthroplasty despite increased risk for blood transfusion and intraoperative fracture.

EP.06.033

POSTOPERATIVE ACROMIOHUMERAL INTERVAL AFFECTS RANGE OF SHOULDER MOTIONS FOLLOWING REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: Reverse total shoulder arthroplasty (RTSA) improves function and reduces pain for patients with complex shoulder problems such as irreparable rotator cuff tears with and without arthritis. However, there is a lack of literature regarding the association of radiographic parameters on clinical outcomes after RTSA. The aim of this study was to analyze various radiographic parameters that may be predictive of clinical outcomes after RTSA.

Methods: A total of 55 patients treated with RTSA were enrolled. Shoulder radiographic parameters were used for measurement of critical shoulder angle (CSA), acromial index, acromiohumeral interval (AHI), deltoid lever arm (DLA), acromial angulation, glenoid version, and acromial height. Preoperative and postoperative clinical outcomes (visual analog scale score, the University of California at Los Angeles shoulder score, American Shoulder and Elbow Surgeon score, and active range of motion) were evaluated at a minimum 2-year follow-up. An analysis of correlations between radiographic parameters and clinical outcomes was then performed.

Results: A significant change in CSA, AHI, and DLA was observed between preoperative and postoperative radiographic measurements. A significant improvement was observed in all clinical outcomes and range of motions from preoperative to postoperative (all $P < .001$). A significant correlation of postoperative AHI with forward flexion ($r = -0.270$; $P = .046$), external rotation ($r = -0.421$; $P = .001$), and internal rotation ($r = 0.275$; $P = .042$) was observed at final follow-up. In addition, postoperative AHI less than 29 mm had an 86% positive predictive value of obtaining 130° of forward flexion and 45° of external rotation.

Conclusions: It was found that postoperative AHI showed an association with active range of motion in patients who underwent RTSA. In particular, excessive distalization reduced forward flexion and external rotation motion of the shoulder in patients treated with RTSA.

EP.06.034

REVERSE TOTAL SHOULDER ARTHROPLASTY IN LOCKED ANTERIOR SHOULDER DISLOCATION WITH GLENOID BONE DEFECT

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Background: Locked anterior shoulder dislocations are a rare and challenging condition that may cause anterior soft tissue damage and posterior capsule tightness. As time progressed, the locked anterior shoulder dislocation would cause bone defect over the glenoid surface or Hill-Sach lesion. The literature discussed the treatment outcome of reverse total shoulder arthroplasty in patients who suffered from a locked anterior shoulder dislocation. However, limited studies focus on the treatment outcome and the management of locked anterior shoulder dislocations with bone defects.

Methods: From 2019 to 2022, we retrospectively enrolled patients diagnosed with an anterior locked shoulder dislocation and treated with reverse total shoulder arthroplasty. The locked dislocation was defined as a dislocation period over three weeks. Patients with glenoid bone defects were included. Patients who lost follow-up after the surgery or with an incomplete medical record were excluded. The patient demographic data and bone defect of the glenoid from computed tomography were recorded. The clinical outcome was assessed by shoulder range of motion, subjective shoulder value, and constant score.

Results: Nine female patients were identified from our database, with all of them suffering from right shoulder locked anterior dislocation. The average dislocation period was 2.75 months. There were two patients with severe bone loss, five with moderate bone loss, and two with mild bone loss in bone defect by surface. The average glenoid bone defect in diameter was 24.3%. There were six patients received autogenous bone grafting over the glenoid bone defect. The average forward flexion and external rotation were 126 and 42 degrees post-operatively. The average subjective shoulder value improved from 10 to 75, and the average constant score improved from 25.7 to 72.6. No complications presented during and after their surgeries.

Conclusions: The need for bone grafting in glenoid defects depended on the size of the defect, with no difference in clinical outcomes in patients receiving bone grafting or not. The reverse total shoulder arthroplasty is a reliable and safe method for treating anterior locked shoulder dislocation with bone defects.

EP.06.035

DISCORDANCE BETWEEN PATIENT-REPORTED AND OBJECTIVELY-MEASURED INTERNAL ROTATION AFTER REVERSE SHOULDER ARTHROPLASTY

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Background: Satisfaction after reverse shoulder arthroplasty (RSA) partly relies on restoring internal rotation (IR). While postoperative IR assessment includes objective and subjective measures, these evaluations may not vary together uniformly. We assessed the relationship between objective, surgeon-reported assessments of IR and subjective, patient-reported ability to perform IR-related activities of daily living (IRADLs).

Methods: Patients undergoing primary RSA with a minimum 2-year follow-up were included. Wheelchair bound patients or those with preoperative infection, fracture, and tumor were excluded. Objective IR was measured to the highest vertebral level reached with the thumb. Subjective IR was based on patients' rating (normal, slightly-difficult, very-difficult, or unable) of their ability to perform four IRADLs (tuck in shirt with hand behind back, wash back/fasten bra, personal hygiene, and remove object from back pocket). IR was assessed preoperatively and at latest follow-up.

Results: 443 patients were included (52% female) at mean follow-up of 4.4 ± 2.3 years. Objective IR improved pre- to postoperatively from L5-L4 to L3-L1 ($P < 0.001$). Preoperative IRADLs of 'very-difficult' or 'unable' decreased postoperatively for all IRADLs ($P < 0.005$) except those unable to perform personal hygiene (3.2% vs. 1.8%, $P = 1$). The proportions of patients that improved, maintained, and lost objective and subjective IR was similar between IRADLs; 14-20% improved objective IR but lost or maintained subjective IR and 19-21% lost or maintained the same objective IR but improved subjective IR depending on IRADL assessed. When IRADLs improved postoperatively, objective IR also increased ($P < 0.001$). In contrast, when subjective IRADLs worsened postoperatively, objective IR did not significantly worsen for 2/4 IRADLs. In those that reported no change in pre- vs. postoperative IRADLs, statistically significant increases in objective IR were found for 3/4 IRADLs.

Conclusions: Objective improvement in IR parallels improvements in subjective functional gains uniformly. However, in patients with worse or equivalent IR, the ability to perform IRADLs postoperatively does not uniformly correlate with objective IR. When attempting to elucidate how surgeons can ensure patients will have sufficient IR after RSA, future investigations may need to utilize patient-reported ability to perform IRADLs as the primary outcome measure rather than objective measures of IR.

EP.06.036

COMPUTER AIDED IDENTIFICATION AND SEVERITY GRADING OF GLENOHUMERAL OSTHEOARTHRITIS AND AVASCULAR NECROSIS OF THE HUMERAL HEAD FROM PLAIN RADIOGRAPHIC IMAGES

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Background: Glenohumeral osteoarthritis (OA) and avascular necrosis of the humeral head (AVN) are two debilitating diseases of the shoulder. Patients with any of these diseases benefit from early and correct diagnosis. DL networks, a field within artificial intelligence (AI) have in recent years shown great potential to analyse radiographic images and could potentially be trained to identify and grade OA and AVN in order to ensure that these diagnoses are not missed. Our aim was to train a Deep learning (DL) network to identify and grade OA using the modified Samilson-Prieto classification system according to Allain (SPA) in mixed plain radiographs of the shoulder. Our secondary aim was identical for AVN using the Cruess classification system.

Methods: 6733 plain radiographic examinations were split into a training- (6172 exams) and a validation set (560 exams), for training, validation and evaluation of network performance. A DL network was trained to in turn identify and classify alone. Our primary outcome measurement was Area under curve (AUC) in Receiver Operator Characteristics (ROC) analysis.

Results: For OA, our network achieved an AUC ranging from 0.75 to 0.96 for individual SPA grades. SPA grade "definitive" and "severe" yielded overall best results whereas "none", "mild" and "moderate" were more challenging to identify and grade. Our network achieved AUC 0.85 (95% confidence interval 0.70 to 0.99) for diagnosing AVN despite few cases in the study sample.

Conclusions: We demonstrated as a novelty, that a DL network is a feasible approach for identification and grading of OA and AVN on plain radiographs.

EP.06.037

TIMING OF BILATERAL SHOULDER ARTHROPLASTY: ARE EARLY OUTCOMES AFTER FIRST TOTAL SHOULDER ARTHROPLASTY PREDICTIVE OF CONTRALATERAL SUCCESS?

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Background: The ideal timing of bilateral total shoulder arthroplasty (TSA) is unclear. The purpose of this study was to determine whether early outcomes after 1st TSA can be used to predict clinical outcomes after TSA of the contralateral shoulder and to evaluate the ideal time after aTSA to perform the contralateral shoulder.

Methods: A single-institution prospectively-collected shoulder arthroplasty database was reviewed. Patients undergoing bilateral primary anatomic or reverse TSA(aTSA+rTSA) without fracture, tumor, or infection were identified. Included patients had minimum 2-year follow-up on their 2nd TSA and postoperative follow-up after their 1st TSA at 3-months, 6-months, 1-year, or 2-years. Our primary outcome was whether outcome scores and motion at 3-month, 6-month, 1-year, and 2-year follow-up after 1st TSA predicted clinical success after 2nd TSA at final follow-up, defined as achieving the patient acceptable symptomatic state (PASS=the highest level of symptom beyond which patients consider themselves well). Outcomes included the ASES and Constant scores, abduction, forward-elevation, and external/internal-rotation. Multivariable logistic regression determined whether postoperative outcomes after 1st TSA were predictive of achieving the PASS after 2nd TSA independent of age, sex, and BMI. ROC analysis determined cutoffs of postoperative outcomes after 1st TSA at each timepoint that best predicted achieving the prosthesis-specific PASS after 2nd TSA.

Results: We included 134 patients (110 aTSA,158 rTSA). Range of motion and outcome scores at late (1 or 2-year) follow-up after 1st aTSA were more predictive of achieving the 2nd TSA PASS compared to early (3 or 6-month) outcomes. In contrast, outcomes after early and late follow-up after 1st rTSA were similarly predictive of achieving the 2nd TSA PASS. For example, the Constant score threshold at 2-years after 1st aTSA (79.4;AUC=0.804) better-differentiated achieving the 2nd TSA PASS versus the 6-month threshold (72.0;AUC=0.600). In contrast, the Constant score threshold at 2-years after 1st rTSA (76.4; AUC=0.703) was similarly-discriminant of achieving the 2nd TSA PASS compared to the 6-months threshold (65.8;AUC=0.711).

Conclusions: Patients with good outcomes after 1st rTSA can proceed to contralateral TSA as early as 3-months postoperatively with confidence of a similar result on the contralateral side. Success after 1st aTSA does not reliably predict contralateral success until ≥ 1 -year.

EP.06.038

CAN SHOULDER ARTHROPLASTY SURGEONS HELP ADDRESS THE OSTEOPOROSIS EPIDEMIC?

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Background: Osteoporosis is currently undertested and undertreated, leading to increased risks of adverse outcomes such as fragility fractures and periprosthetic fractures (PPF) As patients undergoing TSA tend to be in the osteoporotic range, shoulder arthroplasty surgeons can help address the osteoporosis epidemic. This study aims to observe the overlap of shoulder arthroplasty patients and those at high-risk for osteoporosis as well as the cumulative five-year PPF and fragility fracture.

Methods: A retrospective analysis was conducted using the PearlDiver database. Patients who underwent primary elective TSA from 2010 to 2021 were included. Patients younger than 50 and those with a prior diagnosis or treatment for osteoporosis were excluded. Patients were stratified to those "high-risk" and "low-risk" for osteoporosis based on the most current endocrinology screening guidelines. The primary outcome was to observe the prevalence of osteoporosis screening in high-risk patients via DEXA scan within 3 years before TSA and stratify based on high-risk category. The secondary outcome was to observe the five-year cumulative incidence of periprosthetic fracture and secondary fragility fracture between the low-risk and high-risk cohorts.

Results: In total, 101,021 patients who underwent TSA were included. 34,881 (34.53%) were considered low-risk and 66,140 (65.47%) were considered high risk for osteoporosis. Of the high-risk patients, 11.68% were screened via DEXA three years prior. Chronic steroid users (30.9%) were the most likely to be screened, followed by females 65 and older (19.7%), those underweight (14.1%), smokers (7.8%), those with alcohol abuse/dependence (5.9%), those with a prior fragility fracture (5.1%), those with metabolic conditions (3.6%), and lastly men 70-years and older (2.4%). Within 5-years, high-risk patients had higher cumulative incidence for periprosthetic fractures (HR: 1.40; 95% CI: 1.02-1.92) and secondary fragility fractures (HR: 2.42; 95% CI: 2.06-2.84) when compared to low-risk patients.

Conclusions: More than half of shoulder arthroplasty patients are at high-risk for osteoporosis with less than 15% of these patients receiving endocrinology guideline recommended screening. As there is a strong overlap of shoulder arthroplasty patients and those at risk for osteoporosis, shoulder arthroplasty surgeons can play a role in addressing the osteoporosis epidemic by enforcing pre-operative osteoporosis screening.

EP.06.040

CLINICAL AND RADIOLOGICAL OUTCOMES OF THE STRYKER ASCEND FLEX UNCEMENTED METAPHYSEAL BEARING STEM AT A MINIMUM 5-YEAR FOLLOW UP

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Background: The Ascend Flex (Stryker, Memphis, TN, USA) is a short stem humeral implant with a proximal titanium plasma coating to help with osseous integration. It has been reported to have good early clinical outcomes and low revision rates (0 - 13%). The reported rates of stress shielding for this implant varies greatly from 3% to 71% and the clinical implications of this are unknown. Few studies have reported the mid/long-term outcomes of this implant.

The aim of this study was to evaluate the mid-term clinical and radiographic outcomes of patients who underwent primary shoulder arthroplasty with this uncemented implant.

Methods: Consecutive patients who underwent shoulder arthroplasty using the Ascend Flex stem with a minimum of 60 months follow up were included in this retrospective series. Outcome measures included; revision rate, reoperation rate, radiographical loosening, subsidence, stress shielding, preoperative and postoperative glenoid version, distalisation and lateralisation shoulder angles (DSA, LSA), complication rate, Oxford Shoulder Score (OSS).

Results: 51 shoulders (50 patients) were eligible for inclusion. There were 26 anatomic total shoulder arthroplasties, 24 reverse geometry, and 1 hemiarthroplasty. Mean age was 72.3 ± 7.7 years. 60.8% were female. Mean follow up duration was 72.3 ± 9.2 months. No patients underwent humeral component revision. One case (2%) underwent reoperation for open reduction and internal fixation of an acromial stress fracture within a total complication rate of 7.8%. 2 cases (3.9%) met the criteria to be deemed radiologically loose. 5 cases (9.8%) demonstrated stress shielding. Mean preoperative and postoperative glenoid version was $10.9 \pm 9.2^\circ$ and $5.8 \pm 2.7^\circ$ respectively. Mean DSA and LSA was $36.5^\circ \pm 30.8^\circ$ and $90.3^\circ \pm 11.4^\circ$ respectively. Mean subsidence was 2.3 ± 2.11 mm. Functional outcomes by way of OSS statistically improved from 14.6 ± 9.0 preoperatively to 36.9 ± 15.5 postoperatively ($p=0.002$).

Conclusions: The findings of this series demonstrate encouraging mid-term clinical and radiological outcomes for the Ascend Flex humeral implant in primary shoulder arthroplasty. Stress shielding was found to be low at 9.8%. Further investigation is required to document the long-term outcomes for this relatively new humeral component.

EP.06.041

ANALYSIS OF B2 GLENOID EROSION PATTERN IN PRIMARY OSTEOARTHRITIS.

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Background: B2 glenoid deformity is described as posteroinferior bone erosion. The purpose of the current study is to demonstrate that the location of this pathologic glenoid bone loss causing biconcavity is variable in glenohumeral joint osteoarthritis. We hypothesize that orientation and direction of posterior glenoid bone loss is correlated with rotator cuff muscle quality.

Methods: We performed three-dimensional (3D) computed tomography (CT) scan reconstruction of 180 type B2 glenoids with an intact rotator cuff. 3D CT scan data was utilized to analyze glenoid erosion pattern for orientation and direction. Glenoid orientation and direction were based off of the angle between the glenoid center line and the glenoid axis (anterior, posterior, superior, or inferior). By convention positive orientation or direction indicates posterior superior and negative angle indicates posterior inferior. Sagittal CT scan images were used to grade rotator cuff muscle atrophy and fatty infiltration of the supraspinatus as well as infraspinatus. Rotator cuff muscle fatty infiltration was grading according to the Goutallier classification and muscle atrophy was graded according to the muscle occupation ratio.

Results: The average B2 glenoid retroversion was $20.2^{\circ} \pm 8^{\circ}$, inclination $6.9^{\circ} \pm 5.3^{\circ}$, 3D orientation $21.7^{\circ} \pm 7.8^{\circ}$, and direction $13.3^{\circ} \pm 19.9^{\circ}$ (range -37° to 76°). The majority of cases demonstrated posterosuperior glenoid erosion as demonstrated in Figure 1 but did cover a spectrum from posteroinferior to posterosuperior. The average supraspinatus atrophy score was 1.6 ± 0.6 and the average Goutallier classification was 0.9 ± 0.6 . The average infraspinatus atrophy score was 1.1 ± 0.2 and the average Goutallier classification was 1.0 ± 0.5 . Regression analysis demonstrated a significant ($r=0.20$; 95% CI 0.05 to 0.33, $p=0.007$) correlation of supraspinatus Goutallier classification on the direction of glenoid wear with increased supraspinatus fatty infiltration correlating with increased posterosuperior glenoid erosion.

Conclusions: We found the direction and orientation of bone erosion to be more commonly posterosuperior in B2 glenoids. Additionally, rotator cuff muscle quality correlates with direction of deformity. Specifically, increased supraspinatus muscle fatty infiltration correlates with posterosuperior glenoid bone loss. Therefore, surgeons should be aware of the variable direction and orientation of B2 glenoid biconcavity during preoperative planning for total shoulder arthroplasty.

EP.06.042

LATERALIZATION IN REVERSE TOTAL SHOULDER ARTHROPLASTY: COMPARISON OF GLENOID VERSUS HUMERAL LATERALIZATION

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Background: Recent RTSA implants feature a lateralized center of rotation (COR) compared to the original Grammont design. Less scapular notching and improved internal/external rotation are the expected advantages. Though this is done by either lateralizing the glenoid or the humerus, no study yet has directly compared the two means.

Methods: This retrospective cohort study was conducted with 73 patients that underwent RTSA using either one of the following two lateralized implants - DJO Reverse Shoulder Prosthesis (n=42, Group LG) with glenoid lateralization or Tornier Aequalis Ascend Flex (n=31, Group LH) with humeral lateralization. Radiologically, acromiohumeral distance (AHD), lateral humeral offset (LHO), acromial fracture, and scapular notching were analyzed. Clinical parameters including the range of motion (ROM) and motor power in forward elevation (FE), external rotation (ER) / internal rotation (IR) at the side were evaluated. Outcome measures University of California Los Angeles score, American Shoulder and Elbow Surgeons score, Simple Shoulder Test, Constant-Murley score, and pain visual analogue scale were also compared between the groups.

Results: Demographic data, preoperative radiologic, clinical parameters, and follow-up period (LG vs. LH: 29.3±17.1 vs. 23.9±13.5 months, P=0.154) were comparable between the groups. Group LG demonstrated a significantly less decrease in ER ROM (LG vs. LH: -0.9±27.2 vs. -15.8±28.6 degrees, P=0.045), greater increase in ER power (LG vs. LH: 12.9±10.3 vs. 3.5±15.5 Newtons, P=0.012), less arm lengthening as measured by the postoperative change in AHD (LG vs. LH: 22.5±8.2 vs. 29.8±8.3 mm, P<0.001), and less incidence of scapular notching (LG vs. LH: 2.4% vs. 38.7%, P<0.001). However, in last follow-up, group LH showed a greater FE ROM (LG vs. LH: 132.0±21.2 vs. 143.2±14.8 degrees, P=0.010), and a higher Constant score (LG vs. LH: 60.3±18.8 vs. 70.7±16.1, P=0.015). Yet, the proportions of patients who exceeded the minimal clinically important difference in each clinical score were comparable between the groups.

Conclusions: Though both means of global lateralization in RTSA were able to achieve a satisfactory outcome, glenoid lateralization offered advantages in ER and less scapular notching. However, a greater FE ROM could be achieved through humeral lateralization. Implant selection based on such findings may produce better patient satisfaction.

EP.06.043

QUANTIFYING SUCCESS AFTER REVISION REVERSE TOTAL SHOULDER ARTHROPLASTY: THE MINIMAL CLINICALLY IMPORTANT AND SUBSTANTIALLY CLINICALLY IMPORTANT PERCENTAGE OF MAXIMAL POSSIBLE IMPROVEMENT

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Background: While revision reverse total shoulder arthroplasty (RTSA) is increasingly commonplace, benchmarks of clinically-important improvement in this population have not been previously defined. In comparison to the minimum clinically important difference (MCID) and substantial clinical benefit (SCB), the percentage of maximal improvement (%MPI) assesses clinical improvement with regard to their "ceiling" possibly providing more equitable comparison. Our purpose was to define the minimal clinically important %MPI (MCI-%MPI) and substantial clinically important %MPI (SCI-%MPI) for outcome scores and range of motion (ROM) after revision reverse total shoulder arthroplasty (RTSA) and to quantify the proportion of patients achieving clinically-relevant success.

Methods: This retrospective cohort study used a prospectively-collected single-institution database of patients undergoing revision RTSA between August 2015 and December 2019. Patients with a diagnosis of infection were excluded. Outcomes scores included the ASES, Constant, SPADI, SST, and UCLA scores. ROM measures included abduction, forward elevation (FE), external rotation (ER), and internal rotation (IR). The MCI-%MPI was determined using an anchor-based method comparing patients describing their treatment as "better" compared to "worse" or "unchanged" and using a distribution method defined as 0.5 standard deviation. SCI-%MPI was determined using an anchor-based method comparing patients describing their treatment as "much better" compared to "worse" or "unchanged". The proportions of patients achieving each threshold were assessed.

Results: 108 revision RTSAs with minimum 2-year follow-up were evaluated. Mean age was 67 years, 59% were female, and average follow-up was 55 months. Revision RTSA was performed most commonly for failed anatomic TSA (n=53), followed by hemiarthroplasty (n=26), RTSA (n=18), and resurfacing (n=11). The indication for revision RTSA was most commonly glenoid loosening or rotator cuff failure (n=25 for both), followed by instability (n=21) and unexplained pain (n=11). The anchor-based MCI-%MPI values (% of patients achieving) were: ASES=33%(54%), Constant=22%(61%), UCLA=50%(52%), SST=28%(66%), and SPADI=31%(55%). The distribution-based MCI-%MPI values (% of patients achieving) were: ASES=25%(65%), Constant=13%(70%), UCLA=22%(77%), SST=23%(67%), and SPADI=34%(93%). The anchor-based SCI-%MPI values (% of patients achieving) were: ASES=57%(37%), Constant=42%(27%), UCLA=67%(36%), SST=75%(31%), SPADI=51%(35%).

Conclusions: This study established thresholds for the MCI-%MPI and SCI-%MPI at minimum 2-years after revision RTSA, providing physicians an evidence-based method to counsel patients and assess outcomes postoperatively while mitigating ceiling effects.

EP.06.044

EFFECTS OF NEUROMUSCULAR ELECTRICAL MUSCLE STIMULATION ON THE DELTOID FOR SHOULDER FUNCTION RESTORATION AFTER REVERSE TOTAL SHOULDER ARTHROPLASTY IN THE EARLY RECOVERY PERIOD: A PROSPECTIVE RANDOMIZED

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Background: Neuromuscular electrical stimulation (NMES) is a treatment modality that has been used to accelerate the rehabilitation of patients with neurological damage. However, it is unclear whether NMES of the deltoid can lead to the early restoration of shoulder function after reverse total shoulder arthroplasty (RSA).

Methods: In this prospective and randomized study, 88 patients who underwent RSA with the same prosthesis design for cuff tear arthropathy or irreparable rotator cuff tear were assessed. The patients were divided into two groups (NMES group and non-NMES group, 44 patients each). For the NMES group, two pads of the NMES device were placed over the middle and posterior deltoid area, and NMES was maintained for 1 month after surgery. Shoulder functional outcomes and deltoid thickness were compared at 3, 6, and 12 months postoperatively. Shoulder functional outcomes were assessed based on the visual analog scale (VAS) for pain, American Shoulder and Elbow Surgeons (ASES), and Constant scores and the range of motion (ROM) and power of the affected shoulder. The thickness of the anterior, middle, and posterior deltoid was measured by ultrasonography.

Results: A total of 76 patients (NMES group, 33 patients; non-NMES group, 43 patients) were enrolled in the final analysis. The preoperative demographics and status of the remaining rotator cuff of both groups were not significantly different. At postoperative 3 months, the ROM and power of external rotation of the NMES group were significantly greater than those of the non-NMES group ($P < .002$). The ROM of external rotation of the NMES group at postoperative 6 months was also greater than that of the non-NMES group ($P = .013$). However, there was no significant difference in the VAS, ASES, and Constant scores at all follow-up points despite gradual improvements until 1 year postoperatively. Serial measurements of the thickness of the anterior, middle, and posterior deltoid of both groups did not show significant differences.

Conclusions: Postoperative NMES of the deltoid after RSA contributed to significantly faster ROM restoration and considerable improvement in the power of external rotation. Therefore, NMES following RSA could lead to the early restoration of external rotation and recovery of deltoid function.

EP.06.046

RETURN TO RACKET SPORTS AFTER SHOULDER ARTHROPLASTY: PERFORMANCE AND OUTCOME SCORES

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Background: Tennis and other racket sports remain popular amongst active patients considering shoulder arthroplasty. While the ability to return to tennis following hip and knee arthroplasty has been previously studied, the capacity to participate following shoulder arthroplasty is less well known, especially following reverse shoulder arthroplasty (RSA), which alters shoulder kinematics. This study aimed to evaluate patients treated with shoulder arthroplasty who identified tennis and racket sports as a preferred sport. We hypothesize that shoulder pain and performance will improve during racket sports similarly after both anatomic and reverse total shoulder arthroplasty, with a preserved capacity to participate.

Methods: This is a retrospective cohort study of 43 patients identified as playing a racket sport before undergoing either anatomic total shoulder arthroplasty (TSA) or RSA. All patients were cleared to return to racket sports activities beginning 3 months following surgery. Patients were contacted by phone or email and a racket sport-specific questionnaire was administered, focusing on their experience returning to racket sports.

Results: The median age at surgery was 71 years, with 26 TSA and 13 RSA patients. Of the 43 patients, 90% were able to return to sport, 4 (3 RSA, 1 TSA) stated that they were unable to return due to a shoulder-related complaint. Of the 39 patients still playing, 19 (49%) returned within 6 months and 33 (85%) returned within 12 months, with no differences among cohorts ($p=0.344$). Overall perceived performance following surgery stayed the same or improved in 90% of the patients. Similarly, overall enjoyment of racket sports either improved or stayed the same in 98% of patients. Pain experienced during racket sport improved significantly from a median VAS pain score of 5 to 0 ($p < 0.001$) with no significant difference seen when comparing RSA and TSA. The dominant arm was treated in 14 (54%) TSA and 8 (62%) RSA patients with minimal impact on outcomes.

Conclusions: Return to racket sports following both reverse and anatomic total shoulder arthroplasty is a realistic expectation, with significant improvements in both pain and sport-specific function while playing. Patients treated with anatomic and reverse shoulder arthroplasty can expect similar racket sport experiences following surgery

EP.06.047

ANTIBIOTIC-LOADED DISSOLVABLE CALCIUM SULFATE BEADS WITH CEMENTLESS TSA FOR ONE-STAGE REVISION OF INFECTED SHOULDER ARTHROPLASTY

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Background: Purpose: Clinical and radiographic outcomes of single stage revision with cementless implants for infected shoulder arthroplasty with ALCSDB (antibiotic-loaded calcium sulfate dissolvable biodegradable) beads.

Background: Treatment of infected shoulder arthroplasty is controversial. Conventional two-stage revision involves two surgical procedures, extended damage to the soft tissues and long recovery.

The use of antibiotic loaded cement requires using cemented implants. Antibiotic loaded cement beads require future removal of the beads. We introduced a single-stage revision using ALCSDB beads with cementless implants.

Methods: Methods: 27 patients underwent revision TSA for suspected infection using ALCSDB beads.

Following removal of the infected implants and meticulous debridement and washout, the biodegradable spheres were inserted into bones and soft tissue layers, before the re-implantation of cementless new implants.

Demographics, radiographs and intraoperative cultures were prospectively collected. Constant Score, Subjective Shoulder Value and ROM were recorded. Radiographic analysis was performed in every FU.

Results: Results: Mean age was 66.5 years. Of 27 patients, 25 patients underwent single-stage revision (7 TSA to rTSA, 5 resurfacing to rTSA, 3 infected plating to rTSA and 3 resection arthroplasty (post infection) to rTSA).

In 2 cases of acute infection, DAIR (exchange of modular components) was attempted and failed, followed by successful formal 2-stage revision using ALCSDB beads.

Perioperative cultures grew *C. acnes*; *Staphylococcus aureus* and *Streptococcus Oralis*. Several cultures of clinical evident low-grade infection failed to grow an organism. In 1 year FU, infection was successfully eradicated and good function restored in all patients.

On radiographs: beads resorbed within 3-6 weeks post-op. No lucencies around the implants, loosening, subsidence or stress shielding were seen. Beads in bone-deficient areas were substituted by bone formation.

Conclusions: Conclusion: The use of ALCSDB beads is an effective and practical option for single-stage revision with cementless implants for infected TSA, with excellent outcomes and rapid recovery.

EP.06.048

OUTCOMES OF SHOULDER ARTHROPLASTY IN YOUNG PATIENTS

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Background: Shoulder replacement is a reliable treatment for the relief of pain and improvement of function in patients with glenohumeral arthritis, rotator cuff arthropathy, osteonecrosis and fracture. This study aimed to compare the survivorship of hemiresurfacing (HRA), stemmed hemiarthroplasty (HA), total shoulder arthroplasty (TSA) and reverse total shoulder arthroplasty (RTSA) in younger patients using data from a large national arthroplasty registry.

Methods: Data from the Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) was obtained for the period April 16, 2004 to December 31, 2018. A total of 8742 primary shoulder arthroplasty procedures were analysed (1936 procedures in the <55 years and 6806 in the 55-64 year age group).

Results: Results: In patients <55, there was no difference in revision rate for TSA versus RTSA at any time point. RTSA had a higher early rate of revision in the first 12 months compared to HRA ($p=0.018$), however from two years RTSA had a lower revision rate overall ($p=0.029$). In the 55-64 year patient age group, RTSA again had a higher earlier revision rate. This was statistically significant compared to HRA ($p=0.028$), HA ($p=0.049$) and TSA ($p<0.001$). The reason for revision varied depending on the class of shoulder replacement used. Glenoid erosion and pain were key reasons for revision for the HA and HRA in patients under 55, whereas rotator cuff insufficiency for was a key reason for revision for HA and TSA in patients aged 55 to 64. Implant loosening was the main reason for late failure in the TSA group. Instability and dislocation was also a key reason for revision for TSA and RTSA and occurred most frequently in the early post operative period.

Conclusions: This study demonstrated that for patients aged <55 years there was no significant difference in the rate of revision when TSA and RTSA were compared. RTSA had a lower rate of revision when compared to HRA and HA after two years. Despite having a higher earlier revision rate due to instability, RTSA had the lowest comparative revision rate in patients aged 55-64 years at mid term follow up.

EP.06.049

BIO-RSA VS METAL AUGMENTED BASEPLATE IN SHOULDER OSTEOARTHRITIS WITH MULTIPLANAR GLENOID DEFORMITY: A COMPARATIVE STUDY OF RADIOGRAPHIC FINDINGS AND PATIENT OUTCOMES

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Background: We hypothesized that i) metal augmented baseplate restore the joint line and preserve glenoid bone stock similar to BIO-RSA patients; ii) bone graft viability and healing in BIO-RSA patients become compromised over time.

Methods: Eighty-one patients (83 shoulders) underwent RSA with glenoid lateralization using bone (BIO-RSA group, 44 shoulders) or metal augmented baseplate (MIO-RSA group, 39 shoulders). Preoperative 3D planning was performed to assess the orientation and direction of glenoid erosion. Active range of motion, and the Western Ontario Osteoarthritis of the Shoulder (WOOS) index were evaluated before arthroplasty and at the last follow-up visits.

Radiologic measurements included: changes around the prosthetic components, healing and thickness of bone graft, postoperative global glenoid inclination (beta angle) and retroversion.

Results: Delta scores of AAE were higher in the MIO-RSA group ($p= 0.027$). The differences in the other planes of shoulder motion and in WOOS index scores between the groups were not significant. Preoperative glenoid retroversion was higher in BIO-RSA patients, glenoid inclination was similar in both the groups.

Type B2 and B3 glenoids had a posterior-central (91%) and posterior-superior (90%) erosion with a posterior humeral head subluxation up to or greater than 80%. The direction of erosion in Type E2 and E3 glenoids was posterior-superior, with a rate of posterior humeral head subluxation of 66%.

The value of beta angle was similar in the two groups. BIO-RSA group showed radiolucent lines < 2 mm around bone graft in 16 patients (36.4%) and decreased thickness in 15 (34.1%). The overall rate of bone graft healing was 64%. Radiolucent lines at the interface glenoid-baseplate < 2 mm were found in 3 MIO-RSA patients.

We found higher rate of humerus condensation lines in MIO-RSA group ($p= 0.01$) and higher rate of cortical tinning and tuberosity resorption in the BIO-RSA group ($p= 0.027$ and $p = 0.004$, respectively).

Conclusions: Metal augmented glenoid is a viable alternative to BIO-RSA to preserve bone and to restore the joint line in arthritic glenoid with multiplanar glenoid deformity. Bone graft resorption in BIO-RSA patient raise concern about the risk of baseplate loosening in the long term.

EP.06.050

REVERSE TOTAL SHOULDER ARTHROPLASTY (RTSA) WITH LOWER TRAPEZIUS TRANSFER FOR COMBINED LOSS OF ELEVATION AND EXTERNAL ROTATION (CLEER)

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Background: RTSA for cuff tear arthropathy is well accepted and consistent with restoring active forward elevation. However, when there is loss of the posterior rotator cuff (infraspinatus and teres minor) patients can exhibit a "hornblower's sign". This can be functionally disabling. RTSA alone will not consistently restore external rotation (ER) ability in this scenario. We present a series of RTSA with lower trapezius transfer (LTT) (utilizing tibialis anterior allograft) for patients with CLEER.

Methods: Ten patients (9 male, 1 female) underwent RTSA with LTT (9 with tibialis anterior, 1 achilles tendon allograft) Avg. age was 68.1 yrs (52-82). Avg follow-up was 2.5 yrs (1-4 yrs). All had loss of ER ability with avg. active ER at the side being -9.4 degrees (20 to -30). Avg. active elevation was 68.9 degrees (30-120). All exhibited hornblower's sign with elevation. MRI revealed massive rotator cuff tears of supraspinatus and infraspinatus. In all cases, the teres minor had significant atrophy and/or fatty replacement. Five of ten patients (50%) had undergone previous surgery. Pre-operative outcome scores were: ASES 43.0 (± 19.4), SANE 32.3 (± 19.2), and Pain 5.6 (± 2.6).

Results: All patients were able to actively elevate and keep the forearm pointed to the ceiling in the scapular plane, thus the "hornblower's sign" was eliminated. The avg active FE was 145.6 degrees (120-170, $p=0.0002$). The avg active ER at the side was 32.8 degrees (10-40, $p=0.00003$). Post-op outcome scores were: ASES 72.3 (± 17.5 , $p=0.004$), SANE 60.9 (± 21.0 , $p=0.027$), VAS pain 2 (± 2 , $p=0.014$). Patient satisfaction with the procedure was high.

Conclusions: Latissimus dorsi (with or without teres major) transfer has been described to address CLEER with RTSA. If the subscapularis is absent or deficient, this can compromise internal rotation ability. LTT has been described for rotator cuff deficient shoulders without arthritis to restore ER ability without a prosthetic implant. This series, with early-term follow-up, reports the results of RTSA with LTT to restore ER ability in severely dysfunctional shoulders. Consistent functional returns and high patient satisfaction were obtained with RTSA and LTT with a tibialis anterior tendon allograft in patients with CLEER. The hornblower's sign was eliminated in all patients.

EP.06.051

PREDICTIVE FACTORS OF ACROMIAL FRACTURES FOLLOWING REVERSE TOTAL SHOULDER ARTHROPLASTY: A SUBGROUP ANALYSIS OF 860 SHOULDERS

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Background: Fractures of the acromion (ASF) or scapular spine (SSF) following reverse total shoulder arthroplasty (RTSA) are common complications with impaired clinical outcome. The underlying biomechanical factors remain unclear. The aim of this study was to evaluate basic demographic and radiographic parameters predicting occurrence of different types of ASF/SSF in a large single center study cohort.

Methods: A total of 860 RTSA (805 patients) with available minimum follow-up of 2 years were implanted between 2005 and 2018 at a tertiary academic center. All RTSA with subsequent ASF/SSF (n=45 in 43 shoulders (42 patients, 5%)) were identified and classified as Levy I to III. Predictive demographic, surgical and radiographic factors were evaluated for each subtype and compared to the control group (817 RTSA, 763 patients). The radiographic analysis included critical shoulder angle (CSA), lateralization shoulder angle (LSA), distalization shoulder angle (DSA), acromio-humeral distance (ACHD), acromial thickness, deltoid tuberosity index (DTI), deltoid length (DL), and center of rotation.

Results: Of the 45 ASF/SSF in 42 patients, 8 were classified as Levy I, 21 as Levy II and 16 as Levy III. Demographic analysis revealed indication as risk factor for Levy I fractures, higher ASA score as risk for Levy type II fractures and higher age as risk factor for Levy type III fractures. None of the measured radiographic parameters were predictive for occurrence of Levy type I and Levy type II ASF. However, analysis of Levy III SSF revealed a higher postoperative LSA ($89^\circ \pm 10^\circ$ vs. $83^\circ \pm 9^\circ$, $p=0.015$), a lower postoperative DSA ($45^\circ \pm 8^\circ$ vs. $53^\circ \pm 12^\circ$, $p=0.002$), less distalization (ACHD of 33 ± 8 mm vs. 38 ± 10 mm, $p=0.049$), and a more medial center of rotation preoperatively (COR-LA 16 ± 8 mm vs 12 ± 7 mm, $p = 0.048$) as predictive radiographic factors.

Conclusions: All ASF/SSF should be individually analyzed and treated with respect to the exact location because the biomechanical reason for ASF/SSF might be different. The present analysis showed a significant association of higher postoperative LSA, lower DSA, a lower ACHD and higher age as predictive factor only for Levy type III fractures.

EP.06.052

THE ANATOMICAL STEMLESS TESS ARTHROPLASTY HAS STOOD THE TEST OF 10-YEAR FOLLOW-UP

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Background: Shoulder osteoarthritis (OA) is common and results in pain and loss of function. Less pain and improved function are typically the goal of surgery using shoulder implants. The design of anatomic prostheses improved from the first generation in the 1950's with the Neer I, to modular components in order to deal with the offsets. In 2005, the first stemless shoulder prosthesis, Total Evolutive Shoulder System (TESS; Biomet France, Valence, France), was launched. The stemless shoulder prosthesis was designed to be as less invasive as possible to save bone stock for the future. The stemless shoulder prosthesis was also developed to make the surgery easier by avoiding the complications from using offsets. Previous studies showed good short and medium-term results with all anatomic stemless shoulder implants. This manuscript reports 10 years follow-up results of TESS stemless in hemiarthroplasty (HA) and total shoulder arthroplasty (TSA).

Methods: This study is a prospective consecutive case series. Between 2005 and 2008, 48 subjects were implanted with TESS in anatomic configuration. Patient's mean age was 71 at the time of surgery. Functional outcomes and radiological results were studied, specifically looking for bone modifications and loosening on the humeral side.

Results: At mean follow-up of 134 months, functional outcomes improved significantly, from 29 to 72 points on the Constant Score. Radiolucent lines (RLLs) were frequent in the peripheral rim of the humeral side, in zones 1 and 5. There was no humeral loosening.

Conclusions: The TESS stemless implant provided good functional outcomes at the 10-year follow-up, demonstrating to be a reliable system for shoulder arthroplasty. Minimally invasive stemless humeral implants can be used with confidence for anatomical arthroplasties.

EP.06.053

CLINICAL OUTCOMES OF THE PYROTITAN™ SHOULDER IMPLANT IN HUMERAL RESURFACING ARTHROPLASTY FOR PATIENTS WITH TYPE B2 AND C GLENOID

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Background: While the long-term safety and efficacy of anatomic total shoulder replacement is well established, long-term survivorship of the glenoid component can be concerning, especially with altered glenoid morphology. The strongest indication for hemiarthroplasty, excluding salvage procedures, would be the younger active patient with a perfectly centered glenoid (type A1 glenoid) and a preserved rotator cuff, whereas altered glenoid morphology (Walch type B2 or C) is associated with poorer outcomes. The biomechanical properties of pyrocarbon humeral resurfacing arthroplasty (HRA) make this an attractive option for patients with altered glenoid morphology.

Methods: 514 shoulders with pyrocarbon HRA (PyroTITAN™) implants have been prospectively followed since June 2010. Of 428 glenoids classified, 43.7% showed type B2/C glenoids. Pain and satisfaction were measured on a 0 – 100 visual analogue scale. Function was measured with both the Western Ontario Osteoarthritis of the Shoulder (WOOS) score and the Constant score. Data of 137 patients with 5-year follow-up compared with pre-operative measures are reported as mean ± standard deviation. The T-test was used for comparison of means.

Results: Average pain in B2/C type glenoids was 17±28 at 5-year follow-up compared to 62±22 at pre-operative assessment. WOOS and Constant median scores in B2/C glenoids improved from 35±15 and 32±16 at pre-op assessment, to 84±23 and 77±19 at 5 years. No statistically significant differences ($p>0.05$) were found for pain, satisfaction, functional scores or active range of motion between the two glenoid cohorts at pre- or post-operative intervals. Eight participants with B2/C glenoids had revision surgery at a mean of 23 months post index surgery (range 4 – 61 months). All revisions were due to implant fracture.

Conclusions: Patients with Walch type B2/C glenoid have historically been associated with poorer outcomes. However, these results show that the outcomes in this cohort when using PyroTITAN humeral resurfacing arthroplasty were similar to those obtained with other glenoid types.

EP.06.054

EFFECT OF STEROID INJECTIONS ON PREOPERATIVE PAIN AND FUNCTION PRIOR TO SHOULDER ARTHROPLASTY

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Background: Subacromial and intraarticular corticosteroid injections are well-known short-term treatments used with the intent of reducing pain and improving function as a first line treatment for patients with shoulder pathology. However, little is known about the preoperative effect of steroid injections in patients who eventually undergo shoulder replacement surgery. The purpose of this study was to determine the effect ipsilateral steroid injection on preoperative function and pain scores for patients who eventually undergo shoulder arthroplasty.

Methods: A retrospective chart review was performed on 347 patients who underwent shoulder arthroplasty by a single fellowship-trained orthopedic surgeon from 2017-2020. Patients were divided into two groups: non-injection SA group (NG) versus injection SA group (IG), using criteria of at least one injection within 1 year prior to surgery. Patient demographics, range of motion (ROM), patient reported pain, and American Shoulder and Elbow Surgeons Score (ASES) were collected from latest preoperative visit and analyzed between groups.

Results: The overall cohort had 54% females with an average age of 70.5 years and BMI of 29.7. There were 268 patients in the OG group and 75 patients in the IG group with a mean time from injection to surgery of 6.5 months. The IG had significantly more females (72% vs 49%; $p < 0.01$) and older average age (73.3 vs 69.9; $p = 0.016$). The IG had significantly greater ROM for active forward flexion (83.6° vs. 73.6° ; $p = 0.04$) and active abduction (74.3° vs. 62.3° ; $p < 0.01$). There was no significant difference in patient reported pain ($p = 0.21$) or ASES score ($p = 0.42$).

Conclusions: The results of our study indicate that patients who receive steroid injections within 1 year of shoulder arthroplasty have better ROM and comparable pain, satisfaction, and ASES scores at the time of preoperative visit. This may have an important impact on patient outcomes after Shoulder arthroplasty as better preoperative function has been demonstrated to positively impact postoperative outcomes. However more research needs to be done to further elucidate which patients might benefit from a steroid injection prior to SA and if there may negative tradeoffs.

EP.06.055

CAN MODIFIABLE LIFESTYLE RISK FACTORS IMPACT HEALTHCARE RESOURCE UTILIZATION AND COSTS AFTER SHOULDER ARTHROPLASTY?

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Background: Hospital readmission rates are a significant measure of both quality of care and healthcare costs. Furthermore, many modifiable lifestyle risk factors can influence readmission rates for patients following surgery. The purpose of our study was to identify of key modifiable lifestyle risk factors that might pose the greatest risk for hospital readmissions and additional ER visits after Shoulder Arthroplasty (SA).

Methods: A national healthcare system with a large system wide database was queried to identify 1,721 patients who underwent SA between 2017 and 2021. Specific modifiable lifestyle risk factors such as smoking tobacco, narcotics use, BMI, and hypertension were collected. Logistic regression and odds ratio point estimate analysis was utilized to assess for associations between hospital readmission statuses and lifestyle risk factors.

Results: The cohort consisted of 61.35% female (n = 1,056) with a mean age of 71 years and BMI of 29.4. For every whole number increase in BMI, patients were 1% more likely to be readmitted both within 30 days (1.010, 95% CI: 1.001 - 1.019, p = 0.0299) and within 90 days (1.009, 95% CI: 1.002 - 1.015, p = 0.0081). There was no significant association found between BMI and an ER visit (p = 0.65). Moreover, smokers were indicated to be 21% more likely to be readmitted within 30 days (1.210, 95% CI: 1.002 - 1.461, p = 0.0479) and 28% more likely to be readmitted within 90 days following surgery (1.279, 95% CI: 1.123 - 1.457, p = 0.0002). Similarly, smokers were 44% more likely to have an ER visit when compared to non-smokers (1.440, 95% CI: 1.190 - 1.741, p = 0.0002). Additionally, patients who used narcotics were 23% more likely to be readmitted within 90 days than those who didn't (1.231, 95% CI: 1.015 - 1.494, p = 0.0352).

Conclusions: Our results report modifiable lifestyle risk factors have a significant impact on increased risk of readmission after SA up to 23%. There was an incremental effect of BMI on hospital readmissions. By mitigating these risk factors, this would likely result in a drastic decline in the cost of healthcare for patients undergoing SA.

EP.06.056

MRI AND FUNCTIONAL EVALUATION AFTER SUBSCAPULARIS TENDON REPAIR IN RSA

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Background: The function of the subscapularis tendon is considered important in shoulder arthroplasty. However, the role of the subscapularis tendon in reverse shoulder arthroplasty is controversial. The purpose of this study was to evaluate MRI, internal rotation strength, and clinical outcomes of patients who underwent repair of the subscapularis tendon during reverse shoulder arthroplasty at 1 year postoperatively.

Methods: The period was 6 years, from September 2016 to September 2020, and the patients were 61 shoulders, 26 males and 35 females, with a mean age of 75.2 years (60-86). Subscapularis tendon fixation was performed using peel and tenotomy on 46 and 15 shoulders, respectively. The implants used were Aequalis Ascend Flex at 46 shoulders and Comprehensive reverse at 15 shoulders. The subscapularis tendons were evaluated using the Goutallier classification on MRI for those in stage 2 or less (mild group) that could be repaired, and the results were analyzed to determine whether they changed to the mild group or the severe group (stages 3 and 4) at 1 year postoperatively. Clinical scores were obtained for internal rotator strength, tuberosity score, Constant score, and VAS at 1 year postoperatively. The MRI system itself was a Siemens Healthineers MAGNETOM ESSENZA 1.5T with artifact reduction software for the subscapularis tendon on T1-weighted and Scapular Y images.

Results: The preoperative Goutallier classification of stage 0, stage 1, and stage 2 was 5, 32, and 24 shoulders, respectively. Of these, 24 had MRI changes at 1 year postoperatively in the mild group and 37 in the severe group. There were no significant differences in internal rotation strength, tuberosity score, Constant score, or VAS at 1 year postoperatively in either group.

Conclusions: About 60% of patients who underwent subscapularis tendon repair for reverse shoulder arthroplasty had advanced fatty infiltration, but this did not affect muscle strength or clinical outcomes at 1 year postoperatively.

EP.06.059

REVERSE SHOULDER ARTHROPLASTY CLINICAL OUTCOMES FOR DISLOCATION ARTHROPATHY VS OSTEOARTHRITIS

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Background: Dislocation arthropathy (DA) of the shoulder is an advanced arthritis due to recurrent glenohumeral dislocations with or without previous stabilization surgery. The goal of this study was to evaluate the clinical results of reverse shoulder arthroplasty (RSA) in DA patients compared to those with primary osteoarthritis (OA) with glenoid bone loss.

Methods: This is a retrospective matched cohort study of 13 patients with DA who were treated with RSA by one surgeon between 2011 and 2019 and a 3 to 1 matched control group of 39 patients with osteoarthritis and similar amounts of glenoid bone loss. All patients in both groups had a minimum of two years of follow-up and were treated with the same RSA system: a lateralized glenoid, sphere, a 135° neck shaft angle, and an uncemented humeral stem. Glenoids were reamed eccentrically until there was at least 90% coverage of the baseplate. No bone grafting or augmented glenoid components were utilized.

Results: The implant survival at follow-up was 100% in the DA group and 98% (38/39) in the OA group. In the DA group there were no signs of osteolysis nor notching in any patient. The complication rate was similar in the two groups (15% vs 13%, $p=0.41$). Both groups showed statistically significant improvements in PROMs (SST, ASES, WOOS, SANE, satisfaction) and ROM following RSA procedure. At final follow-up there was no statistically significant difference between the groups in PROs and ROM.

Conclusions: This single institution study found that the clinical results of RSA for DA treated with eccentric reaming are comparable to the results of a matched cohort of OA patients with similar treatment. In the short run, RSA with eccentric glenoid reaming is a valid treatment strategy in patients with DA but longer follow up is warranted.

EP.06.060

LATISSIMUS DORSI TRANSFER COMBINED WITH BONY LATERALIZED REVERSE SHOULDER ARTHROPLASTY: OUTCOMES OF THE SUBPECTORALIS SPARING APPROACH AND DOCKING TECHNIQUE

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Background: High rates of complications (up to 43%) and reoperations (up to 24%) have been reported by combining a reversed shoulder arthroplasty (RSA) with a latissimus dorsi transfer (LDT) for patients with combined loss of elevation and external rotation (CLEER). The present study reports the complications and outcomes of the combined technique using a less aggressive (subpectoral sparing) approach to harvest LD tendon and a stronger (docking) fixation.

Methods: 47 consecutive CLEER patients (mean age: 69 years, 63–79). underwent a LDT with a lateralized RSA (BIO-RSA technique) and were reviewed with minimum 2 years follow-up. All patients had shoulder pseudoparalysis with dropping arm, resulting from massive irreparable posterosuperior cuff tear. Primary outcome measures included morbidity and failure of the combined procedure. Secondary outcome measures included restoration of active ROM, the Constant Score (CS), Subjective Shoulder Value (SSV), Activities of Daily Living Requiring External Rotation (ADLER) score. The mean follow-up was 59 months (range, 24–81).

Results: Overall, 91% of patients had no longer a dropping arm: 68% had no dropping arm with restoration of active ER1/ER 2 (Active LDT) while 23% had no dropping arm with no or little active ER1/ER 2 (Passive LDT). Four patients (9%) had persistent dropping arm secondary to rupture of tendon transfer after a complication (2 dislocations, 1 infection, 1 fall with traumatic failure). At last follow-up, the ADLER score increased from 10 to 25/30, the adjusted Constant score from 42% to 96%, the SSV from 33% to 80% ($p < 0.001$). Active forward elevation improved from $80^\circ \pm 16$ to $151^\circ \pm 26$ (mean difference: $+71^\circ$, $p < 0.001$); active external rotation at side (ER1) improved from $-12^\circ \pm 10$ to $12^\circ \pm 18$ (mean difference: $+24^\circ$, $p < 0.001$).

Conclusions: (1) LDT combined with BIO-RSA, performed through a single deltopectoral incision, restores shoulder function in CLEER patients with a high satisfaction rate and low (9%) failure rate; (2) morbidity of the combined procedure can be reduced with a less aggressive (pectoralis sparing) approach and tendon transfer integrity improved with a stronger fixation (docking) technique; (3) the tendon transfer can prevent dropping arm either actively (with muscle contraction) or passively (with a tenodesis effect).

EP.06.062

REVISION REVERSE SHOULDER ARTHROPLASTY FOR THE MANAGEMENT OF BASEPLATE FAILURE: AN ANALYSIS OF 676 REVISION RSA PROCEDURES

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Background: Baseplate failure (BPF) is a rare but potentially catastrophic complication after reverse shoulder arthroplasty (RSA). The purpose of this study was to describe patients who underwent RSA and were revised (rRSA) for baseplate failure or loosening. Method of BPF and total arthroplasty burden (failure of a primary or revision RSA) were evaluated for their impact on complications and patient outcomes.

Methods: Database of a single surgeon was queried to identify all patients undergoing RSA or rRSA between 2006-2021. A total of 676 procedures were identified with 46 patients (6.8%) who underwent rRSA for baseplate failure with a confirmed loose/failed baseplate. The primary outcome was repeat failure of the reimplanted baseplate following rRSA. The method of baseplate failure was stratified into 3 groups: aseptic, septic, or traumatic. Twenty-four patients underwent primary revision, and 22 had undergone >1 previous arthroplasty undergoing re-revision. Five patients had a previous rRSA for baseplate failure by an outside surgeon. Thirty-two patients and 23 patients met criteria for secondary outcome analysis of final ASES, SST, and ROM scores at 1- and 2- year follow up, respectively.

Results: Three patients met the primary outcome with repeat baseplate failure requiring revision (6.5%); two patients failed <1 year due to septic baseplate failure and were converted to hemiarthroplasty. The third patient suffered traumatic failure at 10 years and underwent successful rRSA. Matched ASES scores improved significantly at 1- and 2- years (final mean ASES at 1-year: 65.7; and 2-years: 63.4). There was no significant difference in outcomes or based on mode of BPF ($p=0.232$) or total arthroplasty burden ($p=0.305$) at one year. There were 13 total complications in 11 patients, 5 of which required reoperation for reasons other than BPF.

Conclusions: BPF is rare in RSA. In our cohort, the overall prevalence of revision for baseplate failure was 6.8% over 15 years, and 3 of 46 required additional revision for repeat baseplate failure. rRSA for BPF provides modest improvement in outcomes and shoulder function with a low incidence of repeat failure. Complications and reoperation rates are higher than that for primary RSA, and comparable to rRSA for all causes.

EP.06.063

DOES THE 2018 CONSENSUS PERIPROSTHETIC INFECTION CLASSIFICATION CORRELATE WITH RECURRENCE RATE IN REVISION SHOULDER ARTHROPLASTY?

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Background: The surgical treatment of periprosthetic infection about the shoulder is controversial. The purpose of this study was to apply the classification system, developed by the 2018 consensus statement to determine if it would correlate with the recurrence rate depending on the different probabilities of being infected. Additionally, to determine if a single vs 2 stage surgery would affect recurrence rate.

Methods: A database of 800 revisions performed by a single surgeon from 2004-2020 was reviewed for patients with minimum 2 year follow up and at least 1 positive culture or positive pathology. 157 cases in 144 patients met the criteria for inclusion. Cases that met the above criteria were then categorized infection probability according to the consensus statement. Forty-six of 157 cases were classified as probable or definitively infected, 25/157 were classified as possibly infected and 86/157 were classified as unlikely to be infected.

Results: The 86 cases in unlikely group were treated with 81 one stage and 5 two stage revisions and had recurrence rate of 1%. The 25 cases in the possible group were treated with 24 one stage and 1 two stage revision and had a recurrence rate of 12%. The 46 cases in the probable/definite group were treated with 33 one stage revisions and 13 two stage revisions with a recurrence rate of 17% overall. One stage revisions had a 4% recurrence rate and of the 33 patients with an infection classification of probable or definite there was a 6% recurrence rate.

Conclusions: The consensus statement categories do predict recurrence rates of peri prosthetic infections, with unlikely group having a 1 percent recurrence, the possible infection group 12 percent recurrence and probable infection group 17 percent recurrence rate. Additionally, even in the probably/definitive group one stage surgery has a low reinfection rate(6%).

EP.06.065

HUMERAL OSTEOPHYTE SIZE AND CLINICAL OUTCOMES AFTER ANATOMIC TOTAL SHOULDER ARTHROPLASTY

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Background: The severity of primary glenohumeral osteoarthritis (PGOA) has been associated with advanced radiographic findings including inferior humeral head osteophytes. The primary objective of this study is to analyze for any correlation between the size of the inferior humeral head osteophyte and functional outcomes in patients undergoing anatomic total shoulder arthroplasty (TSA) for PGOA.

Methods: A retrospective review of a multi-surgeon database was performed to identify all patients with PGOA from (2015-2019) with a minimum of two-year clinical follow-up. Preoperative anteroposterior and Grashey views were used for all included patients to obtain measurements of the inferior humeral osteophyte. Two groups at the extremes of osteophyte width were identified: 1) patients with absent or minimal osteophytes (lowest quartile of width, < 4.9 mm) and those with large osteophytes (highest quartile of width, > 10.1 mm). Change in active range of motion (ROM) from baseline, patient-reported outcomes (PROs), strength and complications were assessed at a minimum of 2 years postoperatively and compared between the two groups.

Results: The large osteophyte group had significantly more restricted preoperative ROM for all measures ($p < .05$ for all). There were no significant differences in final ROM achieved between the two groups. Patients in the large osteophyte group had greater improvement from baseline for external rotation at the side (31° vs 21° , $p = 0.015$), external rotation at 90° abduction (38° vs 20° , $p = 0.004$), and internal rotation at 90° abduction (30° vs 12° , $p < 0.001$) compared to the small osteophyte group. Overall, there were very few differences between the small and large osteophyte groups in final PROs, with the exception of a higher ASES score in the large osteophyte group (90.8 vs 85.9 , $p = 0.048$).

Conclusions: The significance of this study stems from large osteophytes in the knee and hip being classically associated with poorer outcomes for patients post-arthroplasty as opposed to outcomes of patients with smaller osteophytes. This study shows that the same association does not hold true for osteophytes in the shoulder, as patients with small and large osteophytes had similar PROs and ROM post shoulder arthroplasty.

EP.06.067

SHORT TERM FUNCTIONAL OUTCOMES OF LIMA HYBRID, METAL-BACKED AND ALL CEMENTED POLYETHYLENE GLENOIDS

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Background: The long-term survival of the glenoid component in anatomic total shoulder arthroplasty (TSA) is important for outcomes. If revision procedure to a reverse total shoulder arthroplasty (RSA) is needed, the ideal glenoid would be easily convertible with minimal bone loss. Thus, proper implant selection during the primary surgery is crucial. This study aims to compare short-term functional outcomes and conversion rates to RSA between patients who underwent TSA using a modular metal backed glenoid (MBG) component, a hybrid glenoid component, and an all polyethylene component.

Methods: After IRB approval, a retrospective review of individuals undergoing TSA by one surgeon between October 2014 to December 2020 was performed. Patients were included if they had a minimum 2-year follow-up with above components, ASES and functional outcomes noted in their charts pre and post operatively. Baseline demographics were collected, and outcomes were assessed pre and post-operatively using the American Shoulder Elbow Society score (ASES) at follow up, as well as functional range of motion (ROM) taken before and after surgery. Revision rates were documented, and summary statistics were performed.

Results: A total of 268 TSAs with the three implants of were performed during this time period, and the study's final cohort consisted of 138 total patients (12 hybrid implants, 65 MBG implant, 61 all polyethylene implant) who had at least a 2-year follow-up. Of these, 53 (10, 21, 22 respectively) patients had complete pre and post-surgery ASES and ROM results. The average time for follow-up was 3.6 years (standard deviation = 1.4 years). There was no significant difference between the three groups' post-operative ASES scores, forward elevation, or external rotation. 2 patients in the hybrid group, 13 patients in the MBG group, and 7 in the all polyethylene implant group had undergone a revision surgery to a RSA.

Conclusions: In the short-term, functional outcomes, and patient-reported outcomes are similar in all groups. We are currently evaluating if there is a statistical difference in revisions to RSA in the three groups.

EP.06.068

CLINICAL OUTCOMES OF ANATOMIC VERSUS REVERSE TOTAL SHOULDER ARTHROPLASTY IN STIFF SHOULDERS WITH PRIMARY OSTEOARTHRITIS: A CASE CONTROL STUDY

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Background: The popularization of reverse total shoulder arthroplasty (rTSA) has begun to challenge the place of anatomic total shoulder arthroplasty (aTSA) as a primary procedure for rotator cuff intact glenohumeral osteoarthritis (RCI-GHOA). One purported benefit of aTSA is improved postoperative range of motion (ROM) compared to rTSA especially in internal rotation; however, patients with preoperative stiffness may require extensive soft tissue release predisposing to instability and have poorer subscapularis function. We compared clinical outcomes of aTSA and rTSA performed in stiff versus non-stiff shoulders for RCI-GHOA.

Methods: A retrospective review of an international shoulder arthroplasty database identified 1,608 aTSAs and 600 rTSAs performed for RCI-GHOA with minimum 2-year follow-up. Preoperative stiffness was defined as $\leq 0^\circ$ of passive ER. Subsequently, three cohorts were matched: stiff aTSAs (n=257) were matched 1:3 to non-stiff aTSAs, stiff rTSAs (n=87) were matched 1:3 to non-stiff rTSAs, and stiff rTSAs (n=87) were matched 1:1 with stiff aTSAs. We compared ROM, outcome scores, and the rate of complications and revision surgery at latest follow-up.

Results: Compared to non-stiff aTSAs, despite stiff aTSAs having poorer preoperative ROM and functional outcome scores for all measures assessed, only poorer postoperative active abduction, active ER, and passive ER persisted postoperatively. Similarly, stiff rTSAs had poorer preoperative ROM and functional outcome scores for all measures assessed compared to non-stiff rTSAs, but only poorer active abduction, active ER, and passive ER persisted. When comparing stiff rTSAs to matched stiff aTSAs, no significant differences in preoperative ROM or functional outcome scores were found. However, stiff aTSAs had greater postoperative active IR score, active ER, and passive ER. Postoperative outcome scores were similar across all matched cohort comparisons despite motion differences. The rate of complications and need for revision surgery did not differ between any group comparisons.

Conclusions: Patients with RCI-GHOA and preoperative rotational stiffness have poorer postoperative ROM compared with non-stiff patients following both aTSA and rTSA. Notably, preoperative limitations in passive ER do not appear to be a limitation to utilizing aTSA. Indeed, patients with limited preoperative ER treated with aTSA had greater postoperative rotation compared to those treated with rTSA.

EP.06.069

INCREASED RISK OF 90-DAY DEEP SURGICAL SITE INFECTION AND PERIPROSTHETIC JOINT INFECTION FOLLOWING TOTAL SHOULDER ARTHROPLASTY IN PSORIASIS PATIENTS

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Background: Psoriasis, a chronic, immune-mediated disease, is a known risk factor for infectious complications following certain surgical procedures such as lower extremity arthroplasty. However, there is a paucity in the literature that observes the association of psoriasis and infectious complications following total shoulder arthroplasty (TSA). The purpose of this study was to observe whether a diagnosis of psoriasis is associated with increased odds of short-term infectious complications and long-term surgical complications.

Methods: A retrospective cohort analysis was performed using a national all payer's claims database. Patients who underwent primary TSA were identified using Current Procedural Terminology (CPT) and International Classification of Diseases (ICD) procedure codes. Patients were then stratified into two groups: (1) patients with psoriasis who underwent TSA and (2) patients without psoriasis who underwent TSA. Primary outcomes included the incidence of 90-day infectious complications including PJI, deep SSI, and sepsis. Secondary outcomes included the incidence of 5-year surgical complications including all-cause revision, aseptic revision, and septic revision. Univariate and multivariable regression analysis was conducted to compare complications between the cohorts.

Results: In total, 89,321 patients were included in this study, with 3,311 (3.71%) patients with psoriasis. Patients with psoriasis had significantly higher odds of 90-day infectious complications following TSA including PJI (1.63; $p = 0.014$) and deep SSI (1.79; $p = 0.003$) when compared to those without psoriasis. There were no significant differences in odds of 5-year all-cause revisions, septic revisions, and aseptic revisions between the two cohorts.

Conclusions: Psoriasis is associated with significantly higher 90-day infectious complications but not long-term implant complications. Orthopaedic surgeons should be aware of the increased acute infectious complications in this population, promote preoperative counseling and extensive infectious precautions, and consider the use of alternative prophylaxis against infection. These findings also have implications for risk adjustments in increasingly common bundled payments or shared risk payment models.

EP.06.070

THE OBESITY PARADOX: OVERWEIGHT PATIENTS HAVE A LOWER RATE OF 30-DAY POSTOPERATIVE MEDICAL COMPLICATIONS AFTER TOTAL SHOULDER ARTHROPLASTY

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Background: While increased mass index (BMI) has traditionally been associated with negative health effects and poor surgical candidacy, prior studies suggest increased BMI may be contradictorily protective. This obesity paradox has been identified in knee and hip arthroplasty, but not total shoulder arthroplasty (TSA). Our primary purpose was to determine the BMI associated with the lowest rate of medical complications post-TSA.

Methods: The American College of Surgeons National Surgical Quality Improvement Project (ACS NSQIP) database was queried to identify adults who underwent primary TSA between January 1, 2012, and December 31, 2020. We included 31,755 elective TSAs. Thirty-day postoperative medical complications were extracted which included death, readmission, pneumonia, pulmonary embolism, renal failure, and cardiac arrest among others. BMI was classified into 5 categories (underweight [BMI < 18.5 kg/m²], normal weight [BMI ≥ 18.5 and < 25 kg/m²], overweight [BMI ≥ 25 and < 30 kg/m²], obese [BMI ≥ 30 and < 40 kg/m²], and morbidly obese [BMI ≥ 40 kg/m²]). We examined the risk of any 30-day postoperative complications and BMI using aforementioned categories and on a continuous basis modeled as a third-degree polynomial using multivariable logistic regression controlling for age, sex, procedure year, and all comorbidity variables.

Results: Most TSAs were Caucasian (84%), 56% were female, and the average age was 69.2 ± 9.3 years. The rate of any 30-day postoperative medical complication was 4.53% (n = 1440). When adjusting for age, sex, procedure year, and comorbidities, patients with greater than normal BMI demonstrated lower odds of any medical complication compared to normal-weight patients (overweight 0.80-times, obese 0.81-times, and morbidly obese patients 0.77-times). When assessed on a continuous basis, a U-shaped relationship between BMI and 30-day medical complication risk was found, with the lowest risk in BMI between 30-35 kg/m². Although the probability of medical complications increased with age and was greater for females, all strata demonstrated lower probability of complications in the obese BMI range.

Conclusions: The relationship between BMI and probability of medical complications in patients undergoing TSA does not appear to be linear. Obesity alone should not preclude patients from being eligible for TSA; rather, surgical candidacy should be evaluated in the context of patients' overall health and likelihood of benefit from shoulder surgery.

EP.06.071

PYROCARBON SPACER AS A SALVAGE TREATMENT FOR PERIPROSTHETIC AND SHOULDER JOINT INFECTION

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Background: The most common treatment approach in periprosthetic joint infection (PJI) and chronic shoulder joint infection (SJI) is a two-stage revision involving interval placement of an antibiotic cement spacer (ACS) or a resection arthroplasty (RA). Since Pyrocarbon material prevents adhesion of pathogens, could it be used effectively in this setting as a temporary or permanent spacer? The objective of the present study was to assess the infection healing rate after temporary or definitive implantation of Pyrocarbon Interposition Shoulder Arthroplasty (PISA) in patients with recalcitrant PJI or SJI.

Methods: Fifteen patients (mean age 52 ± 19 years) with chronic shoulder infection underwent, after joint debridement, implantation of PISA (InSpyre, Tornier-Stryker) with tailored perioperative antibiotics. In 7 cases, PJI occurred after hemiarthroplasty ($n=2$), reverse shoulder arthroplasty ($n=2$), hemi-reverse ($n=2$), and resurfacing arthroplasty ($n=1$). In 8 cases, SJI occurred in the context of failed surgery after fracture sequelae ($n=4$), instability ($n=2$), and cuff arthropathy ($n=2$). Preoperatively, patients had a mean of 3 previous failed surgeries before PISA implantation. Patients were evaluated with clinical, laboratory, and radiographic assessment at a minimum of 2 years after surgery

Results: At a mean follow-up of 55 ± 18 months, no patient experienced reinfection after temporary (3 cases) or definitive (12 cases) PISA implantation. The adjusted Constant score increased from $33\% \pm 20$ preoperatively to $65\% \pm 28$ at last follow up, and subjective shoulder value (SSV) from $22\% \pm 19$ to $63\% \pm 23$ ($p < 0.001$). Active forward elevation increased from $27^\circ \pm 19$ to $113^\circ \pm 30$, external rotation from $7^\circ \pm 21$ to $25^\circ \pm 25$, and internal rotation level 3 ± 2 to level 5 ± 2 points ($p < 0.001$). On final radiographs of definitive PISA, complete humeral densification, or a neocortex, formed around the implant in 64% (7/11).

Conclusions: In select patients with recalcitrant SJI and PJI, PISA can be used as a temporary or permanent spacer to cure shoulder infections, improve pain, and restore shoulder motion. The Pyrocarbon material, used as "functional spacer", was shown to facilitate resolution of complex shoulder infections and provides acceptable shoulder function. PISA may be an alternative to ACS (avoiding painful glenoid erosion) and RA (avoiding flail shoulder with limited motion).

EP.06.072

VERTICAL INCOMPLETE HUMEROTOMY (VIH) WITH SUTURE CERCLAGE AND NICE KNOT FIXATION IN REVISION OF SHOULDER ARTHROPLASTY. SURGICAL TECHNIQUE AND OUTCOMES

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Background: Extraction of well-fixed humeral implants during revision shoulder arthroplasty may be challenging and intraoperative humeral fractures may occur in a certain number of cases. To prevent this complication, we perform a Vertical Incomplete Humerotomy (VIH) with suture cerclages with Nice Knot fixation.

Purpose. To describe the surgical technique and outcomes of revision shoulder arthroplasty with a VIH with sutures cerclage and Nice Knot fixation.

Methods: This was a retrospective study of consecutive patients who underwent revision shoulder arthroplasty with a VIH at a single institution (2007–2022). A longitudinal humeral osteotomy was created posterior and parallel to the bicipital groove. This allows for extraction of the humeral stem and cement mantle. Osteotomy closure was performed with 2 to 6 suture cerclages with Nice knots fixation. The primary outcome was assessment of complications (intraoperative and postoperative). The secondary outcome was osteotomy healing at 6 months. The mean follow-up was 2.7 years (range 0.6–12)

Results: Forty-seven patients with a mean age of 60 years (range 37–80) at time of surgery were analyzed. There were 20 Hemiarthroplasty (HA), 10 Total Shoulder Arthroplasty (TSA) and 17 Reversed Shoulder Arthroplasty (RSA). There were 4 revisions to TSA, 30 revisions to RSA and 13 revisions to spacer secondary to periprosthetic joint infection (PJI). Primary osteotomy healing and callus formation were evident in all cases by 6 months, there was 1 (2.12%) case of intraoperative humeral fracture during stem removal, and no post-operative complication related to the humerotomy. There were 15 reinterventions, 2 instability, 1 infection, and 12 second stage revision of PJI with multiple interventions in 4 cases.

Conclusions: VIH facilitates extraction of well-fixed humeral components and prevents intra- or postoperative humeral fractures in difficult revision shoulder arthroplasty. The procedure is safe (minimizing bone damage and reducing the risk of neurovascular injuries). Suture fixation, using suture cerclage and Nice Knots, provides constant bone healing and is an alternative to wire for cerclage fixation of humerotomy.

EP.06.073

CAN TOTAL SHOULDER ARTHROPLASTY IMPROVE PATIENTS SLEEP QUALITY?

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Background: Shoulder pain is estimated to affect 7%-34% of the general population. Poor sleep quality from nocturnal pain has increasingly been reported as a major symptom in various shoulder conditions, with 81%-94% of patients complaining of sleep disturbance after only 3 months. The purpose of this study is to determine the effects of shoulder arthroplasty on sleep improvement regarding 1) speed of recovery 2) plateau of maximal improvement and 3) efficacy of treatment.

Methods: A retrospective review identified 518 Total Shoulder Arthroplasty (TSA) patients and 473 Reverse Shoulder Arthroplasty (RSA) patients with 1 year follow-up. Patients were excluded if they had no sleep disturbance preoperatively. Patients were asked sleep-specific questions including "Ability to sleep on the painful side" on a scale from 0-3 (unable to do so, very difficult to do, somewhat difficult, and not difficult) and "Does your shoulder allow you to sleep comfortably?" (yes or no). The responses were compared from pre op at 3 months, 6 months, 12 months, and most recent follow-up.

Results: There were minimal differences in the improvement of sleep ability postoperatively between the two cohorts. TSA and RSA patients demonstrated a false plateau of improvement at 3 months for ability to sleep comfortably and another false plateau at 6 months for the ability to sleep on the operative side. 69% of TSA patients gained the ability to sleep comfortably by 3 months and 80% by 6 months while RSA patients had 68% by 3 months and 79% by 6 months. ($p = 0.647$, $p = 0.706$) 39% of TSA patients could sleep on the operative arm at 3 months compared to RSA's 31% ($p = 0.027$) but there was no difference at 6 months as 59% of TSA patients and 55% of RSA patients gained were able to. ($p = 0.233$)

Conclusions: TSA and RSA both provide effective treatment, as patients can expect rapid improvement in their ability to sleep. Patients with both implants may see a plateau of maximal improvement around 3 months in their ability to sleep comfortably after surgery and around 6 months in their ability to sleep on the operative arm.

EP.06.075

ANALYSIS OF 90-DAY COMPLICATIONS IN TOTAL SHOULDER ARTHROPLASTY PERFORMED IN THE AMBULATORY SETTING

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Background: There is limited data documenting the safety and clinical outcomes following outpatient total shoulder arthroplasty (TSA) and reverse TSA (RTSA). The primary purpose of this study was to evaluate the 90-day complication and readmission rates in patients undergoing outpatient TSA and RTSA. We aim identify to any significant predictors of complications in the entire outpatient cohort.

Methods: A prospectively maintained institutional registry was retrospectively queried for all patients undergoing primary TSA or RTSA between September 2016 and April 2019 and confirmed as having undergone outpatient surgery, defined as surgery performed at an ambulatory surgery center (ACS). Ninety-day complications, readmissions, and emergency room (ER) visits were analyzed for outpatient TSA and RTSA. The 90-day complications included infection, thromboembolic disease (pulmonary embolism, deep venous thrombosis), neurovascular injury, revision surgery, and inflammatory processes).

Results: One hundred and forty patients underwent outpatient TSA or RTSA. Four complications (3.7%) were reported in the TSA cohort, compared to four complications (12.9%) in the RTSA cohort ($P = 0.060$). Three ER visits occurred in the RTSA group compared to zero in the TSA group ($P = 0.001$). Higher rates of complications based on procedure in the RTSA trended toward significance ($P = 0.060$). In addition, the RTSA had a significantly higher rate of ER visits ($P = 0.001$). Hypertension and smoking were found to significantly increase the risk of complication after TSA ($P < 0.050$). In the RTSA group, higher BMI trended toward decreasing risk of postoperative complication ($P = 0.051$, OR 0.74, CI [0.54-1.00]). In addition, there were no readmissions or reoperations in either TSA or RTSA patients.

Conclusions: The rate of complications, ER visits, and readmission rates in outpatient TSA and RTSA was found to be relatively low given the sample size of this study and minor complications reported. There were no readmissions or reoperations in either TSA or RTSA patients. Elevated BMI may significantly increase the risk of complications after both a TSA and RTSA. This study suggests that outpatient TSA and RTSA is safe in select patients.

EP.06.076

INCREASING INCIDENCE OF PRIMARY ANATOMIC AND REVERSE TOTAL SHOULDER ARTHROPLASTY IN PATIENTS LESS THAN 50 YEARS OF AGE & HIGH EARLY REVISION RISK

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Background: Compared to the overall incidence of shoulder arthroplasty (SA), the relative risk and burden of revision may vary amongst patients specifically 40–50 years of age, and less than 40 years of age. Our aim was to investigate the incidence of primary anatomic total shoulder arthroplasty (TSA) and reverse shoulder arthroplasty (RSA), rate of revision within one year, and determine the associated economic burden in patients <50 years.

Methods: 509 patients <50 years old who underwent SA were included, using a national private insurance database. Costs were based on the grossed covered payment. Multivariate analyses were performed to identify risk factors associated with revisions within one year of index procedure.

Results: SA incidence in patients <50 years old increased from 2.21 to 2.5 per 100,000 patients from 2017-2018. The overall revision rate was 3.9% with a mean time to revision of 96.3 days. Diabetes was a significant risk factor for revision ($p=0.043$). Surgeries performed in patients <40 years cost more than those performed in patients aged 40-50 years for both primary ($\$41,943 \pm 23,842$ versus $\$39,477 \pm 20,874$) and revision cases ($\$40,370 \pm 21,385$ versus $\$31,669 \pm 10,430$).

Conclusions: This study demonstrates that the incidence of SA in patients <50 years is increasing, most commonly reported for primary osteoarthritis. Given the high incidence of SA and subsequent high early revision rate in this subset population, our data portends a large associated socioeconomic burden. Policymakers and surgeons should use this data for implementing training programs focused on joint sparing techniques.

EP.06.077

FULFILLMENT OF EXPECTATIONS FOLLOWING REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: To our knowledge, this is no literature characterizing fulfillment of patient expectations following reverse total shoulder arthroplasty (RTSA). Thus, the purpose of this study was to determine the proportion of expectations that were fulfilled following RTSA and how patient characteristics impact fulfillment of these expectations.

Methods: We prospectively enrolled patients who underwent a primary RTSA for a diagnosis of glenohumeral arthritis. Demographic information such as age, sex, race, and BMI was collected. Preoperative patient expectations were evaluated using the Hospital for Special Surgery's Shoulder Surgery Expectation Survey (HSS-ES). Patients were then queried about the fulfillment of their expectations at their 2-year postoperative follow up visit with a questionnaire that mirrored the HSS-ES. Fulfillment of expectations were reported as the percentage of expectations that were considered 'very fulfilled' at 2-year follow-up.

Results: Out of the 93 patients who qualified for inclusion into the study, 81.7% (n=76) completed both the preoperative HSS-ES and the 2-year postoperative fulfillment questionnaires and were included in our analysis. The mean age was 70.8 ± 7.2 years, the mean mass index 30.8 ± 7.2 kg/m², and 56.6% (n=43) of the patients were female. The most fulfilled expectations at 2 years post-operatively were the ability to drive or put on a seatbelt, improve self-care, and relief of daytime pain with 76.3% (n=58), 75.0% (n=57), and 74.0% (n=54) of patients reporting being very fulfilled, respectively. The least fulfilled expectations were the ability to exercise or play sports, shoulder to be back to the way it was before the problem started, and shoulder range of motion with only 39.4% (n=30), 50.0% (n=38), and 52.6% (n=40) of patients reporting being very fulfilled, respectively.

Conclusions: At 2 years post-operatively, the vast majority of patients undergoing RTSA achieve very high fulfillment in their expectations for pain relief and their ability to perform basic activities of daily living (driving, self-care). However, expectations for more strenuous activities such as exercising or playing sports are much less often achieved.

EP.06.078

IMPACT OF HUMERAL LINER CONSTRAIN ON IMPINGEMENT FREE RANGE OF MOTION AND IMPINGEMENT TYPE IN REVERSE SHOULDER ARTHROPLASTY

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Background: Dislocation is one of the major complications in reverse total shoulder arthroplasty (RSA). The humeral liner may be changed to constrained type when dislocation is not improved by increasing the size of the glenosphere or lateralization with implants. In this study, we used ROM simulation system to investigate the effect of constrain humeral liner on impingement-free ROM and impingement type.

Methods: Twenty-five patients with massive cuff tear and cuff tear arthropathy were included in this study, and Impingement-free ROM was measured in flexion, extension, abduction, adduction, external rotation, and internal rotation. Impingement pattern was also investigated. In each case, eight different simulations of 2 x 2 x 2 were performed in each of the 25 cases, for a total of 200 simulations ; Glenosphere (38mm Standard type VS. Expanded type), humeral liner thickness (+0mm VS. +2.5mm), humeral liner constraint(normal type VS. constraint type).

Results: The use of constraint humeral liner showed decrease in range of motion in abduction ($p < 0.001$), extension ($p < 0.001$), external rotation ($p < 0.001$), and internal rotation ($p < 0.001$). In addition, the Impingement pattern was also significant. In abduction, the humeral liner was more likely to be impinged on the superior part of the glenoid neck, and in flexion, the humeral liner was more likely to be impinged on the anterior part of the glenoid neck.

In glenosphere lateralizaion, abduction ($p < 0.001$), flexion ($p < 0.001$) and external rotation ($p = 0.015$) were improved. In terms of impingement pattern, cases of impingement of the humeral liner on the superior part of the glenoid neck in abduction were improved in the extended glenosphere.

Conclusions: In the present study, the use of the constraint humeral liner resulted in a decrease in impingement-free ROM and an increase in implant-to-bone impingement, which was improved by the use of the extended glenosphere. Based on the results of this study, we believe that glenosphere lateralization is necessary when using the constraint humeral liner.

EP.06.080

DEFINING CLINICALLY IMPORTANT IMPROVEMENT FOR THE OXFORD SHOULDER SCORE: DATA FROM THE AUSTRALIAN ORTHOPAEDIC ASSOCIATION NATIONAL JOINT REPLACEMENT REGISTRY PATIENT-REPORTED OUTCOMES MEASURES PROGRAM

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Background: Clinically important improvements in Oxford Shoulder Scores (OSS) have been defined for patients with general shoulder problems or those undergoing subacromial decompression. To date no threshold has been reported for classifying improvement after shoulder replacement surgery. This study aimed to establish the minimal clinically important change (MCIC) for the Oxford Shoulder Score in patients undergoing primary total shoulder replacement (TSR) from a national level dataset.

Methods: Patient-reported outcomes data were sourced from the Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) Patient-Reported Outcome Measures Program. These included pre- and 6-month post-operative Oxford Shoulder Scores and a rating of patient-perceived change after surgery (5-point scale ranging from 'much worse' to 'much better'). Two anchor-based methods (using patient-perceived improvement as the anchor) were used to calculate the MCIC: 1) mean change method; and 2) predictive modelling, with and without adjustment for the proportion of improved patients.

Results: The analysis included 612 patients undergoing primary TSR who provided pre- and post-operative data (58% female; mean (SD) age 70 (8) years). Most patients (93%) reported improvement after surgery. The MCIC derived from the mean change method was 6.8 points (95%CI 4.7 to 8.9). Predictive modelling produced an MCIC estimate of 11.6 points (95%CI 8.9 to 15.6), which reduced to 8.7 points (95%CI 6.0 to 12.7) after adjustment for the proportion of improved patients.

Conclusions: For patient-reported outcome measures to provide valuable information that can support clinical care, we need to understand the magnitude of change that matters to patients. Using contemporary psychometric methods, this analysis has generated MCIC estimates for the OSS. These estimates can be used by clinicians and researchers to interpret important changes in pain and function after TSR from the patient's perspective. We conclude that an increase in Oxford Shoulder Scores of at least 9 points can be considered a meaningful improvement in shoulder-related pain and function after TSR.

EP.06.081

PREDICTING PAIN WHILE SLEEPING ON THE AFFECTED SHOULDER AFTER PRIMARY REVERSE SHOULDER ARTHROPLASTY

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Background: Preoperative pain is a primary motivating factor for patients to undergo shoulder arthroplasty. Specifically, pain at night is a common symptom for these patients and the ability to sleep comfortably while lying on the affected side after a reverse total shoulder arthroplasty (rTSA) is a common question of patients in the preoperative course. The purpose of this study is to evaluate mass index (BMI), patient demographics, and any implant specific factors in a large database of primary rTSA patients to determine any correlation with pain while lying on the affected side. We hypothesize that there will be no correlation between BMI or implant specifics with pain while lying on the affected side after a primary rTSA.

Methods: A prospectively collected international multi-center single-system shoulder arthroplasty database was reviewed for rTSA patients with 1-year follow-up. Shoulders with fractures, infection, sickle cell disease, or a complication or revision were excluded. Bivariable and multivariable tests were performed to identify the influence of demographics, comorbidities, and implant characteristics on preoperative, postoperative, and pre- to postoperative improvement in patient-reported pain when lying on the affected shoulder (scale 0-10).

Results: 3,259 patients were included. Bivariable analysis revealed significant effects of age ($p=0.001$), BMI ($p=0.000$), gender ($p=0.000$), and diabetes ($p=0.001$) on preoperative pain. Age, BMI, and gender remained significant factors in analyses of both postoperative pain ($p=0.000$, 0.012, and 0.035, respectively) and improvement ($p=0.021$, 0.018, and 0.000, respectively); however, there were no monotonically increasing or decreasing relationships. Postoperatively, heart disease ($p=0.005$), diabetes (0.000), tobacco use (0.004), and no comorbidities (0.033) were significantly different than groups without. Logistic regression showed that age ($p=0.000$; OR=0.98[95%CI=0.97-0.99]), female sex ($p=0.045$; OR=1.26[95%CI 1.01-1.59]), hypertension ($p=0.032$; OR=0.78[95%CI 0.63-0.98]), heart disease ($p=0.048$; OR=1.27[95%CI 1-1.6]), diabetes ($p=0.007$; OR=1.36[95%CI 1.09-1.71]), tobacco use ($p=0.008$; OR=1.55[95%CI 1.12-2.14]), combined offset of the liner/tray ($p=0.014$; OR=0.93[95%CI 0.88-1.09]), and preoperative pain ($p=0.000$; OR=1.21[95%CI 1.15-1.26]) were significant predictors of postoperative pain greater than or equal to 3.

Conclusions: This study demonstrates that in a large multicenter operative database, no significant correlation can be found to predict a patient's postoperative pain while sleeping on the affected side after rTSA besides their level of pain preoperatively.

EP.06.083

CORRELATION OF SUBJECTIVE WITH OBJECTIVE MEASURES OF OUTCOME IN SHOULDER ARTHROPLASTY

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Background: Patient-reported outcomes measures (PROMs) are becoming increasingly important in quantifying outcomes in shoulder arthroplasty. Multiple outcome scores have subjective elements as part of their overall value. We sought to determine the degree to which these subjective assessments correlate with objective measures of function.

Methods: We analyzed a multi-center international database of a single implant (Exactech, Inc, Gainesville, FL) that uses a standardized method of measuring shoulder arthroplasty outcomes using several outcomes tools that include a subjective, patient-reported component. These include: SST, Constant, ASES, UCLA, SPADI and Shoulder Arthroplasty Smart Score (SAS) as well as pain on a daily basis, and subjective assessment satisfaction. 2401 anatomic (ATSA) and 3915 reverse (RTSA) shoulders, all with minimum 2-year follow-up were included. Pearson correlation coefficients (CCs) were calculated for correlation between each of these subjective measures and objective measures of active forward elevation, abduction, external rotation and internal rotation score. Average correlation between each subjective score and the objective measures was then calculated to determine PROMs that best correlate with objective postoperative range of motion measures. A threshold of > 0.5 was set as moderate correlation.

Results: For ATSA, only the Constant Score and SAS Score achieved CCs above 0.5 (0.63 and 0.60 respectively). Daily pain had a negative CC (-0.34) and global assessment of satisfaction had a weak correlation of 0.37. Similarly, for RTSA, Constant and SAS score were the only PROMs to score above 0.5 (0.60 and 0.57 respectively). Postoperative daily pain and overall satisfaction also had either a negative or weak correlation with functional outcomes.

Conclusions: Collection of PROMs is increasingly important in the shift toward value-based care. This study demonstrates that the subjective component of several commonly used outcomes scores as well as assessment of residual pain and satisfaction have only a weak positive correlation with functional outcomes. This suggests that non-diagnosis-specific scores may fail to accurately capture a full picture of patient outcomes and may not fully reflect the value achieved by these procedures. Diagnosis-specific scores, like the SAS, achieved moderate positive correlation and may be considered a better alternative to other historical measures for shoulder arthroplasty.

EP.06.084

IS SHORT-STEM UNCEMENTED ANATOMICAL TOTAL SHOULDER REPLACEMENT VALUABLE FOR OSTEOARTHRITIS IN PATIENTS OLDER THAN 70 YEARS?

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Background: Despite a new trend to systematically use reverse shoulder arthroplasty (RSA) in elderly population, total anatomical shoulder arthroplasty (TSA) can get good functional results in this population. The purpose of this study was to evaluate clinical and radiological outcomes of uncemented short-stem TSA for primary glenohumeral osteoarthritis in patients older than 70 years and to compare these results to a matched population with an uncemented short-stem RSA.

Methods: In this retrospective monocentric study, clinical outcomes were based on constant score (Cst), subjective shoulder value (SSV) score, and range of motion. The aim of radiographic analysis was to identify glenoid component loosening and humeral bone remodeling around the uncemented short stem.

Results: At an average follow-up of 44 ± 12.5 months, 32 uncemented short-stem TSA in 31 patients with a minimum of 2 years of follow-up were included and were compared to 32 uncemented RSA. 53% of the patients had a forgotten prosthesis. ROM was significantly improved in all cases. Cst reached 73 ± 9 pts and SSV $90 \pm 10.8\%$. In 8 patients with repairable supraspinatus tendon tears, clinical outcomes were not statistically different from patients with an intact rotator cuff: Cst (77 ± 6.2 points vs 72 ± 9.6 points) and SSV ($88 \pm 11.5\%$ vs $91 \pm 10.5\%$). The type of glenoid wear (A vs B) did not influence the Cst: 73 ± 9 points versus 74 ± 11 points respectively. Despite a complication rate of 6%, no prosthesis revision was performed. At last follow-up, ROM was better in the TSA group compared to the RSA group for internal (7.8 ± 1.3 vs 6.25 ± 2) and external (47 ± 14 vs 24 ± 21) rotations. The postoperative SSV score was also better in the TSA group ($91.3 \pm 10\%$ vs $82.2 \pm 13\%$).

Conclusions: At medium-term, uncemented short-stem anatomic TSA in patients older than 70 years provided satisfactory clinical results. Patients have forgotten their prosthesis in over 50% of cases. This prosthetic design is still indicated in this patient population in case of primary osteoarthritis with a functional rotator cuff with an almost normal rotator cuff muscle trophicity.

EP.06.085

THE NEWEST SEMI-INLAY HUMERAL COMPONENT DESIGN PLACED AT 145° OR 155° DOES NOT AFFECT THE CLINICAL AND FUNCTIONAL OUTCOMES OF THE REVERSE SHOULDER PROSTHESIS AT A MINIMUM FOLLOW-UP OF 1 YEAR

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Background: Humeral lateralization is an important parameter to be evaluated during the preoperative phase to achieve an accurate shoulder replacement. Humeral Stem can be classified into three different types: inlay, semi-inlay and onlay. Each of these stem types differentially affects humeral lateralization, deltoid wrapping, and more generally the biomechanics of reverse shoulder arthroplasty.

In this study, we investigated the semi-inlay humeral stem.

Specifically, the purpose of this study was to evaluate whether there were any differences on clinical and functional outcomes in polyethylene placement at 145° or 155° at a minimum follow-up of 1 year.

Methods: 42 patients were prospectively enrolled and underwent semi-inlay humeral stem RSA between March 2021 and December 2021.

The patients selected were all affected by rotator cuff tear arthropathy.

The polyethylene humeral component was used at 145° or 155° based on the best intraoperative stability of the prosthetic implant. The humeral stem was always placed at 20 degrees of retroversion.

Outcomes evaluated included: Range of ROM, complications and patient reported outcomes at different follow-up (VAS, DASH, SST, Constant Score and ASES).

The Mann-Whitney U test was applied to verify differences between the groups.

Results: All patients were treated with a semi-inlay humeral component: 26 pts with a 145° polyethylene insert (group A) and 16 with a 155° polyethylene insert (Group B)

No statistically significant differences emerged between the 2 groups in terms of ROM, VAS, DASH, SST, CS and ASES (P = n.s.).

Although without a statistically significant difference, forward flexion was better in group B than in group A (157° VS 148°).

The rate of scapular notching was 6 % in group A and 15 % in the group B

No other complications have been reported.

Conclusions: The new semi-inlay design of the humeral component ensures us optimal clinical results and in line with the remaining available prosthetic designs.

No statistically significant differences were found based on the type of polyethylene used (145° vs 155°).

Further clinical studies with longer follow-up will allow us to evaluate whether the semi-inlay component can be the right middle ground between the humeral inlay and onlay component.

EP.06.086

MINIMUM 15 YEARS-FOLLOW UP OF CONVERTIBLE METAL-BACKED GLENOID IN TOTAL SHOULDER ARTHROPLASTY

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Background: Glenoid component loosening and failure in total shoulder arthroplasty (TSA) remain the most common complication. In 2010 the results of a new convertible metal-backed glenoid (MBG) were presented with a promising 100% survival rate at a mean follow-up of 6.3 years. The aim of the current study is to evaluate outcomes and survival rate of the same cohort at a minimum follow-up of 15 years.

Methods: This is a retrospective monocentric study. There were 35 patients in the original study. The aetiology was rheumatoid arthritis (RA) in three patients (8.6%), post-traumatic arthritis in five (14.2%) and idiopathic osteoarthritis in 27 (77.1%). At minimum 15 years all the patients were contacted asking for complications, revisions or reoperations. If the patient was available a clinical examination, assessing Constant Score and range of motion, and an X-ray was performed at last follow-up.

Results: 6 patients were lost and 8 patients died at last follow-up, leaving 21 patients contacted at a mean follow up of 17 years (range 15-25).

All patients presented a reduced thickness of the polyethylene. 10 (48%) patients presented rotator cuff insufficiency with eccentric polyethylene wear. 9 (43%) patients had no further surgeries, 6 (29%) underwent conversion to reverse shoulder arthroplasty (RSA) retaining the MBG and the humeral stem, 3 (15%) underwent surgical fixation for a humeral fracture, 1 patient (5%) underwent revision to TSA with autograft, 1 patient (5%) underwent revision to hemiarthroplasty, 1 patient (5%) was scheduled for revision for a radiographically loosed implant. Mean time after revision or conversion was 13 years (range 8-18). The 6 patients converted to RSA presented no complications after a mean follow-up of 4.5 years (range 15-25) with improved Constant score and range of motion. Considering only patients evaluated at both follow-ups, there were a significant decrease in Constant score and range of motion.

Conclusions: TSA with metal-backed glenoid is not a definitive long-term solution. Rotator cuff failure and polyethylene wear remain a main problem leading to high rate of revision. Conversion to RSA retaining the baseplate is possible in most of the cases.

EP.06.087

PATIENT SPECIFIC IMPLANTS AND PLANNING METHODS IN REVERSE SHOULDER ARTHROPLASTY. WHAT IS THE MOST ACCURATE ALTERNATIVE?

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Background: In recent years, development in shoulder arthroplasty has been oriented towards planning methods and technologies that allow optimizing the position of the implants, especially the glenoid component. The aim of this paper is to evaluate the precision of glenoid implant placement through the use of patient specific implants guidance based on 3D planning, comparing it with the exclusive use of 3D and 2D planning.

Methods: During the period from March 2021 to March 2022, a specific patient guide, printed with SLA technology (Copper3D™ Glaciarys AR3), planned in a specific 3D model, was used for the placement of the glenoid component in a reverse shoulder arthroplasty in 10 patients (PSI-3D). During the period from August 2019 to January 2021, 10 patients underwent exclusive 3D preoperative planning using BluePrint software from Imascap™ (3D-Only). As control group, during the same period of time, a sample comparable in demographic characteristics, indication and glenoid morphology was selected, where only preoperative planning was used based on 2D Computed Tomography with multiplanar reconstructions using the Horos™ software (2D-only). All patients were operated on by the same surgeon.

Error was defined as the difference between the target angles of the specific preoperative planning for each group and those obtained in the immediate postoperative computed tomography, considering glenoid version and inclination through the RSA angle. For the comparative statistical analysis of precision, analysis of variance using STATA v11 was used.

Results: The PSI-3D group obtained significantly less error in the version compared to the 3D-Only and 2D-only groups ($0.75^\circ \pm 0.51$ v/s $2.86^\circ \pm 2.49$ v/s $2.75^\circ \pm 3.12$ respectively). In relation to glenoid inclination, the PSI-3D group obtained significantly less error than the others ($1.17^\circ \pm 0.64$ v/s $1.54^\circ \pm 2.25$ v/s $3.75^\circ \pm 3.15$ respectively). We did not find significant differences between the 3D-only and 2D-only groups for the different angles

Conclusions: The use of a specific patient guide, based on a 3D planning model for the placement of the glenoid component in reverse shoulder arthroplasty, is more precise than just carrying out classic 3D and 2D planning, obtaining a placement error of $<1^\circ$ in version and $<1.5^\circ$ in inclination.

EP.06.088

OUTCOMES OF REVERSE TOTAL SHOULDER ARTHROPLASTY FOLLOWING BALLOON SPACER IMPLANTATION

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Background: Balloon spacer implantation is used to treat cases of irreparable rotator cuff tear, but in cases of treatment failure reverse total shoulder arthroplasty (RTSA) is indicated. The effect of a previously performed balloon implantation on outcomes following RTSA are unknown.

Methods: A single center retrospective study. Patients with a history of balloon spacer implantation who subsequently underwent RTSA in the same shoulder between 2010 and 2021 (Balloon) were matched based on number of previous rotator cuff repair surgeries and age to patients who underwent RTSA for cuff tear arthropathy without balloon implantation history (No Balloon). Minimum follow up was 1 year.

Results: Thirty cases were included, 15 in each group. Mean follow up was 46 ± 23 months without significant differences between groups. Balloon cases included only male patients whereas No balloon cases included 47% female patients, and Balloon cases had a less advanced arthritic disease as evident by a lower Hamada grade than No Balloon cases ($p=0.03$). There were no significant differences in pre or post operative range of motion between groups, with an average forward flexion increase of 39° and no gain in rotations. Patient reported outcomes were comparable between groups: VAS 4.7 vs 3.3; SSV 50 vs 64; QDASH 65 vs 49, all not statistically significant. There were four (27%) postoperative complications leading to re-intervention in the Balloon group, and one (7%) in the No balloon group ($p=0.15$).

Conclusions: In this preliminary study of patients undergoing RTSA for cuff tear arthropathy, a history of previous balloon spacer surgery was associated with identical range of motion outcomes and similar patient reported outcomes, compared with patients without such history. While a trend towards inferior patient reported outcomes was observed in patients with a history of balloon surgery, this would have to be examined in future studies with larger populations.

EP.06.089

DETERMINING THE MINIMAL CLINICALLY IMPORTANT DIFFERENCE AND SUBSTANTIAL CLINICAL BENEFIT FOLLOWING REVISION REVERSE SHOULDER ARTHROPLASTY

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Background: Reverse shoulder arthroplasty (RSA) has become a common procedure because of its expanded indications and increased popularity. However, RSA has been shown to have many complications that may warrant revision. Previous literature has investigated the minimum clinically important difference (MCID) and substantial clinical benefit (SCB) following RSA. However, little is known about these values following revision RSA. This study aims to determine the MCID and SCB following revision RSA.

Methods: A retrospective review of 90 patients who underwent revision RSA from 2007-2020 by a single fellowship trained orthopedic surgeon was performed. Demographics, range of motion (ROM), patient reported shoulder condition, and outcome scores SST, Constant-Murray Score (CMS), UCLA, SPADI, Shoulder Arthroplasty Smart score (SAS) and ASES following revision RSA were collected preoperatively and postoperatively at the last follow-up visit (mean, 22.7 months). MCID and SCB were calculated using the anchor-based method as illustrated by Simovitch et al.

Results: Of the 90 patients, 66 met either MCID (26) or SCB (40) while 24 patients did not meet either. The cohort had a mean age of 67.78 and an average BMI of 29.71 kg/m². A majority of the cohort was Caucasian (92.1%), with 51.7% being male and 48.3% female. The MCID was found to be 3.9 for SST, 28.5 for CMS, 12.5 for UCLA, -41.5 for SPADI, 19.4 for SAS, 29.5 for ASES, 1.9 for global shoulder function, 56.5° for abduction, 62.8° for forward flexion, 0.46 and 9.0° for external rotation. The SCB was found to be 6.5 for SST, 40.6 for CMS, 17.4 for UCLA, -63.3 for SPADI, 32.2 for SAS, 46.5 for ASES, 7.9 for global shoulder function, 123.8° for abduction, 145.8° for forward flexion, and 35.3° for external rotation.

Conclusions: To achieve a minimum clinically important difference or substantial clinical benefit following revision RSA, patients must achieve the scores as illustrated in our results. This information is beneficial for orthopedic surgeons as it can help to set and guide patient expectations when planning for a revision reverse shoulder arthroplasty.

EP.06.090

IS THERE A HIGHER RISK OF COMPLICATIONS WITH INCREASED OPIOID USE AFTER SHOULDER ARTHROPLASTY?

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Background: Although opioid-based medications have proven effective in both managing chronic arthritis pain and postoperative pain after orthopaedic surgery, there is a growing epidemic of prescription opioid abuse and dependence. The purpose of this study was to examine the impact of high opioid consumption on outcomes and complication rates following shoulder arthroplasty (SA).

Methods: A retrospective review of 225 patients undergoing total shoulder arthroplasty (TSA) from 2014-2016 was performed. Opioid data was collected for a year surrounding surgery from PDMDs and dependence was defined as 3 months of continuous opioid prescriptions. Pre- and postoperative opioid use was stratified into low (0-2 prescriptions), mid (3-4 prescriptions) and high (5+ prescriptions) levels. Complications were recorded up to 1 year following surgery and categorized as revision surgeries, medical complications, and readmissions.

Results: The average age of the cohort was 69.1 years with 122 females and mean ASA grade was 2.74. In the cohort, 81 patients were in the high consumption group, 73 were in the mid consumption group and 71 were in the low group. There were no differences in age, gender, or ASA class between groups ($p > 0.05$). The rate of postoperative opioid dependence was significantly higher in the high consumption group at 47% compared to 30% in the overall population ($p < 0.001$). For patients in the high, mid, and low opioid consumption groups, revision rates were 10%, 4.3%, 0% respectively. Relative risk of a revision in the high opioid consumption group was 6.07 times higher than mid and low consumption groups ($p = 0.073$). Perioperative medical complication rates were 14% and 12% for the high and low groups ($p = 0.675$) and the relative risks of medical complications and readmissions for other reasons in the high opioid consumption group (1.16 [CI: 0.56-2.39]) were comparable to the overall population (1.00 [CI 0.21-4.83]).

Conclusions: It appears that high opioid consumption in the perioperative period may lead to an increased risk of opioid dependence and correlate with higher revision rates after TSA. Further research is needed to utilize risk assessment tools and follow opioid usage more closely to elucidate the link between increased opioid consumption and higher revision rates.

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SUTURE CERCLAGE TENSION TECHNIQUE FOR AUGMENTATION OF LESSER TUBEROSITY OSTEOTOMY REPAIR DURING ANATOMIC TOTAL SHOULDER ARTHROPLASTY

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Background: Repair of the lesser tuberosity osteotomy (LTO) during anatomic total shoulder arthroplasty (ATSA) may influence subscapularis healing and function. We present a novel approach to the LTO repair utilizing a suture cerclage technique with a tension augment that individualizes the repair construct.

Methods: To repair the LTO, a standard transosseous suture bridge technique using four high-strength #2 sutures was performed to reduce the fragment. The construct was compressed with a suture-tape cerclage using a mechanical tensioner. The magnitude of tension on the cerclage suture was determined case-by-case, influenced by patient age and proximal humeral bone quality. Patient demographics, operative information, and postoperative complications were recorded. Patient-reported outcomes (PROs), including SANE, ASES, and VAS, were collected at 3-and 6-month follow-up.

Results: 55 consecutive patients (average age 64 ± 12 years) were included with a mean follow-up of 5 ± 3.2 months. End-stage arthritis was the most frequent indication for surgery (89.1%) followed by AVN (10.9%). Average suture cerclage tension was 30 ± 11 pounds (Range 20-60 pounds). There were no instances of intraoperative LTO fracture or greater tuberosity cut-out. One patient (1.8%) required reoperation for a hematoma evacuation. Two patients (3.6%) suffered rotator cuff injuries that will require conversion to reverse TSA – one traumatic dislocation and one chronic tear. There were no cases of nonunion, deep infection, implant loosening, periprosthetic fracture, or neurologic injury. At 3-months, there were significant improvements in SANE (63.6 ± 21.3 [$p < .001$]), ASES (74.3 ± 15.3 [$p < .001$]), and VAS (2.2 ± 1.8 [$p < .001$]) compared to preoperative baseline. Improvements continued to trend at 6-months for SANE (75.5 ± 20.8), ASES (82.5 ± 17.8), and VAS (1.3 ± 2.2). Compared to 2-weeks postoperative, there were significant increases at 6-weeks in forward elevation ($123^\circ \pm 23^\circ$, $p = 0.007$) that continued to increase at 3-months ($146^\circ \pm 13^\circ$) and 6-months ($153^\circ \pm 12^\circ$). External rotation significantly increased at 6-weeks ($35^\circ \pm 13^\circ$, $p < .001$) and continued to increase at 3-months ($46^\circ \pm 11^\circ$), and 6-months ($54^\circ \pm 10^\circ$).

Conclusions: Augmentation of the LTO repair with the suture cerclage technique demonstrated a minimal complication profile with significant improvements in PROs and joint mobility that was sustained at 6-month follow-up. Precision tensioning with suture cerclage fixation may strengthen the osteotomy construct and promote union. Future study is necessary to compare these preliminary results to standard manual knot-tying.

EP.06.092

IMPACT OF AGE ON GLENOID SIZE: GLENOID ENLARGES WITH AGE

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Background: Predictors of glenoid size are not fully understood. Reported factors include ethnicity, sex, and height. However, many studies have been conducted with relatively younger age groups on the assumption that no significant change in the size of the glenoid fossa occurs after the termination of bone growth. The purpose of this study was to examine glenoid size in a population representing the age groups eligible for rotator cuff surgery and to identify the influence of age on the size of the glenoid.

Methods: This retrospective review included 380 shoulders in 380 patients (151 females and 229 males; mean age: 67.2 ± 10.1 years; range: 27–89 years) who underwent preoperative three-dimensional-computed tomography (3D-CT) evaluation and elective shoulder surgery (open or arthroscopic). The exclusion criteria were: history of prior shoulder surgery or glenoid fractures; history of shoulder instability; patients aged younger than 25 years; and those with advanced glenohumeral osteoarthritis. Anatomic parameters of the glenoid (height and width) were measured using 3D-CT images.

A generalized linear model with the gamma distribution (multivariate gamma regression) was used in the analysis with the glenoid size (height or width) as the dependent variable. Initial exploratory models included all independent variables, followed by the stepwise selection of variables based on the p-value, variance inflation factor (VIF), and Akaike's information criterion (AIC) for developing the final models.

Results: The final analytical model showed that age was a significant predictor in both glenoid height and width. The mean glenoid width was 31.2 mm in men and 26.1 mm in women, and the mean glenoid height was 41.1 mm in men and 38.8 mm in women. Other factors that were significant were sex, height, and hand dominance. The analysis models accounted for 65% of the glenoid height (pseudo-r-squared = 0.65; likelihood ratio test, $p = 0.011$) and 73% of the glenoid width (pseudo-r-squared = 0.73; likelihood ratio test, $p < .0001$).

Conclusions: This study showed that the glenoid enlarges with age, with the other positive predictors of glenoid size (height and width) being taller height, male sex, and dominant hand. The influence of rotator cuff tears was not observed.

EP.06.093

IMPACT OF DIFFERENT HUMERAL STEM DESIGN ON IMPINGEMENT FREE RANGE OF MOTION IN REVERSE SHOULDER ARTHROPLASTY

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Background: The purpose of this study was to investigate the influence of implant design on impingement free-range of motion (ROM), using 3-dimensional preoperative planning software.

Methods: Twenty-five patients with massive cuff tear and cuff tear arthropathy were included in this study. DICOM data (Digital Imaging and Communications in Medicine format) were used for the CT imaging conditions. Zed shoulder software (Lexi, Tokyo, Japan) was used for the measurements. Delta Extend (DePuy Synthes, Warsaw, IN, USA) and Equinoxe (Exactech Inc., Gainesville, FL, USA) was used for the reconstruction of 3D model. In order to minimize the influence of the glenosphere, the standard type of The Delta Xtend prosthesis 38mm was used for the glenosphere, and both the glenoid inclination and glenoid version were set at 0 degrees, and the overhang was placed at 5mm from the inferior border of the glenoid. For the humeral side, an automatic anatomical neck osteotomy was performed and the retroversion of the stem was set at 20 degrees. In both groups, standard type stems were selected, and polyethylene was also standard type. Polyethylene of +3 mm was used for the Delta Xtend, and polyethylene of +0 mm was selected for the Equinoxe. Impingement-free ROM was measured in flexion, abduction. The distance from the midpoint of the glenoid width to the most lateral point of the greater tuberosity of the humerus was defined as the global offset and Humeral lengthening was also defined as the most lateral point of the acromion and the most lateral point of the greater tuberosity after implant placement minus the preoperative values

Results: Impingement-free ROM was significantly greater in Delta Xtend for both flexion and abduction. Global offset was 7.0 mm larger in group D, and humeral lengthening was 6.2 mm larger in Exinoque.

Conclusions: In Impingement-free ROM, Delta Extend increased ROM of abduction. In addition, the humeral lengthening was significantly extended in Delta Extend and global offset was increased in Exinoque. This research is useful for implant selection with the characteristics of each implant.

EP.06.094

PERIPROSTHETIC SHOULDER INFECTION. ANALYSIS OF RISK FACTORS AND THE VALUE OF MICROBIOLOGICAL TESTING

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Background: Periprosthetic shoulder infections (PSI) have been diagnosed and treated following the same principles as periprosthetic hip and knee infections. Recently, many articles have been published discussing the ideal PSI approach for treatment. We study the incidence, microbial aetiology, clinical presentation and risk factors for PSI.

Methods: Retrospective study of patients underwent primary shoulder arthroplasty from January 2000 to December 2020 in a Spanish tertiary health care hospital. PSI was defined according to Infectious Diseases Society of America (IDSA) criteria. Early and late infection (cutoff at six weeks) was classified according to Härtle A. et al. Patient's epidemiological and clinical characteristics were analyzed.

Results: 529 patients were included in the study. After a median of follow up of 4.25 years, 30 (5.6%) patients required a revision surgery, 17 due to PSI and 13 due to aseptic failure (AF). Of those diagnosed as PSI: mean age was 62.29 years (41-80); 58.8% were male and Charlson index was 2.82. Reversed shoulder arthroplasty was used on 82.3% (n=14) of cases. The most common clinical presentation was: joint pain 12 cases (70.6%), swelling 4 cases (23.5%), fistula 3 cases (15.9%) and fever one case (5.8%). Six (35.3%) patients had an acute infection and 11 (64.7%) a chronic PSI. Five (29.4%) patients met only the intraoperative microbiological criteria for infection. *Cutibacterium acnes* was the most frequent microorganism isolated (61.2%) followed by *Staphylococcus epidermidis* (22.3%). When comparing PSI and AF patients, PSI were younger (years) (62 vs 70, $p=0.002$), kg/m² (31 vs 29, $p=0.002$), the most common location was right shoulder (59% vs 31%, $p=0.001$) and the commonest etiology was proximal humerus fracture (70.5% vs 15%, $p=0.001$).

Conclusions: The incidence of PSI was 3.2%. *C. acnes* was the most frequent microorganism isolated. PSI cases were mostly males with some degree of obesity who had suffered a fracture of the right proximal humerus. Almost 30% of PSI cases were diagnosed only by intraoperative microbiological cultures. A pre-operative protocol for microbiological sample collection adapted to these patients may be helpful to choose the best tentative therapeutic approach.

EP.06.095

BIOMECHANICAL EFFICACY OF COMBINED LATISSIMUS DORSI AND TERES MAJOR TENDON TRANSFER TO RESTORE ACTIVE INTERNAL ROTATIONAL STRENGTH FOLLOWING LATERALIZED REVERSE SHOULDER ARTHROPLASTY

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Background: Limitation of active internal rotation (IR) following reverse shoulder arthroplasty (RSA) in patients with massive rotator cuff tears (mRCT) with subscapularis insufficiency remains a challenge, having the failure of postoperative satisfaction and clinical prognosis. Recently, RSA with LDTM transfer in patients expected to be limited active IR following RSA was introduced as a reliable treatment option with favorable clinical outcomes. Hereby, the purpose of this study is to demonstrate the biomechanical efficacy of LDTM transfer with RSA in mRCT and subscapularis insufficiency for improving active IR compared to RSA without tendon transfer.

Methods: Eight cadaveric shoulders were tested (mean age, 64.5 ± 1.9 years). Specimens were dissected preserving coracoacromial ligament, tendinous insertions of the rotator cuff and scapulohumeral muscles. All specimens were tested at 0°, 20° and 40° abduction for two conditions: (1) RSA alone (2) RSA with LDTM transfer at three different muscle loads. A prosthesis with a medialized glenoid and lateralized humerus was used in all specimens. IR strength was measured with a torque wrench at 0°, 20°, and 40° abduction and 60° and 45° IR positions. Anterior dislocation force of humeral head was measured at 20° abduction and 10° IR position. For statistical analysis, paired t-test was used.

Results: Significantly higher IR strength was measured for all abductions and muscle loadings in RSA with combined LDTM transfer compared with RSA without transfer condition (at all abduction position, at 45° IR degree) ($p < 0.047$). RSA with LDTM needed higher force for anterior dislocation of humeral head compared to RSA alone, but there was no significant difference ($p = 0.66$).

Conclusions: LDTM transfer with lateralized RSA has superior biomechanical efficacy for restoring internal rotational strength to RSA without tendon transfer in cadaveric specimens, whereas the difference of anterior dislocation force did not reach the statistically significant level between RSA with or without LDTM tendon transfer conditions. It may have clinical implications as a reliable treatment option for patients with mRCT and subscapularis insufficiency who are expected to be limited active internal rotation following RSA.

EP.06.096

TRAJECTORIES OF PAIN INTENSITY AND MAGNITUDE OF CAPABILITY AFTER SHOULDER ARTHROPLASTY

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Background: There is variability in trajectories of pain intensity and magnitude of incapability after shoulder arthroplasty. The evidence that opportunities for better mental and social health make important contributions to musculoskeletal health are contributing to evolutions of care strategies. We used a registry of patients undergoing total shoulder arthroplasty (TSA) and reverse shoulder arthroplasty (RSA) that included the mental component summary score (MCS) of the Veterans RAND-12 (VR-12) questionnaire and asked: (1) Are there distinct trajectories of pain intensity by 1) quartile of the MCS, 2) arthroplasty type, and 3) revision surgery? And (2) Do those groups have distinct trajectories of magnitude of capability?

Methods: We included 755 shoulder arthroplasty patients from a single-surgeon arthroplasty registry that recorded the MCS, a measure of comfort and capability (American Shoulder and Elbow Surgeons; ASES), and visual analog pain intensity pre-operative, 2 weeks postoperative, 6 weeks, 3 months, 6 months, and 1-year after surgery. Unconditional linear and quadratic growth model were generated to identify the general shape of recovery for both outcomes (linear vs. quadratic). We then constructed conditional growth models and curves for pain intensity and magnitude of capability, accounting for mental health (MCS) quartiles, primary or revision arthroplasty, and TSA or RSA in separate models.

Results: Both pain intensity and magnitude of capability were significantly worse at baseline for groups with worse mental health, with no significant differences in rates of recovery amongst groups. Patients treated for revision arthroplasty had significantly worse pain and capability scores at baseline and a slower rate of recovery in magnitude of capability compared to primary arthroplasties. There were no differences in pain intensity or capability between patients treated with RSA or TSA.

Conclusions: The observation that mental health factors account for variation in baseline scores, with no significant differences in rates of recovery among patients recovering from shoulder arthroplasty, and no difference in type of arthroplasty, reminds us that optimal musculoskeletal health depends on optimal mindsets, and directs us to design care strategies that anticipate and address unhelpful thinking (misconceptions) and feelings of distress regarding symptoms.

EP.06.097

LONG-TERM OUTCOMES AFTER HUMERAL HEAD REPLACEMENT AND TOTAL SHOULDER REPLACEMENT FOR OSTEONECROSIS OF THE HUMERAL HEAD: A MEAN FOLLOW-UP OF 8-YEARS

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Background: The purpose of this study was to compare the outcomes and complications after humeral head replacement (HHR) and total shoulder replacement (TSR) in patients with osteonecrosis of the humeral head (ONHH).

Methods: Twenty-six patients who underwent shoulder replacement (13 HHRs and 13 TSRs) for nontraumatic ONHH were included. The mean follow-up period was 96.4 months. The visual analog scale (VAS) pain score, the University of California at Los Angeles (UCLA) score, the American Shoulder and Elbow Surgeon (ASES) score, and range of motion (ROM) at the final follow-up evaluation were used for assessment of clinical outcomes.

Results: The mean VAS pain score, UCLA score, and ASES score showed significant improvement from 6.3, 11.6, and 35.0 before surgery to 2.2, 28.9, and 82.6 at the final follow-up evaluation (all $p < 0.001$). No significant differences regarding all clinical scores and ROMs were observed between the HHR group and the TSR group, except that a greater abduction angle was observed in the HHR group compared with the TSR group (123.1° versus 96.9°, $p = 0.014$). Two patients in the TSR group underwent multiple reoperations due to periprosthetic joint infection. No revision surgeries were performed for glenoid erosion following HHR or aseptic glenoid loosening following TSR.

Conclusions: The findings of this study showed satisfactory clinical and radiological outcomes with implant longevity for both HHR and TSR in patients with nontraumatic ONHH. The HHR group had a greater abduction angle compared with the TSR group.

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REVERSE TOTAL SHOULDER ARTHROPLASTY IMPROVES EMOTIONAL STATUS AND QUALITY OF LIFE IN PATIENTS WITH ROTATOR CUFF INSUFFICIENCY

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Background: The purpose of this study was to investigate sequential changes of emotional status and quality of life after reverse shoulder arthroplasty (RSA) for the treatment of rotator cuff insufficiency and to determine the predictors that can affect postoperative clinical outcomes. This study was conducted to prove the hypothesis that RSA would improve emotional status and quality of life.

Methods: Fifty patients undergoing RSA for rotator cuff insufficiency were prospectively included. Evaluation using Visual Analogue Scale (VAS) pain score, American Shoulder and Elbow Surgeons (ASES) score, Subjective Shoulder Value (SSV), Hospital Anxiety and Depression Scale (HADS), and Abbreviated scale of World Health Organization Quality of Life (WHOQOL-BREF) was performed before surgery and at 1.5, 3, 6, and 12 months after surgery.

Results: Mean VAS pain score, HADS-depression, and HADS-anxiety scores showed a significant decrease from 6.6, 13.3 and 13.9 before surgery, to 1.5, 3.9 and 3.7 after 12 months after surgery (all $P < .001$). Mean ASES score, WHOQOL-BREF score, and SSV showed significant improvement from 28.5, 32.3, and 23.6% to 81.3, 79.1, and 78.4% (all $P < .001$). All outcome measurements showed significant improvement from 6 weeks after RSA. In multivariate analysis, age was an independent predictor of final ASES score and WHOQOL-BREF score ($P = .037$ and $.004$).

Conclusions: This study showed sequential improvement of emotional status and quality of life as well as functional recovery with pain relief from 6 weeks after RSA in patients with rotator cuff insufficiency. Especially, younger patients had better postoperative functional ability and quality of life. These findings suggest that RSA for rotator cuff insufficiency provides rapid improvement of emotional status and quality of life.

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HEMIARTHROPLASTY VERSUS TOTAL SHOULDER ARTHROPLASTY IN B2 GLENOIDS WITH AN INTACT ROTATOR CUFF: A LONG-TERM MATCHED COHORT ANALYSIS

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Background: Walch B2 glenoids present unique challenges to the shoulder arthroplasty surgeon, particularly for young active patients who may not want restrictions typically associated with a total shoulder arthroplasty (TSA). Long-term data is limited when comparing hemiarthroplasty (HA) and TSA for patients with an intact rotator cuff. The purpose of our study was to compare the long-term outcomes of HA versus TSA in a matched cohort of patients with B2 glenoids, primary osteoarthritis, and an intact rotator cuff.

Methods: A retrospective review was performed of all patients who underwent HA or TSA between January 2000 and December 2011 at a single institution. Inclusion criteria were primary osteoarthritis, B2 glenoid morphology, an intact rotator cuff intraoperatively, and at least 2 years of clinical follow up. 14 HAs met inclusion criteria and were matched 1:2 with TSAs using age, sex, mass index, and implant selection. Clinical outcomes including range of motion (ROM), pain, subjective shoulder value (SSV) score, American Shoulder and Elbow Surgeons (ASES) score, revisions, and complications were recorded. Postoperative radiographs were reviewed to assess for stem loosening, humeral head subluxation, glenoid loosening, and glenoid erosion.

Results: A total of 14 HAs and 28 TSAs met inclusion criteria at a mean follow-up of 9.2 years. The mean age at the time of surgery was 61.4 years for HA and 67.0 for TSA ($p = 0.06$). Both cohorts had significant improvements in ROM, SSV, and VAS pain scores ($p < 0.001$) without significant differences between the cohorts. TSA had higher postoperative ASES scores compared to HA, although this did not reach statistical significance ($p = 0.11$). HAs were more likely to have posterior humeral subluxation ($p < 0.001$) and stem lucencies ($p = 0.02$). Revisions occurred in 7.1% of the cohort with no difference for HA and TSA ($p = 0.68$).

Conclusions: At nearly 10 years of follow-up, HA and TSA both showed significant improvements in ROM and pain when performed for B2 glenoids with intact rotator cuffs. TSAs had less posterior humeral subluxation and stem lucency compared to HA and trended towards higher ASES scores. However, our study failed to demonstrate a difference in ROM, pain, or revision rates between HA and TSA.

EP.06.101

SHORT-TERM OUTCOMES OF THIRD GENERATION METAL-BACKED CONVERTIBLE GLENOIDS IN YOUNG ACTIVE PATIENTS

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Background: Early studies comparing metal-backed glenoid implants to traditional cemented all-polyethylene implants in anatomic total shoulder arthroplasty (TSA) have shown high failure rates. Mid-term and long-term results of these first-generation prostheses showed high failure rates.

The purpose of this study is to compare the short-term functional outcomes scores of patients undergoing TSA using a convertible third-generation un-cemented metal-backed glenoid implant to those undergoing TSA with a traditional cemented all-polyethylene glenoid implant.

Methods: We conducted a retrospective case-control study of 43 patients (48 shoulders) who underwent TSA using a convertible metal-backed glenoid implant and 41 patients (54 shoulders) who underwent TSA with a traditional cemented all-polyethylene glenoid implant over a 4 year period. The metal-back and control groups were matched for age at time of surgery, medical comorbidities and length of follow-up .

Results: Our overall results showed that baseline ASES, SANE and SAS scores improved significantly in both groups.. There was no statistically significant difference in terms of improvement in ASES scores (GEE -4.38; p=0.391) at final follow up between the metal-backed and control group. However, the metal-backed group was found to have significantly lower baseline ASES scores compared to the control group (GEE -7.32; p<0.0001). The patients undergoing metal-backed convertible procedures had greater glenoid deformity with 20 (41.7%) shoulders having Walch B2 glenoids in the metal-backed group compared to 10 (18.5%) in the control group. TSA using a convertible metal-backed glenoid component leads to significantly improved functional outcomes scores with no difference in functional outcome scores or revision rates when compared to TSA using a traditional cemented all-polyethylene glenoid implant at 2 years post-operatively despite worse pre-operative glenoid deformity.

Conclusions: TSA using a convertible metal-backed implant may be an effective option for the young male patient with significant glenoid wear

EP.06.102

1-YEAR OUTCOMES FOLLOWING MINIMAL HUMERAL PREPARATION USING A SELF-BROACHING, STEMLESS, ANATOMIC TOTAL SHOULDER ARTHROPLASTY

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Background: As anatomic total shoulder arthroplasty innovation continues; many surgeons have been concerned with bone quality when employing stemless humeral implants. Our center began implementing a zero humeral preparation technique combined with a novel self-broaching humeral implant for patients undergoing anatomic total shoulder arthroplasty in hopes of decreasing these concerns. This retrospective, single center study evaluates 1-year outcomes with use of this technique in anatomic total shoulder arthroplasty.

Methods: All patients underwent an anatomic total shoulder arthroplasty using a minimal humeral prep technique: the humeral head was cut, the center pin was placed using a trial head guide, an inset reamer was used to allow the final implant to sit flush, the center pin removed, and the final implant was impacted allowing it to cut its own way into the proximal metaphyseal bone. A retrospective database query was performed for eligible patients greater than 1-year post-operative. Patient satisfaction, ASES, Constant, and EQ-5D scores were collected pre-operatively and 1-year post-operatively. Pre-operative and post-operative data were available for paired analysis of 32 patients. Routine follow up was done for each patient with radiographs of the operative shoulder at 1-week and 1-year post-operatively.

Results: Data analysis showed improvement in Constant scores from 42.98 to 74.54 ($p < 0.001$), ASES scores from 33.91 to 86.77 ($p < 0.001$), and EQ-5D indices from 0.547 to 0.852 ($p < 0.001$) at 1-year. Additionally, analysis revealed significant increases in patient satisfaction, patient shoulder rating and increased overall health at 1-year. No intraoperative complications were found. No instances of loosening or osteolysis were observed on follow-up radiographs. There were no observed post-operative complications or need for revision.

Conclusions: This study demonstrates that a minimal humeral preparation technique combined with a novel self-broaching, stemless humeral component offers improved outcomes at a minimum of 1-year follow up with no instances of humeral component loosening. Patients experienced a statistical improvement in their ASES, Constant, EQ-5D and patient satisfaction scores at 1 year. Concerns regarding bone quality may be mitigated with this approach although longer follow-up is needed.

EP.06.103

MEDIUM TERM OUTCOMES AFTER REVERSE SHOULDER ARTHROPLASTY: A SYSTEMATIC REVIEW WITH A MINIMUM 5 YEARS FOLLOW UP

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Background: Excellent short term outcomes have been reported after Reverse Shoulder Arthroplasty (RSA), but longer term outcomes in the existing literature vary widely. The purpose of this systematic review was to assess outcomes after RSA at a minimum of 5 years of follow up.

Methods: A Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) compliant systematic literature search of the PubMed and Embase databases was undertaken. Clinical studies which reported outcomes with at least 5 years follow up after RSA were included.

Results: Overall, 48 studies were eligible for inclusion. This represented 28,931 shoulders in 28,877 patients (61.2% females), with a mean age of 70.8 ± 5.8 years (31.6-95) and mean follow up of 95.3 ± 32.3 months (60-243). At final follow up, the mean reported Constant Murley score was 60.1 ± 5.2 (49-68), while the mean age & sex adjusted score was 81.1 ± 12.6 (58-105). The range of active forward flexion, abduction and external rotation were respectively: 126.30 ± 12.80 , 106.10 ± 11.50 and 18.90 ± 8.60 . The overall rate of revision surgery from 33 studies was 5.1%, with reported rates ranging from 0 – 51.4%. At final follow up, the mean reported complication rate was $25 \pm 17.5\%$ and mortality rate was $16 \pm 15.3\%$. Patients rated their satisfaction as either good or very good in 76.6% of cases.

Conclusions: This systematic review shows that RSA results in high satisfaction rates, good clinical outcomes, as well as low revision rates at minimum 5-years follow-up; despite a moderate complication rate.

EP.06.104

THE STATISTICAL FRAGILITY OF THE MANAGEMENT OPTIONS FOR REVERSE SHOULDER ARTHROPLASTY: A SYSTEMATIC REVIEW OF RANDOMIZED CONTROL TRIAL WITH FRAGILITY ANALYSIS

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Background: Reverse shoulder arthroplasty (RSA) is used in the treatment of traumatic and arthritic pathologies, with expanding clinical indications and as a result there has been an increase in clinical research on the topic. The purpose of this study was to examine the statistical fragility of Randomized Control Trials (RCTs) reporting outcomes from RSA. The p value is a ubiquitous statistical tool used to convey if an outcome finding is significant. The Fragility Index (FI) expresses how many events outcomes would have to be reversed to invert the finding of significance.

Methods: A systematic search was undertaken to find RCTs investigating RSA. The Fragility Index (FI) was calculated using Fisher's exact test, by sequentially altering the number of events until there was a reversal of significance. The Fragility Quotient (FQ) was calculate by dividing the FI by the trial population. Each trial was assigned an overall FI and FQ calculated as the median result of its reported findings

Results: Overall, 19 RCTS warranted inclusion in the review, representing 1,146 patients, of which 41.2% were male, with a mean age of 74.2 ± 4.3 and mean follow up of 22.1 ± 9.9 months. The median RCT population was 59, with a median of 9 patients Lost To Follow Up (LTFU). The median FI was 4.5, and median FQ was 0.083, indicating more patients did not complete the trial than the number of outcomes which would have to change to reverse the finding of significance.

Conclusions: This review found that the RCT evidence for RSA management may be vulnerable to statistical fragility, with a handful of events required to reverse a finding of significance. Comparative trials of shoulder surgery should consider reporting the FI, FQ and P value of findings to better demonstrate statistical evidence which informs clinical decision making.

EP.06.105

SHOULDER ARTHROPLASTY IN ANTICOAGULATED PATIENTS: A COHORT STUDY

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Background: To determine whether pre-operative cessation of anticoagulant or antiplatelet medication is necessary for patients undergoing total shoulder arthroplasty (TSA) or reverse total shoulder arthroplasty (RTSA).

Methods: A prospectively maintained database was used to identify 213 consecutive patients treated with TSA or RTSA performed by a single surgeon across 3 centres. This cohort included 24 patients on an anticoagulant agent (warfarin, apixaban, rivaroxaban, dabigatran), 52 patients on an antiplatelet agent (aspirin, clopidogrel), and a control group of 137 patients not on anticoagulant or antiplatelet medication. Patients on anticoagulant or antiplatelet medications continued these agents peri-operatively. Outcomes included haemoglobin drop, intra-operative blood loss, operative time, transfusion requirements and post-operative complications.

Results: The mean age of the cohort was 74.3 years (range 47 - 93) and 75 (35.2%) of the patients were male. TSA was performed in 63 cases and RTSA in 150 cases. The mean haemoglobin drop in the control group was 17.3 g/L, compared to 19.3 g/L in the anticoagulant group ($p = 0.20$) and 15.6 g/L in the anti-platelet group ($p = 0.14$). The mean intra-operative blood loss in the control group was 107.8 mL, compared to 143.0 mL in the anticoagulant group ($p = 0.03$) and 134.3 mL in the anti-platelet group ($p = 0.02$). The mean operative time in the control group was 49.3 minutes, compared to 47.1 minutes in the anticoagulant group ($p = 0.56$) and 50.3 minutes in the anti-platelet group ($p = 0.78$). Post-operatively no patients developed a wound infection or haematoma requiring intervention. Three patients not on anticoagulant or antiplatelet medication developed pulmonary embolism.

Conclusions: Continuing anticoagulant or antiplatelet medication was associated with higher intra-operative blood loss, but produced no statistically significant differences in haemoglobin drop, operative time, transfusion requirements or post-operative complications. We now do not routinely stop any anticoagulant or antiplatelet medication for patients undergoing total shoulder arthroplasty.

EP.06.106

RELATIONSHIP BETWEEN DIFFERENT TYPES OF ETIOLOGY AND FUNCTIONAL INTERNAL ROTATION OUTCOME AFTER REVERSE SHOULDER ARTHROPLASTY

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Background: The number of Reverse shoulder arthroplasty surgeries have been increased in the last 10 years. Despite its good results, some points remain unclear regarding the functional internal rotation after reverse shoulder arthroplasty. The objective of this study is to evaluate the progress of functional internal rotation after RSA in patients with concentric osteoarthritis, massive irreparable cuff tear without arthritis and cuff tear arthropathy.

Methods: A retrospective study including 238 patients with at least 2 years follow up underwent reverse shoulder arthroplasty operated by single surgeon with the same prosthesis onlay type. Ninety five patients (39%) had RSA after concentric osteoarthritis, sixty one patients (25%) after cuff tear arthropathy and eighty two patients (34%) after massive irreparable cuff tear without arthritis. We evaluated the progress of functional internal rotation postoperative according to type I internal rotation with hand blocked to buttock, type II internal rotation with lumbar sliding and type III internal rotation with smooth motion. We classified type I as non-functional internal rotation while type II and III are functional internal rotation. We used Simple shoulder value (SSV) and constant score (CS) also to evaluate the ROM preoperative and postoperative.

Results: Patients with central osteoarthritis have a significant improvement of functional internal rotation postoperative ($p < 0,0001$) while the patients with massive irreparable cuff tear have developed worse functional internal rotation postoperative ($p = 0,0039$). On the other hand, the functional internal rotation for the patients with cuff tear arthropathy is not significant ($p = 0,3523$) as many patients developed type I internal rotation from type II with time. The average SSV improved from 45 preoperatively to 80 at the time of the last follow-up and the average CS improved from 43 preoperatively to 73 at the last follow up.

Conclusions: Constant score and simple shoulder value are improved after RSA in different types of etiology. We can predict an improvement in functional internal rotation in patients with concentric osteoarthritis rather than patients with massive irreparable cuff tear or cuff tear arthropathy. Prediction of these factors may be useful in counseling on functional expectations as well as customizing rehabilitation plans.

EP.06.107

ARTHROSCOPIC REMOLDING OF PROXIMAL HUMERUS MALUNITED FRACTURES WITH LIMITATION OF MOTION AS AN ALTERNATIVE TO HEAD PROSTHESIS

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Background: The main symptoms of malunion of proximal humeral fractures are Reduction of external rotation due to posterior malunion of the greater tuberosity, pain, subacromial impingement due to proximal overhead apex displaced malunion of the greater tuberosity and limited joint range of motion. Most of the cases are treated with hemi or total arthroplasty. In this presentation we will demonstrate an arthroscopic procedure to reconstruct the anatomy for regaining the external rotation and elevation range of motion and daily function demands of the shoulder.

Methods: Twenty-five cases were treated with the arthroscopic remodeling technique of malunited proximal humeral fractures. The procedure was done in a sitting position with the arm hanging. The supraspinatus and infraspinatus are resected from the bony attachment on the proximal humerus, the with an acromionizer the greater tuberosity above the head vivo is resected and the part of the posteriorly mal united greater tuberosity causing loss of the external rotation due to hinging of the bone on the posterior rim of the glenoid will be removed till the external rotation is freed. An anterior acromioplasty is also done to increase the subacromial space. After that the resected part of the infraspinatus and the supraspinatus tendons will be refixed to the greater tuberosity and the posterior head with transosseous sutures using the Giant needle technique and the suture passer wire.

Results: The follow up of the patients showed an average increase in the range of motion of elevation to 155 degrees and external rotation to 56 degrees active and passive. The preoperative pain was dramatically improved. All patients returned doing all needed daily living activity and limited sports activity.

Conclusions: The arthroscopic remodeling of malunited proximal humeral fracture can be a sound alternative to head replacement arthroplasty in cases with preserved head curvature.

EP.06.108

MID-TERM RESULTS OF NEW DESIGN STEMLESS ANATOMICAL SHOULDER ARTHROPLASTY (ATSA) WITH REVERSE ARTICULAR BEARING SURFACE (FULL METAL GLENOID AND NON-SPHERICAL PE HUMERAL HEAD)

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Background: Glenoid loosening is the most common mid- to long-term complication of conventional shoulder arthroplasty with cemented or metal backed glenoid components, especially in eccentric glenoid deformity. Moreover, the non-physiological kinetics of components with spherical geometry is in discussion as cause of premature PE wear. Therefore, since 2018 we use a new stemless ATSA with both, non-spherical design and full metal glenoid and PE humeral head in most cases of osteoarthritis with intact rotator cuff.

Methods: From 2019-2022 we operated on 102 shoulders of 98 patients after 3D pre-OP planning and followed our first 20 cases prospectively till 12/2022 with a mean FU of 2.7 years (3.1-4.7 years) to evaluate the clinical and radiological results of this new type of implant. The mean age was 65 years (53-81). We corrected in 10 patients > 10° retroversion and in 6 > 10° superior inclination by reaming and autologous bone graft. The clinical FU included the DASH and Constant score, the radiological FU X-rays in 3 planes.

Results: We found mostly good and excellent results in all cases with an improvement of CS score from 24.6 to 66.2 P, DASH score from 66 to 26. Active elevation improved from 110° to 161°, VAS score improvement from pre-OP 7,3 to 1.2. There were no signs of aseptic loosening or radiolucency lines nor PE wear and, osseointegration and healing of the bone grafts in all cases. In all cases of B2 deformity recentering of posterior subluxation was observed. There was a trend to lateralisation of COR post-OP.
Complications: 1 partial temporary (sensitive) plexus lesion after ISC block and one LG infection (Cutibact.) after multiple corticoid injections and positive histology in biopsies taken at first surgery. The latter was successfully revised (converted to RSA) in a one stage procedure 10 weeks later.

Conclusions: The new design fulfilled in the mid-term all our expectations. No specific complications of the new design were observed. Because we feel that even after FU of more than 5 years glenoid loosening will be very rare, we extended our indication to B2/B3 deformities to less than 30° of retroversion.

EP.06.109

A COMPARISON OF STANDARD LENGTH, SHORT LENGTH AND STEMLESS ON ANATOMIC HUMERAL RECONSTRUCTION

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Background: Within the last decade options to reconstruct the proximal humerus have expanded. The ability to recreate the anatomic humeral geometry has led to an improved understanding that the stem-to-head relationship may inadvertently alter the optimal position of the articular head segment with respect to the tuberosities. The purpose of this study was to compare three different humeral designs, a standard length, a short and a stemless and evaluate the ability to reconstruct an anatomic humeral morphology in patients undergoing TSA.

Methods: Three distinct time periods were selected to reflect the first year the implant was available: standard length stems (79 patients), short stem (62 patients) and stemless (51 patients). A postoperative AP-Grashey radiograph was used to estimate the best fit circle defined by three points (flair of the greater tuberosity; rotator cuff footprint; and medial calcar). Secondary circle, defined by the prosthetic articulation was also included. The adequacy of the reconstruction was determined by difference between two circle centers (within 3mm threshold). The following measures were calculated: (1) neck-shaft-angle; (2) the distance between the centers of two circles (C2C); (3) the distance between two circles along the normal to osteotomy (ND), and (3) medial complimentary area (MCA).

Results: The average C2C distance in the stemless implant was 3 ± 1.6 mm, compared to the short stem 4.1 ± 1.9 mm ($p=0.01$) and compared to the standard length stem 4.8 ± 2.7 mm ($p<0.001$). Stemless implants had 60% of optimal head reconstructions, compared to 40% in short stem group and 44% in standard stem group. Additionally, there was a significant difference found in MCA, between the stemless (227mm^2) and short stem (378mm^2 , $p<0.001$) cohorts and between short stem (378mm^2) and standard stem (280mm^2 , $p=0.008$) cohorts. Neck shaft angle was on average $138 \pm 3^\circ$ for standard stem, $140 \pm 4^\circ$ for short stem and $137 \pm 6^\circ$ for stemless ($p<0.001$).

Conclusions: A stemless humeral implant provides surgeon a better opportunity to reconstruct proximal humeral anatomy. The optimization of the point to point distance between the idealized and the prosthetic reconstruction has kinematic implications. Irrespective of the length of the stem there is little impact on the reconstruction of the neck shaft angle.

EP.06.110

MENTAL HEALTH DISORDERS ARE AN INDEPENDENT RISK FACTOR FOR PERIOPERATIVE COMPLICATIONS IN PATIENTS UNDERGOING PRIMARY TOTAL SHOULDER ARTHROPLASTY

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Background: The literature examining the relationship of mental health disorders and perioperative complications in patients undergoing primary total shoulder arthroplasty (TSA) is lacking and often conflicting in their conclusions. The purpose of this study is to evaluate the effects of mental health disorders on perioperative outcomes and complications following primary TSA.

Methods: The National Readmissions Database (NRD) was queried, and 128,382 discharges having undergone a primary TSA between 2010 and 2019 were identified, including both anatomic and reverse TSA. Two groups were established, those with and without a history of a mental health disorder. The mental health disorder group was further divided into depression, anxiety, psychosis, and other mental health disorders. Data analysis using IBM SPSS Statistics for Windows v27 identified the most common and significant ($p < 0.05$) comorbidities and complications between the groups were identified.

Results: The prevalence of depressive disorders was 15.2%, anxiety disorders 12.3%, and psychosis 2.1%. Mean age at the time of admission for patients with and without a mental health disorder was 68 and 70 years, respectively ($p < 0.001$). The mean Charlson-Deyo score for patients with and without a mental health disorder was 1.03 and 0.75 respectively ($p < 0.001$). Mean length of stay for patients with and without a mental health disorder was 1.89 and 1.65 days, respectively ($p < 0.001$). Depression ($p < 0.001$), anxiety ($p < 0.001$), and psychosis ($p < 0.001$) were all predictive of an increased risk of any 180-day complication, revision at 180 days ($p = 0.001$, $p < 0.001$, $p < 0.001$, respectively) and increased risk of mechanical loosening ($p = 0.05$, $p < 0.001$, $p = 0.029$, respectively). Anxiety was predictive of a higher risk of infection and pneumonia ($p = 0.009$). None of the mental health disorders were predictive of increased risk of mortality.

Conclusions: In patients undergoing a primary TSA, in-hospital medical complications, medical complications at 180 days, length of stay, and revision surgery at 180 days were significantly higher in patients with preexisting mental health disorders. This information is helpful for both patients and surgeons when making an informed decision regarding TSA. Identifying patients with preexisting mental health disorders prior to TSA can assist in tailoring pre- and postoperative management of these patients.

EP.06.111

GLENOID BASEPLATE FAILURE IN REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: There is little data on the incidence and causes of baseplate failure with modern contemporary designs. The purpose of this study is to determine the incidence of aseptic glenoid baseplate failure following primary rTSA using a contemporary humeral-lateralized system and identify significant risk factors associated with failure.

Methods: Data from a prospectively collected multi-center shoulder database were analyzed. All 7,162 primary rTSA patients performed from 2007 to 2020 were included. Patients with aseptic glenoid baseplate loosening were identified and compared to all other primary rTSA without loosening, evaluating preoperative and postoperative range of motion (ROM), patient reported outcome metrics (PROM), pain, function, satisfaction scores, demographics, co-morbidities, Walch classification, and radiographic changes associated with risk of loosening. Statistical analyses were performed as was a multivariate logistic regression to determine parameters and odds ratios (OR) for baseplate failure after rTSA.

Results: Irrespective of minimum F/U, 53 of 7,162 primary rTSA shoulders experienced aseptic glenoid baseplate failure, for an overall rate of 0.74%. Posterior/superior augmented glenoid baseplates had a 4.7% failure rate compared to 0.6% in non-augmented ($p < .001$). 6mm offset glenospheres had a 2.0% failure rate versus the 0.9% rate associated with 2mm offset glenosphere ($p = 0.0003$). Walch B3 glenoids had a 7.8% failure rate ($p < 0.0001$), and Sirveaux E3 glenoids had a 5.3% failure rate ($p = 0.007$), compared to the other Walch and Sirveaux glenoid classifications. Patients with a beta angle $< 70^\circ$, scapular notching and humeral radiolucent lines had an increased failure rate (all $p < 0.0001$). At latest follow-up the baseplate failure group had significantly lower PROM, function, and ROM ($p < 0.004$), as well as higher pain scores ($p < 0.001$). Multivariate logistic regression analysis showed that Walch glenoid types B2 ($p = 0.002$, OR = 4.513) and B3 ($p = 0.002$, OR = 14.804), use of expanded glenospheres ($p = 0.025$, OR = 2.57) and usage of augmented baseplates ($p = 0.001$, OR = 2.50) were significant risk factors.

Conclusions: The incidence of aseptic glenoid baseplate failure was 0.74%. Failure led to lower PROM, ROM, function, and patient satisfaction, as well as higher pain scores. Higher rates of failure were seen with posterior/superior augmented glenoids, 6mm offset expanded glenospheres, Walch B2 and B3 and Sirveaux E3 glenoids, beta angle $< 70^\circ$, scapular notching, and humeral radiolucent lines.

EP.06.112

INTRAOPERATIVE NAVIGATION SYSTEM INCREASE ACCURACY OF GLENOID COMPONENT INCLINATION IN REVERSE TOTAL SHOULDER ARTHROPLASTY: A PRELIMINARY STUDY

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Background: While the use of computer-assisted navigation systems in prosthetic implantation is steadily increasing, its utility in reverse shoulder arthroplasty (RSA) remains unclear. The purpose of this study was to evaluate the clinical utility of an intraoperative navigation system in patients undergoing RSA.

Methods: Patients undergoing navigated or standard RSA at a single institution between September 2020-May 2021 were prospectively enrolled. Exclusion criteria included noncompliance with study procedures or humeral fracture. Outcome measures included postoperative version and inclination, range of motion, complications, and patient-reported outcomes (PROs: American Shoulder and Elbow Surgeons score [ASES], Disabilities of the Arm, Shoulder, and Hand score [DASH], Simple Shoulder Test [SST], and Visual Analog Scale [VAS]) at final follow-up.

Results: The final cohort contained 7 patients with navigation and 5 with standard RSA at a mean follow-up of 10 months (range 9-12 months). Average age was 73 years (range 66-79 years), and all patients were female. At baseline, the navigated group had a greater proportion of Walch B1 and B2 glenoids ($p=0.04$). There were no differences between groups regarding baseplate type and native/planned/postoperative glenoid version and inclination. In both groups, planned and postoperative version were not significantly different ($p=0.76$). Patients who did not have navigation demonstrated significant differences between planned and postoperative inclination ($p=0.02$), while those with navigation did not ($p=0.07$). PRO scores did not differ between groups at final follow-up for SST ($p=0.44$), DASH ($p=0.24$), ASES ($p=0.62$), or VAS ($p=0.07$). No difference in final range of motion was found between groups ($p>0.05$), including in posterior internal rotation ($p=0.54$). Over 50% of all screws in both groups were positioned outside the second cortex ($p=0.71$), albeit with no complications.

Conclusions: There were no statistically significant differences in range of motion, PROs, and satisfaction between patients receiving computer-navigated and standard RSA at a short-term follow-up. Despite more severe preoperative glenoid erosion in the navigated group, all patients were able to achieve an appropriate neutral axis postoperatively. Navigation use was associated with a greater accuracy of screw placement in the coronal plane.

EP.06.113

HOW DOES PREOPERATIVE SHOULDER EXTERNAL ROTATION STIFFNESS INFLUENCE THE RATE OF MOTION RESTORATION AFTER TOTAL SHOULDER ARTHROPLASTY?

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Background: Although both aTSA and rTSA reliably improve pain and function, there is a subset of patients who lag behind their peers in regaining overhead motion. We compared the rate of recovery in motion after aTSA and rTSA in preoperatively stiff (passive external rotation [ER] $\leq 0^\circ$) versus non-stiff (passive ER $> 0^\circ$) shoulders.

Methods: A retrospective review of a multi-institutional shoulder arthroplasty database was performed between 2001 and 2021. We identified 1,164 aTSAs performed for OA and 539 rTSAs for OA, RCT, CTA, with a minimum 2-year follow-up. Patients were excluded for a preoperative diagnosis of nerve injury, infection, or fracture. Postoperative complications that would affect motion were also eliminated. Included patients at minimum had a follow-up between 3-6 months, minimum 2-year follow-up, and a third visit at any other timepoint. Our primary outcome was the rate and period of recovery in ROM.

Results: Non-stiff aTSAs regained ROM faster than stiff aTSAs for abduction (14.0 vs. 4.9 °/month), IR (0.5 vs. 0.3 points/month), and ER (9.1 vs. 3.1 °/month). However, stiff aTSAs continued to improve over a longer period compared to non-stiff aTSAs for abduction (8.1 vs. 4.6 months), IR (6.8 vs. 4.5 months), and ER (8.7 vs. 4.0 months). FE improvement for stiff vs. non-stiff aTSAs was similar for rate (16.9 vs. 16.6 °/month) and length of improvement (4.4 vs. 4.3 months). Non-stiff rTSAs regained ROM faster than stiff rTSAs for active FE (13.1 vs. 6.6°/month), ER (5.0 vs. 1.0°/month) and abduction (12.4 vs. 3.5°/month). However, stiff rTSAs continued to improve over a longer period compared to non-stiff rTSAs for active FE (6.7 vs. 4.5 months), ER (16.3 vs. 5.0 months) and abduction (8.4 vs 4.2 months). IR improvement was similar for rate (0.2 vs. 0.2 levels/month) and length of improvement (8.4 vs. 8.3 months). Stiff rTSAs had slower ER recovery regardless of subscapularis repair and both stiff and non-stiff groups had slower recovery with repair.

Conclusions: Preoperatively stiff versus non-stiff shoulders had a slower rate of recovery but continued to improve over a longer period for abduction, IR and ER after aTSA and FE, ER, and abduction after rTSA.

EP.06.114

OUTCOMES OF REVERSE TOTAL SHOULDER ARTHROPLASTY WITH LATISSIMUS DORSI TENDON TRANSFER: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Background: For patients undergoing reverse shoulder arthroplasty (RSA) with preoperative loss of forward elevation (FE) and external rotation (ER), latissimus dorsi transfer (LDT) has been a purported option to restore motion. This systematic review sought to summarize range of motion (ROM) and outcome scores after RSA with LDT, both with and without concurrent teres major transfer (TM), as well as discuss the findings in the context of prosthesis design.

Methods: A systematic review was performed per PRISMA guidelines. We queried PubMed, MEDLINE, Embase, and Cochrane databases to identify articles on tendon transfer (TT) with RSA. Our primary outcome was postoperative ER. Secondly, we evaluated FE, Constant score, and complications. We included studies that reported ROM in patients undergoing RSA with concomitant LDT to restore ER and FE. Subanalyses were performed to compare outcomes based on whether the teres major was also transferred and by prosthesis lateralization.

Results: We included 19 articles reporting on 300 shoulders (65% female, mean age=68.7 years, mean follow-up=50.6 months). There were 127 LDT and 173 LDT-TM transfers. The surgical indication was most commonly cuff tear arthropathy and massive irreparable rotator cuff tear. Mean ER was -8.1° preoperatively and 23.6° postoperatively, FE was 72.5° preoperatively and 138.7° postoperatively. Mean postoperative Constant score was 64.8. Sub-analysis comparing lateralized versus medialized implants, classified based on previous literature, revealed no difference for postoperative ER (25.1[19.3-30.8] vs. 20.4[13.8-27.0], P=0.294), FE (136.9[129.0-144.9] vs. 145.9[137.1-154.6], P=0.139) or the Constant score (63.6[60.4-66.9] vs. 66.7[63.6-69.9], P=0.185). Similarly, there were no differences for LDT-only versus LDT-TM (22.9[17.5-28.3] vs. 23.4[17.3-29.5], P=0.893), FE (141.0[132.1-150.0] vs. 140.1[135.0-145.2], P=0.855), or Constant score (65.6[61.8-69.5] vs. 64.8[62.7-66.9], P=0.701). The complication rate was 19.3%, reported in 228 shoulders, including tear in the TT(n=3), revision tendon repair(n=1), glenoid/baseplate loosening(n=5), complication related to polyethylene insert(n=2), peri-prosthetic fracture(n=6), transient neuropraxia(n=5), nerve injury(n=2), dislocation(n=10), and infection(n=10). Humeral cortical erosion at the TT site was identified in 34%(41/121).

Conclusions: RSA with LDT in the setting of loss of ER and FE is a reliable option to restore postoperative motion, with comparable complication rates to standard RSA. Lateralization and addition of TM transfer do not appear to affect outcomes.

EP.06.115

PROXIMAL HUMERAL BONE DEFECT IN REVERSE SHOULDER ARTHROPLASTY COMBINED WITH LATISSIMUS-DORSI TRANSFER IS NOT RELATED WITH A POOR OUTCOME.

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Background: Reverse total shoulder arthroplasty (RSA) associated with modified L'Episcopo (isolated LD) or L'Episcopo (combined TM and LD) procedures had been confirmed to effectively overcome the expected external rotation deficit in patient with posterosuperior massive cuff tear and teres minor deficiency.

The objective of this study was to evaluate the radiological bony lesions of the lateral proximal humerus following RSA combined with tendon transfer, and to determine whether these bony lesions affect the clinical outcome.

Methods: A retrospective review of 24 RSAs (mean age 68.71 years, range 52-83) associated with modified L'Episcopo procedure (9) and L'Episcopo procedure (15) was performed. X-rays were assessed for lateral cortex lesions and were categorized into either intact, irregular or complete lytic appearances. In addition, signs of stem loosening were assessed. Clinical outcome measures included range of motion, SSV, VAS, and Constant

Results: With a mean follow-up of 44.71 months (12-97; SD 27.42), eight (33.3%) patients demonstrated intact lateral cortex, eight (33.3%) irregular and eight (33.3%) lytic lesions. 40% of cemented stems demonstrated a deformed cortex compared to 74% of cementless stems. Radiolucent lines were detected in one cemented stem ($p=0.046$). GT resorption ($p=0.147$), condensations lines ($p=0.449$) and spot weld ($p=0.342$), appeared exclusively in non-cemented stem. Postoperatively all patients (24) demonstrated significant improvements in all clinical and functional parameters. A comparison between patient with (Group 2, 16 patients) and without bony lesions (Group 1, 8 patients) revealed no significant differences in functional scores and range of motion: Constant ($p=0,61$), VAS ($p=0,61$), SSV ($p=0,66$) and external rotation ($p=0,34$).

Conclusions: At short-term follow-up, RSA combined with L'Episcopo or modified L'Episcopo procedure resulted in high incidence (67%) of lateral proximal humerus lesions. Radiolucent lines were noted in cemented stems whereas, signs of stress shielding and GT resorption appeared in non-cemented stems. Yet, no case of humeral loosening was detected and these lesions did not seem to affect the clinical outcome. The use of cemented straight standard-length humeral stems should be positively considered in RSA associated with LD-TM tendon transfer.

EP.06.116

EFFECT OF HUMERAL STEM POSITION AND INCLINATION ON IMPINGEMENT FREE SHOULDER RANGE OF MOTION IN REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: Historically, the biggest weakness of reverse total shoulder arthroplasty is predictable restoration of internal rotation. Theoretically, improvement of impingement free range of motion will increase shoulder extension and rotation. Avoiding the humeral component from making contact with the scapular pillar. Adjustment of implant configuration to a more "anatomic" reconstruction of the humerus contributes to improvement in predictability of functional outcomes. The purpose of this study was to analyze the effects of humeral stem position & neck shaft angle on ROM following reverse total shoulder arthroplasty.

Methods: 21 CT scans A1 glenoids analyzed using 3D computer modeling software. Reverse total shoulder arthroplasty ROM simulated: 3 humeral stem positions, 5 different neck shaft angle inclinations. Humeral stem variables: Neck shaft angles: 145 degrees, 135 degrees; variable stem positions: Onlay, Inlay, or "flush lay" 135 stem. Shoulder ROM analyzed for 5 glenoid configurations: 36 glenosphere, 39 glenosphere, 42 glenosphere, 36 glenosphere with 15 degree wedge baseplate, or 36 glenosphere angled BIORSA. Assessment of lateralization in combination with humeral position on impingement free ROM.

Results: 135 degree neck shaft angle significant improvement impingement free ROM compared to 145 degrees: Extension: .delta 49 degrees ($p < 0.0001$), Adduction: delta 15.5degrees ($p < 0.0001$), External Rotation: delta 12.8 degrees ($p < 0.0001$), Internal Rotation: delta 5 degrees ($p < 0.0001$). No significant difference Onlay vs Inlay. 135 Onlay significantly better compared to "flush lay": Adduction: delta 14.6 degrees ($p < 0.0001$), Abduction: delta 8.3 degrees ($p = 0.0001$), External Rotation: delta 13.8 degrees ($p = 0.0003$).

Conclusions: The results of this study demonstrate that humeral component placement 135 degree onlay or inlay provides the most significant impingement free ROM. Combination of neck shaft angle 135 degrees & glenoid lateralization had the biggest influence on increasing ROM. Impingement free ROM is multifactorial and is influenced by neck shaft angle and humeral stem position, glenoid lateralization, as well as glenosphere diameter. Future clinical studies are needed to validate if humeral component placement with neck shaft angle of 135 degree Inlay influences predictable restoration of extension with internal rotation.

EP.06.117

RAPIDLY PROGRESSIVE DESTRUCTIVE ARTHROSIS (RPDA) OF THE GLENOHUMERAL JOINTS-18 CASES REPORT STUDY

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Background: Rapidly progressive destructive arthrosis (RPDA) of the glenohumeral joint is a unique and rare condition, characterized by rapid progressive collapse of the humeral head without evidence of any underlying pathology. It occurs mostly in elderly women, or rarely after sustained trauma. The purpose of our study was to evaluate the clinical outcomes of reverse total shoulder arthroplasty in the RPDA of glenohumeral joint with literature review.

Methods: From January 2015 to January 2021, eighteen patients with RPDA were enrolled at more than 1 year follow-up in our study. For the management of RPDA, reverse total shoulder arthroplasty (RTSA), arthroscopic debridement and conservative treatment were performed. Clinical presentation, radiographs, MRI and intraoperative findings were evaluated. Also, clinical and radiological outcomes were evaluated at the last follow-up,

Results: Mean duration to collapse the humeral head were 15.6 ± 19.1 (2-48) months. Combined lesions included massive rotator cuff tears and glenoid bone defect in most cases. Trauma history was found in 8 patients (44%). RTSA was performed in 15 patients, arthroscopic debridement in 1 patient and conservative treatment in 2 patients. Their mean age was 77.8 ± 4.7 (71-83) years. All patients were female except 1 patient. Among these patients, patients who had undergone RTSA showed significantly improved clinical outcomes at the last follow-up and significant complications such as infection, instability or loosening were not found.

Conclusions: RPDA of humeral head is unique condition and should be distinguished from infection, AVN, RA or insufficiency fracture which are easy to be misdiagnosed.

In RPDA of the glenohumeral joint, RTSA showed satisfactory clinical and radiological outcomes without any severe complications at mid-term follow-up. Among the treatment of RPDA, RTSA showed satisfactory clinical outcomes at short term follow up in our study.

EP.06.118

LIMITED INTERNAL ROTATION FOLLOWING REVERSE SHOULDER ARTHROPLASTY: ITS PREVALENCE AND IMPACT ON PATIENTS' SUBJECTIVE RATING OF THE PROCEDURE

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Background: Studies have shown that functional internal rotation of the shoulder is often limited following reverse shoulder arthroplasty (RSA). Commonly used patient-reported outcome measures (PROMs) lack components that are specifically designed to capture the impact of limited internal rotation. The purpose of the study was to investigate the prevalence of limited internal rotation following RSA and how limited internal rotation affects patients' subjective rating of their RSA.

Methods: A cross-sectional study on a cohort of patients who had undergone primary RSA with > 6 months of follow up was performed. In-person interview and physical exam were conducted to obtain data for shoulder range of motion (forward elevation, external rotation, internal rotation), patients' subjective rating of their RSA, ability to carry out daily activities requiring internal rotation, and PROMs (ASES, SANE, and PROMIS). Statistical analysis was performed to evaluate the relationships of internal rotation with other demographic and outcome variables.

Results: Seventy-five patients (45 males, mean age = 70 years) were enrolled. In physical exam, internal rotation was found to be very limited (to the ipsilateral side/buttock) in 36% of the patients. Sixty percent of the patients reported a subjective feeling of internal rotation limitation. As for patients' subjective rating of their RSA, 44% felt that their RSA was perfect, and 56% less than perfect. The presence of objective or subjective limitation of internal rotation was significantly associated with lower subjective rating of RSA ($p < 0.01$), and this finding was more obvious in dominant-side shoulders than in non-dominant shoulders. Inability to manage toileting with the dominant hand was significantly associated with lower rating of RSA and lower PROMs ($p = 0.001$). In multiple regression, limited internal rotation and lower SANE scores were the only independent predictors of less-than-perfect rating of RSA ($p = 0.02$).

Conclusions: Internal rotation limitation was prevalent following RSA affecting up to 60% of patients. It negatively affected patients' subjective rating of their RSA, and this was more obvious in dominant-side shoulders. It is important to consider and devise measures to minimize internal rotation limitation when performing RSA.

EP.06.121

THE SUBSCAPULARIS TAKE-DOWN AND RE-INSERTION (STAR) TECHNIQUE, IMAGE AND CLINICAL OUTCOMES

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Background: In shoulder arthroplasty different techniques for managing the subscapularis have been described (tenotomy, peeling, lesser tuberosity osteotomy, sparing) thereby the relationship with clinical and imaging outcome is debate, we proposed an anatomic technique for managing the subscapularis during shoulder arthroplasty and present the outcomes.

Methods: Retrospective study of consecutive patients who underwent hemiarthroplasty with Pyrocarbon head, managing the subscapularis with the STAR technique at a single institution (2014–2020). (1) The primary outcome was the fatty infiltration (Goutallier stage) of the superior and inferior part of the subscapularis evaluated with a CT scan at minimum 2 years-follow-up. (2)The secondary outcomes were complications rates and clinical outcomes in term of Constant Score, Subjective Shoulder Value and range of motion.

Results: Forty-two patients (47 shoulders) with a mean age of 57 years (range 34–73) at time of surgery were analyzed at a mean follow-up of 50 months (range 24–98). The etiologies included 77% (36) primitive osteoarthritis, 21% (10) instability arthropathy and 1% (2) humeral head osteonecrosis.

(1)Preoperatively, all the patients presented less than stage 2 fatty infiltration. Postoperatively, the superior subscapularis presented less than 2 fatty infiltration in 81% (38), postoperatively, the inferior subscapularis presented less than stage 2 fatty infiltration in 100% (47) of the cases. The mean fatty infiltration was less than stage 2 in 89% (41,5) of the patients. (2)There were 2 (4%) traumatic rupture of the subscapularis showing grande 3 and 2 fatty infiltration with pain and impaired function which were revised to RSA. There was a significant improvement for all the clinical outcomes ($P < 0.05$), the Subjective Shoulder Value postoperatively was 85 , and the Constant Score postoperatively was 78.

Conclusions: The start technique provides good imaging outcomes presenting in 89% of the patients less than stage 2 fatty infiltration in 2 years follow-up, had low grade of complications (2 traumatic rupture of the subscapularis, and good clinical outcomes.

EP.06.122

INTRASURGEON AND INTERSURGEON VARIABILITY IN PREOPERATIVE PLANNING FOR PRIMARY REVERSE SHOULDER ARTHROPLASTY USING AN AUTOMATED PROGRAM: A MULTICENTER EVALUATION

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Background: The identification of morphological changes in the shoulder joint is essential for planning and carrying out shoulder arthroplasty. In recent years, automated software has been developed that enables preoperative planning of shoulder arthroplasties. Despite such technologies, the planning of correction of glenoid deformities and implant positioning is still carried out subjectively, since the parameters associated with the best outcomes of arthroplasty are not yet consolidated. Therefore, this study aims to evaluate inter and intrasurgeon variability regarding the correction of version and inclination and use or not of bone graft in reverse shoulder arthroplasty (RSA) planning.

Methods: This is a multicenter cross-sectional study in which 2D CT DICOMs of 42 patients with osteoarthritis of the shoulder were used. The RSA was planned by 7 trained shoulder surgeons, independently, at two different time points with at least one month between both rounds of planning. The automated program, Tornier BlueprintTM was used. Variability within and between surgeons was calculated.

Results: There was a significant inter and intrasurgeon variation in version and inclination planning. Most cases were planned to achieve 0° of version (37%) and 0° of inclination (58%). Assymmetric graft was selected in 80% of cases, and in 9% no graft was used. The mean difference in version and inclination between both rounds of planning was 0,98° and 1,8°, respectively. In 44% of the cases, the version difference between rounds ranged from 1 to 5°. Interclass correlation coefficients for intersurgeon variability ranged from 0.72 for version, 0.26 for inclination, and 0.54 for graft. Pearson coefficients for intrasurgeon variability were 0.55 and 0.58 for version and inclination, respectively. Light's kappa coefficient for graft selection was 0.46.

Conclusions: This study demonstrated that there is an important variability regarding inclination planning between surgeons and a moderated inter and intrasurgeon variability in version planning. Planned inclination varied more than version, suggesting that surgeons have a narrower range of what they consider an acceptable residual version. The use of BIO-RSA-type bone graft varied widely inter- and intrasurgeons. This may suggest that there are different paths to achieve correction and optimize implant placement within a narrow range of values.

EP.06.123

IDEA OF 3D PRINTED MOLDS TO MAKE "IMPLANT-SPECIFIC" ANTIBIOTIC CEMENT SHOULDER SPACER FOR PERIPROSTHETIC JOINT INFECTION

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Background: Periprosthetic joint infection (PJI) is a devastating complication of shoulder arthroplasty. Two-stage revision arthroplasty is the most conservative approach for shoulder PJI, involving interval placement of an antibiotic cement spacer. Although a few companies offer prefabricated spacers or shoulder spacer molds to create cement spacers, it is only applicable in some countries. Making a cement spacer without molds is difficult, and size mismatches could occur frequently. Therefore, in this study, we made 3D-printed molds to produce an "implant-specific" cement spacer that replicates the exact shape of the infected arthroplasty implant.

Methods: The computer-aided design (CAD) software was used to construct the exact shape of the infected implant. In reverse shoulder arthroplasty, a 3D rendering of the mold was produced with an anatomic shoulder arthroplasty implant from the same company. It was fabricated by selective laser melting (SLM) of cobalt chrome alloy. Both halves of the mold were coated with mineral oil to facilitate the spacer extraction.

Results: Two cases of PJI after reverse shoulder arthroplasty were managed with the help of an "implant-specific" cement spacer. In each case, the cement spacer fitted perfectly after removal of the infected implant, and infection was controlled after 3 and 4 months, respectively. Revision surgery was performed after the infection was controlled.

Conclusions: The 3D printed molds provide accurate size and length of cement spacers for the treatment of shoulder PJI. It might improve surgical performance and help surgeons who cannot get commercially available molds. Therefore, 3D printing has the potential to be a useful tool in this challenging situation.

EP.06.124

FUNCTIONAL AND RADIOGRAPHIC OUTCOMES OF SUBSCAPULARIS DYSFUNCTION FOLLOWING ANATOMIC TOTAL SHOULDER ARTHROPLASTY

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Background: The subscapularis is an important rotator cuff muscle that must be managed during a total shoulder arthroplasty (TSA). Failure to heal the subscapularis after TSA can be devastating for some patients, often leading to pain, loss of function, and revision. The etiologies of subscapularis dysfunction are vast but include oversized components, multiple operations, and aggressive rehabilitation. The purpose of this study is to compare differences in patients with normal and dysfunctional subscapularis following TSA regarding 1) patient reported outcome measures (PROM); 2) range of motion (ROM) and strength; 3) minimal clinically important differences (MCID); and 4) functional internal rotation tasks.

Methods: A retrospective review of patients who underwent TSA with a minimum 2-year follow-up was performed. Patients were separated into two cohorts based on internal rotation strength: normal subscapularis and dysfunctional subscapularis. Patient PROM including Simple Shoulder Test (SST), American Shoulder and Elbow Surgeons (ASES), and Visual Analog Scale (VAS) pain and function were compared. ROM, strength, revision rates, and post operative radiographs were also obtained and compared. Institutional MCID values were used to evaluate improvement.

Results: Of the 668 patients included, 34 patients (5.1%) demonstrated evidence of subscapular dysfunction. These patients demonstrated worse postoperative SST, VAS Function, VAS Pain, and ASES scores than the normal subscapularis group. Abduction, elevation, internal rotation ROM, along with supraspinatus and external rotation strength were significantly decreased in the dysfunctional group. Similarly, these patients had decreased functional internal rotation with only 47% of the patients being able to reach the small of their back compared to 85% with normal subscapularis. Radiographically, the dysfunctional cohort demonstrated higher rates of anterior subluxation (56% vs 7%; $p < 0.001$) and glenoid loosening (24% vs 5%; $p = 0.004$). Despite the shortcomings, the dysfunctional cohort met many MCIDs, including the VAS Pain score and the ASES score with a 4.0 ± 3.7 and 46.4 ± 35.9 point improvement, respectively.

Conclusions: Patients who develop subscapularis dysfunction after TSA have significantly worse PROMs, ROM, functional tasks of internal rotation, and radiographic outcomes. Although patients show worse outcomes compared to their normal-functioning counterparts, these patients still meet MCID values, indicating a significant improvement in their preoperative symptoms.

EP.06.126

SHORT TERM RADIOGRAPHIC OUTCOME OF BONE VERSUS METALLIC AUGMENTED, CENTRAL SCREW TYPE BASEPLATE IN REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: Although glenoid bone grafting and metallic augmented baseplates have demonstrated success in restoring the glenohumeral joint line in the recent literature, there remain no consensus guidelines defining the use of one versus the other. The report the short term radiographic outcome of 2 contemporary central screw-in type baseplates: bony augmented and metallicly augmented.

Methods: Between 2017-2020, 15 primary RTSA with screw-in metallicly augmented glenoid baseplates were identified and were 2:1 matched by age, sex, and BMI with primary bony-augmented glenoid baseplate patients. All surgeries were performed by a single surgeon in a tertiary care center. Patients with previous glenoid implantation or fracture were excluded. All patients had preoperative routine radiographs (Grashey, Scapula Y, Axillary lateral) with 3D Computed Tomography (CT) scans, and underwent standard postoperative radiographic follow-up. Structural patient-specific metal or bony augmentation was indicated based on preoperative glenoid morphology (Walch & Favard Classifications) as identified by 3D CT. Aseptic failure was identified as hardware breakage and/or shift in glenoid baseplate component position. Patient demographics and comorbidities were also recorded.

Results: There were 45 eligible cases with a mean age of 65.7 years (range 44-85 years) for the metallic augmented RTSA group and mean age of 65.5 years (range 42-82 years) for the bone graft group. Respectively, the mean follow-up was 22.6 months (range 12-53 months), and 27.3 months (range 11-53 months). Overall, seven baseplate failures occurred at a mean of 27.2 months (range 5-52 months) postoperatively. Two (13.3%) occurred in the metallic augmented RTSA group, and five (16.7%) occurred in the bone graft group. The mean age of the bone failure group was 71.8 years (range 60-79 years).

Conclusions: Contemporary RSA glenoid baseplate designs appear to have low incidence of failure. However, glenoid wear and the structural correction via augmented baseplate appears to confer an increased incidence of failure. Further analysis is necessary to determine if a critical degree of glenoid retroversion or inclination is preferable with a specific form of augmentation.

EP.06.127

SHORT TERM CLINICAL AND RADIOGRAPHIC OUTCOMES WITH MODULAR LONG STEM FOR PRIMARY AND REVISION REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: When performing reverse total shoulder arthroplasty (RTSA) with compromised proximal bone fixation, surgeons have to consider using specialized stem with distal press-fit design. In this study, the report on the clinical and radiographic outcomes of patients who underwent surgical management with modular diaphyseal press-fit stems.

Methods: In 2017-2021, patients who underwent RTSA reconstruction with diaphyseal press-fit stems (Aequalis Adjustable or Aequalis Flex Revive, Stryker, Kalamazoo MI) with minimum 1-year follow-up were identified. Indications for surgery included primary RTSA, revision RTSA and proximal humerus fractures. Patients with complex scapula fractures and custom humeral replacement were excluded.

Demographics and clinical follow-up data including range of motion and Simple Shoulder Value (SSV) were retrospectively reviewed. Postoperative radiographs were reviewed for aseptic humeral loosening, prosthetic instability, stress shielding, periprosthetic fractures and hardware failure.

Results: Seventy patients (32 Adjustable and 38 Flex Revive) had mean follow-up of 24.5 months (SD \pm 15.4). Mean forward elevation improved from 60° preoperative (SD \pm 45) to 122° postoperatively (SD \pm 33). Mean external rotation improved from 8° (SD \pm 20) to 33° (SD \pm 16). Mean internal rotation improved from 11° (SD \pm 25) to 36° (SD \pm 26). Mean SSV improved from 38% (SD \pm 24%) to 73% (SD \pm 18%). There were no notable differences between groups.

There were 18 complications in 14 patients (44%) in the Adjustable group and 14 complications in 10 patients (26%) in the Flex Revive group. The most common complications were aseptic humeral loosening (Adjustable 25%; Flex Revive 5.3%) and prosthetic instability (Adjustable 9.4%; Flex Revive 7.9%). The surgical revision rates were 25% (n=8) and 13% (n=5) for Adjustable and Flex Revive, respectively.

Conclusions: Diaphyseal press-fit modular humeral stem can provide a viable surgical alternative in compromised proximal humeral bone. At short term follow-up, the clinical and radiographic outcome are comparable to other stem designs. Further studies may be necessary to identify risks of failure associated with modular diaphyseal press-fit stems.

EP.06.128

ANTEROSUPERIOR VERSUS DELTOPECTORAL APPROACH FOR PRIMARY REVERSE TOTAL SHOULDER ARTHROPLASTY: ANALYSIS OF 9606 SHOULDERS FROM THE DUTCH NATIONAL ARTHROPLASTY REGISTRY.

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Background: The current evidence comparing the two most common approaches for reverse shoulder arthroplasty (RSA), the deltopectoral and anterosuperior approach, is limited. Previous studies identified some advantages and disadvantages associated with the surgical approach, but report contradicting results. The angle of approach to the glenoid differs between the two approaches, while the positioning of the glenoid is associated with complications such as instability. This study aims to compare the rate of loosening, instability, and implant survival between the two approaches for RSA using data from the Dutch National Registry.

Methods: All patients in the registry who underwent a primary reverse total shoulder between 2014 and 2019 using an anterosuperior or deltopectoral approach were included with a minimum follow-up of two years. Cox and logistic regression models were used to assess the association between the approach and the implant survival, instability, and glenoid loosening, independent of confounders.

Results: In total, 9606 RSAs were included. In 62% a deltopectoral approach was used and in 48% an anterosuperior approach. The mean age was 74 and the most common indications were cuff arthropathy (31%), osteoarthritis (30%), post-traumatic sequelae (10%), and an irreparable cuff rupture (7%). Of the 9606 included RSAs, 406 (4%) were revised at a mean of 1.28 years after primary RSA, resulting in a 5-year survival of 95.4%. The most common reason for revision was a periprosthetic infection (35%), followed by instability (32%), and loosening (17%; glenoid component: 9%, humeral stem 6%, both: 1%). The deltopectoral approach was significantly associated with a higher rate of glenoid component loosening leading to a revision (odds ratio: 3.007, coefficient 1.101, 95% confidence interval: [0.321, 2.030], $p=0.0104$) when correcting for mass index, Walch classification, and centre volume. The implant survival and rate of instability did not differ between the two approaches when corrected for the seven most relevant confounders.

Conclusions: The approach did not influence the overall implant survival or instability rate. Our results suggest a higher rate of glenoid loosening in patients who underwent RSA using the deltopectoral approach. This is in contrast with previous studies and further research is required to unveil the mechanism behind this association.

EP.06.129

FUNCTIONAL AND RADIOGRAPHICAL OUTCOMES OF REVERSE SHOULDER ARTHROPLASTY WITH A MINIMUM FOLLOW-UP OF 10 YEARS

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Background: The use of reverse shoulder arthroplasty (RSA) is becoming increasingly more prevalent. However, few studies have been published reporting the long-term outcomes of RSA. This study aims to report the clinical, radiographic, and patient-reported outcomes of the Delta Xtend reverse shoulder prosthesis, performed by a single surgeon and with a minimum follow-up of 10 years.

Methods: All RSA procedures performed between 2005 and 2012 were identified. Patients were contacted and invited for a follow-up visit including clinical assessment, radiographs, and patient-reported outcome measure (PROM) questionnaires. Patients with a follow-up of less than 10 years were excluded. A Kaplan-Meier survival analysis was performed for the revision-free implant survival.

Results: Between 2005 and 2012, 120 patients meeting inclusion criteria were identified. Of these patients, 35 were deceased before reaching the 10-year follow-up and 23 could not be reached. In total, 62 RSAs could be included in 60 patients (70%). Of these patients, 7 patients underwent a revision after a median of 3 years (interquartile range; IQR: 0.2-9.8). The implant survival was 93% (95% confidence interval: 84-98). At final follow-up, the median anterior elevation was 135° (IQR: 130°-160°), the median abduction was 120° (IQR: 100°-135°), and the median level reached with internal rotation was L5 (IQR: sacrum-L5). The median Auto-Constant score was 67 (IQR: 53-76), the median Subjective Shoulder Value was 80 (IQR: 70-90), and the median pain score was 0.2/10 (IQR: 0-2). In total, radiographs could be obtained in 25 patients (40%). Scapular notching occurred in 13 patients (52%), ossification in 11 patients (44%), and stress shielding in 5 patients (20%). Radiolucencies around the humerus occurred in all patients, and 12 humeral components (48%) were considered at risk of loosening due to the grade or amount of radiolucency. Radiolucencies around the glenoid component occurred in 14 patients (56%).

Conclusions: The long-term results of RSA with a Delta Xtend prosthesis are positive, with sustained improvement in range of motion and PROM results, and a satisfactory implant survival rate. The radiographical analysis showed high prevalence of signs associated with loosening and several revisions occurred after 10 years, warranting a frequent long-term clinical follow-up after RSA.

EP.06.130

LONG-TERM RESULTS OF ROTATOR CUFF RECONSTRUCTION AND HHR USING SMALLER HUMERAL PROSTHESES UNDER 70 YEARS OLD WITH CUFF TEAR ARTHROPATHY.- MINIMUM 10 YEARS-

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Background: Most studies of reverse shoulder arthroplasty (RSA) have shown good improvement in arm elevation without improvements in external rotation (ER). However, high rates of complications after long-term RSA have been reported, suggesting that RSA should be limited to elderly patients, especially those who are older than 70 years old by Boileau et al. Since 2001, we have developed a new strategy of rotator cuff reconstruction with muscle transfer and humeral head replacement (HHR) using smaller humeral prostheses for cuff tear arthropathy. The aim of the present study was to investigate clinical outcome of our strategy average more than 10 years postoperatively in patients under 70 years of age with cuff tear arthropathy. Furthermore, the clinical outcomes were compared with the short-term (average 22.4 months postoperatively).

Methods: 28 shoulders (27 patients) under 70 years old with cuff tears arthropathy, were treated with HHR and cuff reconstruction before December 2011. We investigated 19 shoulders, exclude the shoulders that 1 patient was dead, 1 patient has not been able to come to our hospital for medical condition, 7 patients were lost to follow-up less than 8 years. The average age and follow-up period were 63.9 years (55-70) and 121.3 months (96-146). Clinical outcomes were assessed with the ROM, JOA score, complications and glenoid wear on postoperative radiographs.

Results: Shoulder pain was diminished in all patients after surgery. The preoperative JOA score were 45.2 and 83.9/80.2 (short-term/ last follow-up) respectively after surgery. Active forward flexion has improved from an average of 88.9° to 155/143.4° (short-term/last follow-up), and the ER improved from an average of 17.6 to 39.5/30.5° (short-term/ last follow-up). No complications occurred after surgery. The types of glenoid wear included 2 type 0, 2 type I, 7 type II, and 4 / 3 type IIIB / C that occurred glenoid deformity.

Conclusions: Anatomical reconstruction using smaller head humeral prostheses yielded favorable results and less complication, compared with RSA. Considering another advantage of ability to retain glenoid bone stock even if average 10 years have passed, the current procedure can be a useful option for cuff tear arthropathy under 70 years old.

EP.06.132

NAVIGATION IN REVERSE SHOULDER ARTHROPLASTY: HOW THE LATERALIZATION OF GLENOSPHERE CAN AFFECT THE CLINICAL OUTCOME

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Background: One of the main causes of RSA failure is attributable to the malpositioning of the glenoid component. Initial experiences with computer-assisted surgery have shown promising results in increasing the accuracy and repeatability of the placement of the glenoid component and screws. The aim of this study was to evaluate the functional clinical results, in terms of joint mobility and pain, by correlating them with intraoperative data regarding the positioning of the glenoid component. The hypothesis was that the lateralization more than 25mm of the glenosphere can led to better stability of the prosthesis but should pay in term of a reduced range of movement and increased pain.

Methods: 50 patients were enrolled between October 2018 and May 2022; they underwent RSA implantation assisted by GPS navigation system. Active ROM, ASES score and VAS pain scale were recorded before surgery. Preoperative data about glenoid inclination and version were collected by pre-op X-Rays an CT. Intraoperative data - inclination, version, medialization and lateralization of the glenoid component- were recorded using computer-assisted surgery. - 46 patients had been further clinically and radiographically re-evaluated at 3-month, 6-month, 1- year, and annually follow-up.

Results: We found a statistically significant correlation between anteversion and glenosphere lateralization value (DM -6.057° ; $p=0.043$). Furthermore a statistically significant correlation has been shown between abduction movement and the lateralization value (DM -7.723° ; $p= 0.015$). No other statistically significant associations were found when comparing the values of glenoid inclination and version with the range of motion achieved by the patients after reverse shoulder arthroplasty.

Conclusions: We observed that the patients with the best anteversion and abduction results had a glenosphere lateralization between 18mm and 22mm. When increasing the lateralization above 22mm or reducing it below 18mm, on the other hand, both movements considered decreased their range.

EP.06.133

REVERSE SHOULDER ARTHROPLASTY WITH PECTORALIS MAJOR TRANSFER IN PATIENTS WITH ANTEROSUPERIOR THREE TENDON TEARS OF ROTATOR CUFF

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Background: In reverse total shoulder arthroplasty (RSA), the optimal management for irreparable subscapularis (SSC) tear is controversial. The objective of this study is to evaluate clinical outcomes of addition of pectoralis major (PM) transfer to RSA for three-tendon tears.

Methods: Total 45 patients who underwent RSA to cuff tear arthropathy or revision arthroplasty with a minimum follow-up of 2 years were collected retrospectively. The average age was 78.7 years. Patients who underwent transfer to the greater tuberosity of the humerus with SSC were 27 cases (group S), and transfer with PM due to irreparable SSC tear were 18 cases (group PM). Pre and postoperative clinical outcomes were compared between both groups with using Japanese Orthopedic Association (JOA) score, range of motion (ROM). Radiological outcomes such as scapular notch and loosening and complications were also evaluated.

The Mann-Whitney U test was used to compare preoperative and postoperative parameters regarding clinical and functional outcomes. The level of significance was set at $P < 0.05$.

Results: No significant differences were found between both groups in the age, preoperative flexion ($S55.8^\circ$, $PL55.3^\circ$), internal rotation (IR), and JOA score ($S47.1$, $PL45.7$). Group PL significantly had better preoperative external rotation (ER) ($S16.4^\circ$, $PL28.1^\circ$, $P < 0.01$) than group S. Postoperatively ROM and JOA score of group PM were almost same compared with group S (flexion ($S128.8^\circ$, $PM133.1^\circ$), ER ($S24.4^\circ$, $PM21.7^\circ$), JOA score ($S81.5$, $PM79.8$)). Scapular notch was found two cases in group S and one case in group PM. Postoperatively one surgical site infection was found in group S and one ulnar nerve palsy in group PM.

Conclusions: It is necessary to compare clinical outcomes after RSA with or without PM transfer in patients with anterosuperior three tendons tear. However, this study showed that PM transfer for irreparable SSC in RSA could have similar postoperative results as SSC transfer. PM transfer, which reduces the load to deltoid muscle and improves the function of teres minor by being lifted upwards and covers the defect of torn cuff, has possibility of reduction of postoperative complication, such as dislocation, hematoma, and deltoid muscle insufficiency. PM transfer can improve clinical results and reduce postoperative complications.

EP.06.134

EVALUATION OF ACCURACY AND INTEROBSERVER VARIABILITY IN MEASURING THE REVERSE SHOULDER ANGLE IN THE PREOPERATIVE PLANNING OF REVERSE TOTAL SHOULDER ARTHROPLASTIES

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Background: Reverse shoulder arthroplasty is gaining popularity owing to its proven longevity and good outcome scores. Due to the numerous models of RTSA metallic bases available, most of them metallic circular glenoid bases, the combination of knowledge of the characteristics of these implants associated with an adequate assessment of the anatomy of the glenoid is essential for the correct implantation of the prosthetic components. Differences in implant positioning between anatomical and reverse shoulder arthroplasties led to the perception that the assessment of glenoid inclination by the method that measures global glenoid inclination (Beta angle) was inadequate. Recently the reverse shoulder angle (RSA) has been proposed to measure the inclination of the inferior portion of the glenoid. Thus, the objective of this study was to evaluate the inter-observer agreement of the RSA measurement and its relationship with the Beta angle, using two-dimensional (2D) computed tomography (CT) images.β

Methods: This is a cross-sectional study in which 2D CT images of 38 patients with rotator cuff arthropathy or osteoarthritis. Manual measurements were performed on coronal sections, by 5 independent qualified shoulder surgeons, using Radiant® Dicom Viewer software. The Maurer method was used to assess the glenoid inclination and the Boileau method to measure the RSA. The glenoid tilt was also measured using the automated Blueprint® software.

Results: The mean RSA was 24.7 ± 7.1 , which was significantly superior to both manual (11.12 ± 5.4) and automated (11.18 ± 9.0) glenoid inclination measurements ($p < 0.0001$). Interclass correlation coefficient was 0.72 for RSA and 0.88 for manual global inclination. The mean RSA was on average 14.6 ± 6.3 greater than the glenoid inclination, regardless of the methodology used (manual or automated), diagnosis (rotator cuff arthropathy or osteoarthritis), and glenoid version angle ($\pm 10^\circ$ or $> \pm 10^\circ$).

Conclusions: There is a high interobserver agreement for RSA and glenoid inclination measurement through manual methods. RSA was significantly different from the Beta angle, indicating that the measurement of glenoid inclination for reverse or anatomical arthroplasty cannot be performed using the same methodology and must consider the differences inherent to the specificities of each angle discussed.

EP.06.136

INFLUENCE OF DIABETES MELLITUS ON OUTCOMES AFTER SHOULDER ARTHROPLASTY

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Background: The prevalence of type 2 diabetes mellitus (DM) in the United States is approximately 11% and increasing. Following joint replacement, diabetic patients have close to a threefold increase in risk for postoperative complications. However, there is a relative paucity of studies examining this association for total shoulder arthroplasty (TSA). This present study aimed to address this gap in knowledge by determining the differences in outcomes after TSA in patients with and without DM. Additionally, this study also aimed to determine whether a dose-response relationship exists between Hemoglobin A1c (HbA1c) and adverse or suboptimal outcomes after TSA.

Methods: A total of 812 patients who underwent primary TSA (anatomic or reverse) between 2014 and 2019 were identified by querying the electronic medical record system at our institution. Patients with less than 1-year postoperative follow-up or incomplete outcomes data were excluded. Medical charts were reviewed to identify patients with a preoperative diagnosis of DM and to record the most recent HbA1c measurement prior to the date of surgery for all patients. Primary outcome measures were shoulder range of motion (ROM) and visual analog scale (VAS) pain scores. Secondary outcomes were emergency department (ED) and hospital readmission rates and peri- and postoperative complications.

Results: A total of 595 patients were included in this study with 151 (25%) having a preoperative diagnosis of DM. Both the DM and non-DM groups experienced significant improvements in ROM and VAS score following surgery ($p < 0.05$) and were not significantly different between the two groups. Our analysis also indicated that diabetics have no significant differences in length of stay, postoperative complications, infection rates, hospital readmissions, and all-case ED visitations, when compared to non-diabetic patients. Lastly, HbA1c did not significantly correlate with peri- or postoperative complications, improvement in VAS score or ROM, or readmission rates.

Conclusions: Patients with DM benefited significantly from shoulder arthroplasty and achieved satisfactory pain relief and improvement in shoulder mobility. Furthermore, HbA1c does not seem correlate with increased risk of post-operative complications. Longer term follow up is needed.

EP.06.137

QUANTIFYING SUCCESS AFTER REVISION REVERSE TOTAL SHOULDER ARTHROPLASTY: THE MINIMAL CLINICALLY IMPORTANT DIFFERENCE, SUBSTANTIAL CLINICAL BENEFIT, AND PATIENT ACCEPTABLE SYMPTOMATIC STATE

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Background: When patients require revision of primary shoulder arthroplasty, revision reverse total shoulder arthroplasty (RTSA) is most commonly performed. However, defining clinically-important improvement in these patients is challenging because benchmarks have not been previously defined. Our purpose was to define the minimal clinically important difference (MCID), substantial clinical benefit (SCB) and patient acceptable symptomatic state (PASS) for outcome scores and range of motion (ROM) after revision RTSA and to quantify the proportion of patients achieving clinically-relevant success.

Methods: This retrospective cohort study used a prospectively-collected single-institution database of patients undergoing revision RTSA between August 2015 and December 2019. Patients with a diagnosis of infection were excluded. Outcomes scores included the ASES, Constant, SPADI, SST, and UCLA scores. ROM measures reported in degrees included abduction, forward elevation (FE), external rotation (ER), and internal rotation (IR). An anchor-based method comparing patients describing their treatment as "better" compared to "worse" or "unchanged" and a distribution method defined as 0.5 standard deviation were used to calculate the MCID, SCB, and PASS. The proportions of patients achieving each threshold were assessed.

Results: 108 revision RTSAs with minimum 2-year follow-up were evaluated. Mean age was 67 years, 59% were female, and average follow-up was 55 months. Revision RTSA was performed most commonly for failed anatomic TSA (n=53), followed by hemiarthroplasty (n=26), RTSA (n=18), and resurfacing (n=11). The indication for revision RTSA was most commonly glenoid loosening or rotator cuff failure (n=25 for both), followed by instability (n=21) and unexplained pain (n=11). The anchor-based MCID values (% of patients achieving) were: ASES=18.0(56%), Constant=9.3(68%), UCLA=9.4(57%), SST=1.1(63%), SPADI=-16.3(56%), abduction=11.8(72%), FE=10.9(79%), ER=3.1(56%), and IR=1.0(30%). The distribution-based MCID values (% of patients achieving) were: ASES=12.5(60%), Constant=8.5(70%), UCLA=4.1(75%), SST=1.8(63%), SPADI=13.2(92%), abduction=16.9(66%), FE=18.1(73%), ER=11.6(35%), and IR=1.0(37%). The SCB values (% of patients achieving) were: ASES=33.3(36%), Constant=22.3(34%), UCLA=13.7(33%), SST=4.2(39%), SPADI=-33.8(35%), abduction=21.3(62%), FE=26.2(66%), ER=13.6(30%), and IR=1.3(30%). The PASS values (% of patients achieving) were: ASES=62.5(56%), Constant=48.8(62%), UCLA=24.7(56%), SST=6.8(61%), SPADI=43.0(62%), abduction=94.2(60%), FE=106.6(62%), ER=20.3(68%), and IR=3.2(57%).

Conclusions: This study established thresholds for the MCID, SCB, and PASS at minimum 2-years after revision RTSA, providing physicians an evidence-based method to counsel patients and assess outcomes postoperatively.

EP.06.138

COMPARISON OF CLINICAL OUTCOMES OF REVISION REVERSE TOTAL SHOULDER ARTHROPLASTY FOR FAILED PRIMARY ANATOMIC VERSUS REVERSE SHOULDER ARTHROPLASTY

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Background: Both anatomic and reverse total shoulder arthroplasty (aTSA and RTSA) are being increasingly performed. In the revision setting, RTSA is more commonly performed in both scenarios. The purpose of this study was to compare clinical outcomes between patients undergoing revision RTSA for failed primary ATSA versus RTSA.

Methods: We performed a retrospective review of a prospective single-institution shoulder arthroplasty database. All revision RTSAs between 2007 and 2019 with minimum two-year clinical follow-up were initially included. After excluding patients with a preoperative diagnosis of infection, an oncologic indication, or incomplete outcomes assessment, we included 45 revision RTSAs performed for failed primary aTSA and 15 for failed primary RTSA. Demographics, surgical characteristics, active range of motion (external rotation [ER], internal rotation [IR], forward elevation [FE], abduction), outcome scores (ASES score, Constant score, SPADI, SST, and UCLA score), and the incidence of postoperative complications was compared between groups.

Results: Primary aTSA was most often indicated for degenerative joint disease (DJD) (82%), whereas primary RTSA was more often indicated for rotator cuff arthropathy (60%). On bivariate analysis, no statistically significant differences in any range of motion or clinical outcome measure were found between revision RTSA performed for failed aTSA vs. RTSA. On multivariate analysis, revision RTSA performed for failed aTSA vs. RTSA was not found to significantly influence any outcome measure. Humeral loosening as an indication for revision surgery was associated with more favorable outcomes for all range of motion measures and all outcome scores assessed. In contrast, an indication for revision of peri-prosthetic fracture was associated with poorer outcomes for three of four range of motion measures (ER, FE, abduction) and four of five outcome scores (Constant, SPADI, SST, UCLA). Complication and re-revision rates after revision RTSA for failed primary aTSA and RTSA were 31% and 11% vs. 20% and 0% ($P = .520$ and $P = .318$), respectively.

Conclusions: Clinical outcomes of patients undergoing revision RTSA did not significantly differ based on whether aTSA or RTSA was initially performed. However, larger studies are needed to definitively ascertain the influence of the primary construct on outcomes of revision RTSA.

EP.06.139

DOES HEALTHCARE SETTING INFLUENCE OUTCOMES FOLLOWING SHOULDER ARTHROPLASTY?

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Background: In Australia nearly two-thirds of arthroplasty procedures are performed in the private setting, which is disproportionate to the dimensioning 43.5% of the population with private health cover. The rapid growth of shoulder arthroplasty surgery will be absorbed by both private and public sectors. This study aimed to assess the influence of healthcare setting on elective shoulder arthroplasty outcomes, defined by revision rate, and functional measures.

Methods: Data was collected on all primary procedures performed from 2004 - 2019 within a regional area of Victoria, Australia. Patients were categorised into private or public settings. Trauma cases for acute proximal humerus fractures were excluded. The primary outcome of revision surgery was recorded as a cumulative percentage, and survival analysis conducted to calculate a hazard ratio (HR). Functional outcomes were measured through range-of-motion (ROM) and multiple validated patient-reported-outcome-measures (PROMs).

Results: 458 patients were identified in the study; 290 private and 168 public. There was no difference in the revision rate (3.8% private, 4.8% public), with an adjusted HR of 1.25 ($p=0.66$) for public compared to private. Baseline and post-operative functional measures were significantly greater in the private setting for ROMs and PROMs analysis, in particular post-operative QuickDASH (15.9 ± 14.7 to 32.7 ± 23.5 ; $p < 0.001$) and Oxford Shoulder Score (42.6 ± 6.3 to 35.7 ± 11.2 ; $p < 0.001$). However, there was no significant difference for any of the functional measures in the amount of change from baseline to 12-months between settings.

Conclusions: Although healthcare setting does not appear to influence revision rate for shoulder arthroplasty, clear differences were demonstrated for functional measures both pre and post operatively. This may be attributed to factors such as access to perioperative rehabilitation, and should be an area to target future investigations.

EP.06.140

INTRAOPERATIVE NAVIGATION OF THE GLENOID BASEPLATE POSITIONING IN REVERSE TOTAL SHOULDER ARTHROPLASTY VERSUS STANDARD INSTRUMENTATION: A RADIOLOGICAL CASE-CONTROL STUDY

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Background: There are 2 options for enhancing the quality of glenoid positioning: 1) computer assisted navigation, and 2) patient specific instrumentation. The working hypothesis was that navigation enhance the accuracy of implant placement. The primary objective of the study was to determine whether ct-scan based surgical navigation improved the glenoid base plate positioning and fixation.

Methods: A consecutive series of cases undergoing NAV (N=20) was compared with a series of RSA (controls) implanted with a conventional instrumentation technique (CONV) (N=20).

All patients underwent a preoperative CT-scan. The optimal position of the glenoid baseplate was selected with the objective was to have a glenoid implant version at 0° of retroversion and 10° of inferior tilt. For the NAV group, the software allowed to navigate the correct point for insertion of the guide pin, as well as the correct angle of glenoid reaming, and screws insertion. An optoelectronic camera was positioned at a location that enables tracking of both the flat detector 3D C-arm. The 3D scan images were transferred to the navigation system for further processing and navigation using a navigated drill guide let the optimal insertion point and drilling direction of the guide pin as pre-operatively planned.

Results: The mean version of the glenoid component in the standard instrumentation group was 8.3° of anteversion, compared with 3.1° of anteversion in the navigated group. The mean tilt of the glenoid component was 6.9° in the standard group and 5.4° of inferior tilt in the navigated group. Using navigation, the range of error for version was 8° (SD 3.7°) compared to 12° (SD 6.1°) in controls. For tilt, the range of error was 8° (SD 3.4°) in navigated specimens and 16° (SD 6.0°) for controls. In the control group,

There was no perforation of the central peg in both groups. 1 inferior screw was malpositioned in the conventional group.

Conclusions: Our study shows that the use of computer navigation can improve the accuracy of placement of the glenoid component in RSA. The version and the inferior tilt of the glenoid component were more accurate in the NAV group compared to the CONV group.

EP.06.141

CLINICAL OUTCOMES OF THE PYROTITAN™ HUMERAL RESURFACING ARTHROPLASTY IN PATIENTS UNDER 50 YEARS OF AGE

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Background: Young patients represent an important subset of the population with glenohumeral arthritis. Arthroplasty in this cohort requires durability and good functional performance. Pyrocarbon humeral resurfacing, thanks to its biomechanical properties, may provide a solution to their specific requirements.

Methods: Since June 2010, 514 patients with PyroTITAN™ humeral resurfacing implants have been followed at five sites as part of three prospective trials. Of these patients, 25% were aged under 50 at the time of surgery, the median age of this cohort being 43 years (19 – 49 years). Whilst less HRA patients were female (3F:7M), males were over represented in the younger cohort, accounting for 85% of the patients under 50 years. Primary diagnosis was osteoarthritis in 69% and post-traumatic arthritis in 11% participants. Approximately half of the patients (256) had surgery performed on their dominant side shoulder. Patient reported outcomes of pain and function, in addition to range of motion, are reported as mean ± standard deviation at pre-operative and 5-year post-op timepoints.

Results: Average pain and functional outcome scores were comparable between the two age cohorts at 2- and 5-years post-op, with the exception of 2-year WOOS score which was better in the older group. Range of motion consistently increased between pre-operative and 5-year post-operative assessment: active forward flexion (106° to 145°); abduction (97° to 144°); cross adduction (24° to 48°); external rotation (33° to 60°); external rotation in 90° abduction (47° to 79°). Of 21 joints revised, 7 were in participants under 50 and 14 in patients older than 50 years. Median time to revision for participants under 50 was 19 months post index surgery (3 – 61 months), with the causes of revision for participants under 50 being implant fracture (5) and new or increased pain (2).

Conclusions: Pyrocarbon humeral resurfacing provides an alternative to traditional total shoulder replacement and metal humeral resurfacing arthroplasty for patients under 50 years of age.

EP.06.142

EFFECT OF STEROID INJECTIONS ON OUTCOMES FOLLOWING SHOULDER ARTHROPLASTY

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Background: Steroid injections are well-known short-term treatments for glenohumeral osteoarthritis; however, many patients eventually require more definitive management with surgical treatment. Recent literature has called into question the utility and safety of steroid injections prior to shoulder surgery regarding their effect on infections and revision rates. Conclusive data regarding the relationship of preoperative injection and postoperative outcomes is lacking. The purpose of this study is to determine the effect of ipsilateral preoperative injections on clinical outcomes following shoulder arthroplasty (SA).

Methods: A retrospective study was performed on 563 patients who underwent SA by a single fellowship-trained orthopedic surgeon from 2017-2020. Patients were divided into two groups: 240 who received a preoperative injection (IG) and 323 were the control group (CG). Patient reported pain and satisfaction, simple shoulder test (SST), shoulder pain and disability index (SPADI), complications, reoperations, and range of motion (ROM) were compared between groups. Change (delta) in clinical and functional outcomes were calculated from the pre- to postoperative period and compared.

Results: The cohort was comprised of 55% females with an average age of 71.1, BMI of 29.6, and mean follow-up of 21.5 months. The IG group had a significantly greater proportion of females (64%; $p < 0.01$) and older age of 72.9 ($p < 0.01$). The number of comorbidities between groups was comparable. There was a significantly greater postoperative improvement in range of motion with forward elevation (70 vs. 80, $p = 0.025$) and abduction (60 vs. 70, $p = 0.030$) in patients who did not have a corticosteroid injection within the past year. Patients in the IG group had significantly greater delta in reported outcomes on the SST (+6.25 vs. +5.37, $p = 0.005$). Patient satisfaction, complication rates ($p = 0.98$) and reoperation rates ($p = 0.98$) were comparable between groups.

Conclusions: Ipsilateral shoulder injections lead to inferior functional outcomes, specifically abduction and forward elevation, with superior patient reported outcomes and no concurrent increase in complications. Surgeons can consider maintaining injections as a viable first line management option for SA candidates without concern for inferior postoperative outcomes.

EP.06.143

WHAT THRESHOLD OF RANGE OF MOTION IS ASSOCIATED WITH MINIMAL GAIN IN PATIENT-REPORTED OUTCOME SCORES AFTER TOTAL SHOULDER ARTHROPLASTY?

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Background: There may exist a minimum amount of range of motion (ROM) necessary to perform functional tasks after total shoulder arthroplasty (TSA), beyond which further ROM may provide no further benefit to patient-reported outcome measures (PROMs) or patient satisfaction. We aimed to identify whether there is a threshold of postoperative ROM after TSA after which there is minimal gain in PROMs at minimum 2-year follow-up.

Methods: A retrospective review of a multicenter international shoulder arthroplasty database was performed between 2001-2021 for patients undergoing aTSA or rTSA for primary OA with an intact rotator cuff with minimum 2-year follow-up. Shoulders were excluded for nerve injury or periprosthetic fracture. In total, 1,828 aTSAs and 623 rTSAs were included. Our primary outcome was to determine whether a threshold existed whereby an improvement in postoperative active ROM in abduction, FE, IR, and ER was associated with no additional significant improvement in outcome scores (SST, ASES, and SPADI). For each PROM and ROM pair, continuous two-segment linear regression models were fitted.

Results: For each ROM measure, the highest threshold value corresponding to minimal additional improvement in postoperative PROMs was 100° for abduction, 130° for forward elevation, 47° for ER, and L3 vertebral level for IR. Change in postoperative PROMs with increased postoperative ROM was significantly better before identified threshold values compared to after (early vs. late slope) for all ROM-PROM pairings. Improvement in postoperative PROMs with increased postoperative ROM beyond these identified thresholds was not statistically significant for all ROM-PROM pairings.

Conclusions: Our findings demonstrate threshold values for active abduction, forward elevation, and external rotation after which improvement in PROMs is minimal. Interestingly, improvement in PROMs with greater IR score did not significantly differ before versus after the identified threshold, suggesting that continued IR improvement correlates with improved PROMs and patient satisfaction even at high levels of IR. These results can help surgeons prioritize intraoperative decision-making and physical therapists tailor postoperative rehabilitation regimens to maximize satisfaction and quality of life.

EP.06.144

THE COMPARISON OF RADIOGRAPHIC PARAMETERS AND FUNCTIONAL OUTCOMES IN GLENOID OR HUMERUS LATERALIZATION OF REVERSE SHOULDER ARTHROPLASTY --- EXPERIENCES IN TAIWAN

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Background: Lateralized designs have recently gained popularity. The amount of distalization and lateralization, however, remains a controversial topic. Whether the lateralization in glenoid side or humerus side is still under debate. The purpose of this study was to correlate the change in radiographic parameters, including distalization and lateralization, with outcomes and complications following RSA, and compare the difference in glenoid or humerus lateralization. We hypothesized that a lateralized lateralization following RSA would be associated with improved range of motion, better patient reported outcome measures (PROMs), and fewer complications.

Methods: From 2019 to 2021, a consecutive series of 90 patients (90 shoulders) who underwent primary RSA (Comprehensive Reverse Shoulder System, Zimmer Biomet) was retrospectively evaluated. Less than 6-month follow-up or anterior locked dislocation was excluded. The patients were divided into glenoid lateralization (glenosphere), humerus lateralization (humeral tray or bearing) or standard (no further lateralization) groups according to the operation record. All patients had the distalization (AHD, DSA) and lateralization (LSA, humeral offset, center of rotation) measured on a preoperative and a postoperative radiograph. ROM (FE, ER, IR), functional outcomes (SSV, ASES) and VAS were collected. Complications and revisions were also reported.

Results: The mean age was 72 years with a mean follow-up of 9.2 months. The center of rotation was more lateralized in glenoid lateralization groups (11.6 v.s 8.6 v.s 8.6 mm, $p < 0.001$). The AHD (34.4 v.s 31.6 v.s 28.7 mm), DSA (45.9 v.s 41.6 v.s 41.3 deg), LSA (95.0 v.s 94.7 v.s 96.2 deg) and humeral offset (29.0 v.s 27.2 v.s 29.2 mm) all showed significant difference after RSA, but showed no significant difference between inter-groups groups. The ROM, functional outcomes and VAS showed significant improvement after RSA but no inter-groups difference.

Conclusions: The Comprehensive Reverse Shoulder System of Zimmer Biomet is a lateralized design. In spite of the more lateralized center of rotation in glenoid lateralization group, the other radiographic parameters, ROM and functional outcomes were similar in these three groups. Either glenoid, humerus lateralization or standard groups, all showed improved functional outcomes after RSA.

EP.06.145

DIFFERENTIATION OF CLINICAL OUTCOMES BEFORE AND AFTER SHOULDER ARTHROPLASTY FOR ROTATOR CUFF INTACT OSTEOARTHRITIS USING THE WALCH CLASSIFICATION

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Background: The Walch classification is commonly utilized by surgeons when determining the treatment of osteoarthritis(OA). We assessed the prognostic value of the Walch classification on pre- and post-operative clinical states in total shoulder arthroplasty(TSA).

Methods: A prospectively-collected, multi-center database for a single-platform TSA system was queried for patients with rotator cuff-intact OA and minimum 2 year follow-up. Differences in active range of motion (ROM; abduction, forward elevation[FE], external/internal-rotation[ER and IR]), objective and patient-reported outcome scores (PROs; SST, Constant, ASES, UCLA, SPADI, VAS pain, Shoulder Function, and Shoulder Arthroplasty Smart[SAS] scores) were stratified by glenoid deformity according to the Walch classification. Outcomes were evaluated with one-way ANOVA and post-hoc Tukey correction for multiple comparisons.

Results: 979 TSAs were analyzed. The Walch classification was: A1=416 (aTSA=276, rTSA=140), A2=151 (aTSA=57, rTSA=94), B1=86 (aTSA=48, rTSA=38), B2=255 (aTSA=156, rTSA=99), B3=71 (aTSA=28, rTSA=43). Preoperatively for aTSA, outcomes that differed between groups were abduction($P=0.025$), FE($P=0.006$), ER($P<0.001$), and SAS score($P=0.032$); there were no significant differences in the rTSA cohort ($P>0.05$). Postoperatively for aTSA, the Constant($P=0.023$) and SAS scores($P=0.047$) differed based on Walch classification; however no differences persisted on post-hoc testing. Postoperatively for rTSA, only the VAS score differed based on Walch classification ($P=0.007$); on post-hoc testing, A2 glenoids had significantly less pain than A1 glenoids (0.6 ± 1.3 vs. 1.4 ± 2.1 , $P=0.017$). For aTSA, improvement differed for abduction($P=0.005$; B3>A1 [$67\pm 30^\circ$ vs. $46\pm 38^\circ$, $P=0.037$]), FE($P=0.002$; B2>A1 and B3>A1 [$46\pm 32^\circ$ and $55\pm 29^\circ$ vs. $35\pm 34^\circ$, $P=0.037$ and $P=0.036$]), ER($P=0.001$; A2>A1 and B3>A1 [$35\pm 22^\circ$ and $37\pm 25^\circ$ vs. $22\pm 22^\circ$, $P=0.006$ and $P=0.013$, respectively]), Constant($P=0.012$; B3>A1 [37.0 ± 15.2 vs. 23.2 ± 18.9 , $P=0.025$]), UCLA($P=0.030$; no post-hoc differences), and SAS scores($P=0.001$; B3>A1 [39.2 ± 8.8 vs. 28.5 ± 13.9 , $P=0.031$]). For rTSA, no differences in improvement for any outcomes were found.

Conclusions: We demonstrate a modest association between preoperative glenoid morphology and clinical state when evaluating patients undergoing aTSA for cuff-intact OA, with greater erosion and retroversion being associated with poorer preoperative state. However, these patients also demonstrated greater improvement after aTSA and achieve a similar clinical state postoperatively. The clinical outcome of patients undergoing rTSA is not associated with the Walch classification. Alternative glenoid classification systems or predictive models should be considered to provide more precise prognoses for patients undergoing TSA for rotator cuff-intact OA.

EP.06.146

A MULTICENTER STUDY OF 3620 PRIMARY REVERSE ARTHROPLASTIES COMPARING INLAY TO ONLAY DESIGNS FOR POST-OPERATIVE ACROMIAL AND SCAPULAR FRACTURES

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Background: There remains considerable debate concerning the incidence and risk factors for acromial and scapular fractures following reverse arthroplasty. There have been a number of small to mid-size series noting rates that range from 2% to over 13%. Moreover, there is conflicting information concerning risk factors including whether inlay or onlay presents a higher risk of post-operative fracture. Therefore, the purpose of this study was to perform a large multi-center study to investigate the incidence, timing, and risk factors for post-operative acromial and scapular fractures.

Methods: Over a 16-year period (2004 – 2020), all primary RSA performed at two tertiary referral centers for elective and traumatic indications were identified. Medical records were reviewed to identify all shoulders that sustained a postoperative fracture of the scapular spine or acromion. Univariate and multivariate-adjusted logistic regression analyses were used to determine whether any of the following were significant risk factors for fracture: age, gender, BMI, diagnosis, prior acromioplasty, prior rotator cuff repair, and implant type.

Results: There was a total of 3620 RSAs of which there were 942 inlay and 2678 onlay designs. There were 1532 males and 2028 females with a mean BMI of 30.8. There were 64 acromial and 5 scapular spine fractures, resulting in an overall prevalence rate of 1.91%. Among the inlay designs, the acromial and scapular spine fracture rate was 2.02% (19/942). The rate among the onlay designs was 1.87 % (50/2678).

Conclusions: Postoperative stress fractures of the acromion or spine of the scapula complicated the course of 1.9% of all primary RSAs included in this study. The majority of the fractures involve the acromion, with much less frequent involvement of the spine of the scapula. The data from this study suggest that the rate of post-operative acromial and scapular spine fracture rates comparing inlay to onlay designs are not significantly different.

EP.06.147

DOES ACHIEVING CLINICALLY IMPORTANT THRESHOLDS AFTER FIRST SHOULDER ARTHROPLASTY PREDICT SIMILAR OUTCOMES IN THE CONTRALATERAL SHOULDER?

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Background: Patients are increasingly undergoing bilateral total shoulder arthroplasty (TSA). It is unknown whether success after primary TSA is predictive of success after contralateral TSA. We aimed to determine whether exceeding clinically important thresholds of success after primary TSA predicts outcomes for subsequent contralateral TSA.

Methods: We retrospectively reviewed a prospectively-collected shoulder arthroplasty database for patients undergoing bilateral primary anatomic or reverse TSA starting January 2000 with preoperative and 2- or 3-year clinical follow-up. Primary outcome was whether exceeding clinically important thresholds in the ASES score for the first TSA was predictive of success of the contralateral TSA; thresholds for the ASES score were adopted from prior literature and included the minimal clinically important difference (MCID), substantial clinical benefit (SCB), 30% of maximal possible improvement (30%MPI), and patient acceptable symptomatic state (PASS). The PASS is defined as the highest level of symptom beyond which patients consider themselves well, which may be a better indicator of a patient's quality of life. To determine whether exceeding clinically important thresholds was independently predictive of similar success after second contralateral TSA, we performed multivariable logistic regression adjusted for age at second surgery, sex, BMI, and type of first and second TSA.

Results: Of the 134 patients identified that underwent bilateral shoulder arthroplasty, 65 (49%) had bilateral rTSAs, 45 (34%) had bilateral aTSAs, 21 (16%) underwent aTSA/rTSA, and 3 (2%) underwent rTSA/aTSA. On multivariable logistic regression, exceeding clinically important thresholds after first TSA was not associated with greater odds of achieving thresholds after second TSA when success was evaluated by the MCID, SCB, and 30%MPI. In contrast, exceeding the PASS after first TSA was associated with 5.9-times greater odds (95% CI = 2.5-14.4, $P < 0.001$) of exceeding the PASS after second TSA. Overall, patients that exceeded the PASS after first TSA exceeded the PASS after second TSA at a higher rate (71% vs. 29%, $P < 0.001$); this difference persisted when stratified by type of prosthesis for first and second TSA (64-78% vs. 17-35%, $P = 0.046$).

Conclusions: Patients that achieve the ASES score PASS after first TSA have greater odds of achieving the PASS for the contralateral shoulder regardless of prostheses type.

EP.06.148

A SYSTEMATIC REVIEW OF OUTCOMES FOLLOWING PYROCARBON HEMIARTHROPLASTY OF THE SHOULDER

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Background: Pyrocarbon hemiarthroplasty of the proximal humerus has gained popularity for use in younger patients with proximal humeral fractures or osteoarthritis due to its favourable wear characteristics. This systematic review aimed to summarise existing literature on post-operative outcomes following pyrocarbon hemiarthroplasty.

Methods: A systematic review was performed of Pubmed, MEDLINE, EMBASE and Cochrane according to PRISMA guidelines. Inclusion criteria was all studies assessing outcomes following pyrocarbon hemiarthroplasty in patients under 70 years of age, with exclusion criteria including reviews, opinion based reports and surgical technique papers. Data collection included demographics, function and complications.

Results: 326 patients were studied with a mean age of 54. 65.8% were male. 61.6% underwent hemiarthroplasty for primary glenohumeral osteoarthritis. The mean pre-operative Constant Score (CS) was 37.4 (26-50). Post-operatively, patients were able to achieve a mean of 131.7 degrees abduction (131.4-131.9), 145 degrees forward flexion (132-160 degrees) and 43.8 degrees external rotation (30-57.2). The mean post-operative CS was 76.4 (69-81). The overall revision rate was 6.1% after a mean follow-up of 29.2 (24.3-60.0) months.

Conclusions: Short term follow-up results for pyrocarbon hemiarthroplasty of the shoulder prove positive in terms of functional benefit, range of motion and revision rate. Further long term study is required to ascertain implant longevity.

EP.06.149

ACROMIAL STRESS FRACTURES AND REACTIONS AFTER REVERSE TOTAL SHOULDER ARTHROPLASTY: A CASE-CONTROL STUDY

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Background: Acromial stress fracture can occur after reverse total shoulder arthroplasty (RTSA). We performed this study to assess the incidence, risk factors, characteristics, and outcome of acromial stress fractures and reactions after RTSA.

Methods: We determined the incidence of acromial stress fractures and reactions in a cohort of patients who underwent RTSA, and assessed risk factors using a case-control design. Each patient who developed an acromial stress fracture or reaction after RTSA (case) was matched with two patients who did not develop acromial stress fractures/reactions after RTSA (control subjects); univariate and multivariable analyses were performed to identify risk factors. Characteristics of acromial stress fractures/reactions are described. Outcomes were compared between cases and control subjects.

Results: The incidence of acromial stress fracture/reaction after RTSA was 10.9% (24/220 RTSAs, in 22 patients). Acromial stress fractures/reactions occurred at a median time of 5.5 months after RTSA (range: 20 days to 118 months) and most were fractures (18/24, 75%). Using a multivariable analysis, we found two factors to be independently associated with the occurrence of an acromial stress fracture/reaction after RTSA: use of steroids (adjusted OR: 9.61, 95% confidence interval: 1.07 to 86.14, $p = 0.04$) and previous shoulder surgery (adjusted OR: 7.22, 95% confidence interval: 1.42 to 36.61, $p = 0.02$). In this cohort, in which the management was exclusively conservative, the occurrence of post-RTSA acromial stress fracture/reaction was associated with a significantly worse functional outcome at last follow-up visit, as compared with control subjects. This was illustrated by significantly lower ASES score, higher SPADI and DASH scores, and worse forward elevation and internal rotation as compared with control patients who did not develop acromial stress fracture/reaction after RTSA.

Conclusions: Acromial stress fractures/reactions are relatively common after RTSA, and are independently associated with steroids use and previous arthroscopic shoulder surgery. The occurrence of acromial stress fracture/reaction is associated with a significantly worse functional outcome, as compared with patients who do not develop this complication after RTSA.

EP.06.151

INCREASING UTILIZATION OF REVERSE TOTAL SHOULDER ARTHROPLASTY IN ELDERLY PATIENTS OVER AGE 65

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Background: There is a paucity of literature comparing anatomic total shoulder arthroplasty (ATSA) and reverse total shoulder arthroplasty (RTSA) in the elderly population. The aim of this study was to 1) observe the utilization and 2) compare the risk of 90-day surgical site infection (SSI) as well as 2-year and 5-year revision surgery (all-cause and PJI-related) between elderly patients who underwent ATSA and RTSA.

Methods: Elderly patients (age > 65) who underwent primary RTSA or ATSA between 2010-2015 with minimum 5-year follow-up were identified using a national claims database (PearlDiver Technologies). Trends in utilization were stratified by age (65-69, 70-74, and >75) and reported in terms of compounded annual growth rates (CAGR). Bivariate analysis was conducted to detect differences in patient demographics, baseline comorbidities, and primary outcome measures; 90-day SSI, 2-year and 5-year revision rates. Significant outcome measures found on bivariate analysis were evaluated on multivariable regression analyses, controlling for baseline patient demographics and comorbidities.

Results: RTSA (58.66% utilization) was the most performed shoulder arthroplasty procedure in those 65 and older. From 2010 to 2019, there has been an increase in utilization of RTSA in this population (CAGR: +6.76%; $p < 0.001$), with the greatest increase in those aged between 70-74 (CAGR: +9.22%). Alternatively, ATSA had significantly decreased utilization for all age ranges, with the greatest decrease in those aged >75 (CAGR -12.24%). In terms of complication rates, there was no difference in the 2-year and 5-year all-cause revision rates between elderly patients who underwent RTSA versus ATSA. After controlling for patient demographics and comorbidities, however, elderly RTSA patients had greater odds of having 90-day SSI (OR=3.4), 2-year PJI-related revision (OR=2.0), and 5-year PJI-related revision (OR=1.6) relative to ATSA patients ($p < 0.05$ for all).

Conclusions: Our study suggests that although there has been increased utilization of RTSA, ATSA may be a legitimate option for elderly patients with glenohumeral osteoarthritis, as there were no significant differences in overall 5-year implant survival and complication rates. Longer term follow-up is mandated to determine whether degenerative rotator cuff pathology might affect ATSA survivability among elderly patients.

EP.06.152

AGAINST SURGEONS' ADVICE: THE RETURN TO SPORT IN HIGH DEMAND WEIGHTLIFTERS FOLLOWING ANATOMIC TOTAL SHOULDER ARTHROPLASTY AT AVERAGE 3.6 YEARS FOLLOW-UP

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Background: Return to sport in high-demand weightlifters following total shoulder arthroplasty has rarely been investigated, as most surgeons recommend against returning to heavy lifting postoperatively. The purpose of this study is to determine the incidence of return to sport, patient reported outcomes, patient satisfaction, performance, and failures in a specific population of high-demand weightlifters that continue lifting after undergoing TSA.

Methods: Retrospective review of a specific population of high-demand weightlifters that underwent anatomic TSA with minimum one-year clinical follow-up was conducted. Prospective surveys determining pre- and postoperative participation in weightlifting included maximum weight, frequency, and duration of workouts, Single Assessment Numeric Evaluation (SANE), patient satisfaction, and postoperative range of motion were collected. Secondary outcomes included failure, revision surgery, risk factors for not returning to weightlifting, and performance measured as both absolute value and percentage of prior maximum weight lifted in different exercises. Bivariate and multivariate analysis was performed to compare cohorts and identify risk factors, respectively.

Results: Forty-two shoulders in 36 patients who met inclusion criteria (average age 57.9 years, SD 8.0 years, 97% male). No patient underwent revision surgery at average 3.6 year follow-up. The majority of patients (23/42 shoulders) report returning to heavy weightlifting postoperatively against senior surgeon's recommendations. Mean SANE score for current weightlifters and retired weightlifters were 86.9 and 91.6, respectively ($P = 0.148$). In the weightlifting cohort, only 78.3% of patients achieved patient-acceptable symptom state (PASS) threshold for SANE compared to 89.5% of patients ($p = .332$) in the retired cohort. Patient satisfaction and return to sport satisfaction in current weightlifting shoulders were good-to-excellent in 91.3% ($P = 0.922$) and 82.6% ($P = 0.972$) respectively. Patients who continued lifting reported substantially decreased maximum weight in all lifts compared to pre-symptomatic maximum.

Conclusions: Against surgeon's recommendations, most patients who participated in preoperative weightlifting returned to high-demand weightlifting after surgery, but demonstrated lower lifting performance postoperatively. While caution is still advised with returning to heavy weightlifting, the current data highlights the advances of modern fixation techniques, fourth generations implants, and diminished lifting capacity after surgery, which likely play a role in the high implant survivorship in this cohort.

EP.06.153

PRIMARY REVERSE SHOULDER ARTHROPLASTY, CLINICAL AND RADIOLOGICAL OUTCOMES COMPARED TO DIFFERENT GLENOID AND HUMERAL IMPLANTS LATERALIZATION

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Background: This study aimed to compare the clinical outcomes and radiographic parameters of patients after reverse shoulder arthroplasty (RSA) between the Grammont prosthesis and different lateralizing implants through glenoid or humeral component.

Methods: A total of 92 patients who underwent RSA with a lateralized design (group L; 60 shoulders) and medialized humeral design (group M; 32 shoulders) prosthesis for arthritis, cuff tear arthropathy or irreparable rotator cuff tear were enrolled. Clinical outcomes including visual analog scale (VAS), American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES), and Constant scores and range of motion (ROM) were serially followed up at postoperative 3, 6, 12, and 24 months. Radiographic parameters were measured to evaluate preoperative and postoperative status.

Results: Both prostheses demonstrated similar clinical outcomes and shoulder function preoperatively and at postoperative 2 years ($P > .05$). However, patients in group M had significantly better postoperative active forward flexion (postoperative 3 months, $115^\circ \pm 12^\circ$ vs. $101^\circ \pm 14^\circ$; $P < .001$; 6 months, $125^\circ \pm 13^\circ$ vs. $118^\circ \pm 13^\circ$; $P < .013$) and abduction (3 months, $105^\circ \pm 12^\circ$ vs. $98^\circ \pm 12^\circ$; $P = .002$); VAS (3 months, 3.1 ± 1.2 vs. 3.7 ± 1.4 ; $P = .031$; 6 months, 2.3 ± 1.1 vs. 2.8 ± 1.3 ; $P = .038$); ASES (3 months, 64.2 ± 7.0 vs. 60.4 ± 9.2 ; $P = .022$; 6 months, 70.6 ± 6.0 vs. 66.6 ± 8.1 ; $P = .007$); and Constant scores (6 months, 59.6 ± 6.9 vs. 55.7 ± 9.3 ; $P = .020$). Group L showed a significantly lower rate of scapular notching than group M (15.5% vs. 41.8%; $P < .001$). Further data analysis are in progress to evaluate the differences between the different lateralizing implants through glenoid or humeral component.

Conclusions: RSA with both the Grammont and lateralized design prostheses provided similar shoulder ROM restoration and functional improvements at a minimum of 2 years. However, patients with a humeral lateralized prosthesis showed slower recovery of shoulder function and ROM up to postoperative 6 months despite a lower incidence of scapular notching.

EP.06.156

OUTCOME AND REVISION RATE OF UNCEMENTED HUMERAL HEAD RESURFACING: MID TERM FOLLOW UP STUDY

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Background: Gleno humeral osteoarthritis (OA) is a common cause of pain and disability affecting nearly a third of the world's population over 60 years of age. As in other joints, shoulder arthroplasty appears to be the most effective treatment. The implant design has evolved during time transitioning to shorter humeral stem lengths or even stemless components.

To evaluate the medium-term outcome and survival of a cementless humeral head resurfacing (HHR) in a group of patients affected with OA or avascular necrosis.

Methods: This is a retrospective study of prospectively collected data using HHR in 23 patients (15 female and 8 male) after a 7.4 year follow-up. The collected data included clinical and radiographical evaluation. The Constant score, the visual analogue scale, and a clinical evaluation of range of motion were registered pre- and postoperatively. Fifteen patients affected with OA (2 cases of mild, 6 moderate, and 7 severe) and 10 with avascular necrosis (stage III according to Cruess classification) were enrolled. X-rays were evaluated to detect loosening signs, degenerative changes, and superior humeral head migration. Magnetic resonance preoperatively was also performed to assess the rotator cuff status. Tendon integrity was mandatory to implant the HHR.

Results: In total, 19 patients (21 shoulders) completed the follow-up. Data on 4 shoulders, in 4 patients, were lost because of prosthesis failure. The global revision rate was 16%. A statistically significant improvement in the mean Constant score, visual analogue scale, and range of motion have been reported. No signs of loosening were registered, while in 12 cases a glenoid erosion was found. The osteophytes appeared 7 times on the humeral side and 12 on the glenoid. Superior humeral migration was recorded in only 1 case.

Conclusions: HHR remains a reasonable option in patients with an intact rotator cuff for the treatment of OA and avascular necrosis.

EP.06.157

SHORT-TERM OUTCOMES OF PATIENT-SPECIFIC GLENOID VAULT RECONSTRUCTION SYSTEM IN PATIENTS WITH SEVERE GLENOID BONE LOSS

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Background: Severe glenoid bone loss is a complex problem in shoulder arthroplasty. Traditionally, these cases were treated with bone graft augmentation of standard implants or salvage hemiarthroplasty. A patient-specific glenoid Vault Reconstruction System (VRS, Zimmer Biomet) was designed to provide a solution for patients with severe glenoid bone deficiency. It utilizes pre-operative three-dimensional (3-D) computed tomography (CT) scan to map the remaining glenoid bone stock and create a 3-D printed custom model and implant and insertion system.

Methods: This IRB-approved prospective cohort study that followed patients who had severe glenoid bone deficiency and underwent shoulder arthroplasty with the VRS system. Data was collected prospectively and included preoperative clinical outcomes with in-person clinical and radiographic follow-up. Inclusion criteria included any patient who underwent a shoulder arthroplasty with the VRS, had minimum 2-year follow-up, and been enrolled in the shoulder arthroplasty registry. Clinical outcome scores collected were the American Shoulder Elbow Surgeons, Patient-Reported Outcome Measurement Information System Upper Extremity (PROMIS-UE), Single Assessment Numeric Evaluation (SANE), and Shoulder Arthroplasty Smart (SAS). Statistical analysis was performed using the Mann Whitney U test for continuous variables and Chi-Square test for categorical variables.

Results: There were 26 patients who had minimum 2-year follow-up, 13 males and 13 females Average age was 67.3 years Eleven were primary surgeries and 15 were revisions. The average preoperative glenoid retroversion was 24.9 and the average glenoid vault bone stock was 17.3 mm..

Postoperatively, patients had a significant increase in their clinical outcome scores, including the PROMIS-UE (39.8 vs 31.7, $p < 0.05$), ASES (73.2 vs 37.6, $p < 0.05$), and SANE (66.5 vs 22.6, $p < 0.01$). The SAS score was not significantly different postoperatively (7.7 vs 7.0, $p > 0.05$). there were no intra-operative complications. Six patients had a postoperative complication including 3 dislocations, 1 recurrent deep infection, 1 loose implant and 1 peri-prosthetic humeral fracture after trauma.

Conclusions: The glenoid VRS can be a good solution for patients with severe glenoid bone loss. This study demonstrated significant improvement in clinical outcomes postoperatively at minimum 2-year follow-up. Due to the complex nature of these scenarios, however, complications can occur.

EP.06.158

ANATOMIC TOTAL SHOULDER ARTHROPLASTY USING A SHORT HUMERAL STEM AND A NON-AUGMENTED MINIMALLY CEMENTED ALL-POLYETHYLENE GLENOID: MINIMUM 2-YEARS OUTCOME AND PREDICTORS OF CLINICAL FAILURE

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Background: Anatomic total shoulder arthroplasty (aTSA) using non-augmented glenoid components has demonstrated excellent clinical results, but concerns have been raised regarding their use in patients with posterior glenoid erosion.

Methods: 128 consecutive aTSAs in 122 patients (75 males) with mean age of 66 years (range 48-84) were evaluated at minimum 2 years follow-up (mean 3 years, range 2-5.6 years). Twenty-six patients had undergone previous surgery. All aTSAs combined a proximally coated short humeral stem with a non-augmented all-polyethylene glenoid. No stemless humeral or augmented glenoid components were performed concurrently. Partial glenoid version correction was performed as needed to achieve >90% backside seating and 1 or 2 pegs, including any perforating pegs, were routinely inserted without cement. Active range of motion, plain radiographs, and patient reported outcomes (PROs) comprising ASES, SST, VAS-pain and SANE scores were obtained preoperatively and at final follow-up. Only 9 patients (7%) were lost to follow-up.

Results: Forward elevation improved from $100^{\circ} \pm 25^{\circ}$ to $146^{\circ} \pm 17^{\circ}$, abduction from $87^{\circ} \pm 26^{\circ}$ to $143^{\circ} \pm 24^{\circ}$, external rotation from $22^{\circ} \pm 15^{\circ}$ to $44^{\circ} \pm 12^{\circ}$. and internal rotation from the sacrum to thoracolumbar junction ($p < 0.001$ for all). ASES improved from 39 ± 20 to 89 ± 14 , SST from 4.3 ± 2.9 to 10.1 ± 2.4 , SANE from 35 ± 21 to 87 ± 16 , and VAS-pain from 5.6 ± 2.1 to 0.7 ± 1.4 ($p < 0.001$). A history of previous surgery was associated with an ASES score < 70 ($p = 0.003$). Eight patients underwent subsequent surgery including 5 (4%) undergoing revision to reverse shoulder arthroplasty for subscapularis insufficiency (3 following traumatic injury), 1 for subscapularis repair with graft augmentation, 1 for arthroscopic debridement with biopsy and 1 for unrelated ipsilateral clavicle hardware removal. No revisions for prosthetic joint infection or loose humeral or glenoid components were performed.

Conclusions: aTSA using non-augmented minimally cemented components leads to marked improvements in range of motion and outcomes. There were no reoperations for glenoid loosening or infection at mid-term follow-up. A history of previous surgery predicted an inferior outcome. Early reoperation for subscapularis insufficiency and instability occurred in 5%, but these mostly related to traumatic reinjury. Longer follow-up will be needed to determine the durability of nonaugmented glenoid components implanted with minimal cement.

EP.06.159

CHANGES IN DELTOID MUSCLE VOLUME BEFORE AND AFTER REVERSE SHOULDER ARTHROPLASTY AND ITS RELEVANCE WITH CLINICAL OUTCOMES

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Background: The ability of elevation can be obtained by extending the lever arm of the deltoid muscle in reverse shoulder arthroplasty (RSA) for cuff tear arthropathy (CTA). Although deltoid muscle volume (DMV) is important for function in RSA, the changes in DMV before and after RSA, and its relationship with clinical outcomes are not clarified. The purpose of this study was to investigate changes in DMV before and after RSA and to evaluate the relevance with clinical outcomes.

Methods: A total of 20 shoulders (6 men and 14 women) with CTA who underwent RSA with follow-up of more than 1 year were included in the study. The clinical outcomes were evaluated with anterior elevation, University of California at Los Angeles shoulder rating scale and Constant score in pre-operative and 1 year after surgery, and the changes (DELTA Clinical outcomes) were calculated. The DMV was measured using CT in pre-operative, 1 week and 1 year after surgery, and the changes from pre-operative to 1 year after surgery (DELTA DMV) was calculated.

Two-dimensional axial CT images were demarcated, and the areas of each section were measured. The most proximal part of the deltoid muscle area was noted as D1 and the most distal part as Dn. The distance between each section (slice thickness) was calculated to be 5 mm. The DMV was calculated by using the modified Cavalieri method $[(D1 + D2 + D3 + \dots + Dn) \times 5 = \text{total muscle volume (cm}^3\text{)}]$. As a result, a three-dimensional measurement of the muscle volume was achieved. To reduce metal artifacts in post-operative CT, images were taken using Single Energy Metal Artifact Reduction (SEMAR) installed in TOSHIBA's Aquilion ONE™ / Vision Edition or Smart MAR installed in GE Healthcare's Revolution™ Maxima.

Results: The clinical outcomes significantly improved after RSA. DMV significantly increased 1 week after surgery compared to pre-operative and 1 year after surgery compared to pre-operative. However, there was no significant difference between the DMV 1 week after surgery and 1 year after surgery. Furthermore, there was no correlation between DELTA Clinical outcomes and DELTA DMV.

Conclusions: From our results, DMV significantly increased after RSA.

EP.06.160

PROGRESSION OF CHANGES IN GLENOID MORPHOLOGY FOLLOWING HUMERAL HEAD RESURFACING WITH BIOLOGIC GLENOID RESURFACING IN YOUNG PATIENTS (≤ 60 YEARS) AT MIDTERM FOLLOW-UP

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Background: Glenoid erosion is a common etiology for revision after humeral head resurfacing (HHR) arthroplasty. HHR with biologic resurfacing of the glenoid (rBIOTSA) is an alternative, with the biologic graft material providing short-term protection of the glenoid. The purposes of this study were to quantify the radiographic changes from early post-operative, short-term and final follow-up and to assess if the measures stabilized.

Methods: 74 patients aged ≤ 60 years with ≥ 60 -month follow-up underwent rBIOTSA using consistent implant materials. Subjects with adequate radiographs at early post-operative (10 days to 5.4 months), short-term (12–36 months) and final follow-up (≥ 60 months) were included. Radiographic measurements included medialization, acromial index (AI), joint space, critical shoulder angle (CSA), and Beta-angle. Statistically significant changes from short-term to final follow-up were assessed.

Results: Forty patients (33 males) with mean age of 51.6 years (± 7.5) met inclusion criteria. Mean time from date of surgery (DOS) to early post-operative was 2.6 months (± 1.2), from DOS to short-term was 26.3 months (± 3.8), and DOS to final 81.7 months (± 20.3 , range, 60 to 127). The study was 89% powered to detect a 2.5mm change in medialization in 40 subjects. Changes from early post-operative to short-term were: medialization 2.27 mm (± 4.84); AI ratio 0.04 units (± 0.09); joint space -0.65 (± 1.43) mm, CSA 1.29° (± 5.11), and Beta-angle -0.78° (± 7.21). Changes from short-term to final were: medialization 1.77 mm (± 3.66); AI ratio 0.05 units (± 0.09); joint space -0.10 (± 1.50) mm, CSA 1.21° (± 3.92); and Beta-angle -3.10° (± 6.63). There were no statistically significant changes when comparing results of 'early to short-term' to 'short-term to final' indicating the measures stabilized between these time points. However, AI ratio did reach statistical significance ($p < 0.05$) when evaluating changes from early to final images.

Conclusions: All measures progressed across all time points but did not reach significance indicating the measures tend to stabilize. However, it is unclear whether erosion stabilized as the study was not powered to detect less than 2.5 mm of medialization. The long-term follow-up contributed to the significant change observed in AI ratio as incidence of rotator cuff disease is reported to increase over time.

EP.06.161

REVERSE SHOULDER ARTHROPLASTY: DO THE INCLINATION OF THE HUMERAL COMPONENT AND THE LATERAL OFFSET OF THE GLENOSPHERE INFLUENCE THE CLINICAL OUTCOME?

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Background: Reverse total shoulder arthroplasty is widely used for the treatment of cuff tear arthropathy. Standard implants (Grammont style) consist of a humeral component with an inclination angle of 155° and a glenosphere without lateral offset. Computer models have shown that lower inclination angles and an increased lateral offset is related to an improved range of motion and reduced impingement. This study investigates the clinical results of a Grammont style reverse implant in comparison with an implant with an inclination angle of 135° in combination with a 4 mm lateralized glenosphere in context of cuff tear arthropathy.

Methods: For this retrospective comparative analysis 94 patients treated by reverse total shoulder arthroplasty for cuff tear arthropathy were included. Forty-five patients (m=12, f=33; mean age 76 years; mean follow-up 39 months) were treated with a standard 155° humeral component and a standard glenosphere with caudal eccentricity (group A), while twenty-one patients (m=19, f=30; mean age 73 years; mean follow-up 35 months) were treated with a 135° humeral component and 4 mm lateral offset of the glenosphere (group B). At follow-up patients of both groups were clinically using the Constant Score, the subjective shoulder value and the range of motion.

Results: The clinical results were similar in both groups concerning the Constant Score (group A=64.1 vs. group B=66.7; p=0.477) and the SSV (group A=72.4% vs. group B=79.4%; p=0.136). The range of motion of the operated shoulders did not differ between group A and group B regarding abduction=111.3° vs. 121.2°, p=0.121; external rotation with the arm at side=24.0° vs. 29.9°, p=0.050; forward flexion=127.5° vs. 135.7°, p=0.338 and internal rotation with the arm positioned in 90° of abduction (38.0° vs. 43.3°, p=0.065).

External rotation with the arm positioned in 90° of abduction was better in patients treated with an increased lateral offset and a decreased humeral inclination=50.3° vs. 71.8°; p=0.003.

Conclusions: In comparison to a standard-fashioned implant with a humeral inclination of 155° and a standard glenosphere, implants with a humeral inclination angle of 135° and a 4 mm lateralized glenosphere lead to comparable clinical results except for an improved external rotation in 90° of abduction.

EP.06.162

RESULTS OF METALLIC, GLENOID LATERALIZATION IN REVERSE SHOULDER ARTHROPLASTY AS REVISION PROCEDURE FOR FAILED ARTHROPLASTY

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Background: Revision procedures for loosening of anatomic shoulder arthroplasties are usually associated with osseous defects and rotator cuff insufficiency. Glenoid lateralization offers the possibility of a better pretensioning of the deltoid muscle and the residual rotator cuff and can reduce scapular notching.

Aim of this study was to evaluate the clinical and radiological results of glenoid, metallic lateralization for reverse shoulder arthroplasty (RSA) as revision procedure for septic and aseptic loosening.

Methods: This retrospective study from prospective data included patients who had undergone septic or aseptic replacement surgery with an reverse endoprosthesis with (group A) or without (group B) glenoid lateralization. Inclusion criterion was a clinical-radiological follow-up (FU) at 2 years postoperatively.

The Constant-Murley Score (CS) and the Subjective Shoulder Value (SSV) were collected. Radiologically, possible endoprosthesis loosening and scapular notching (SN) were evaluated. Inclusion criteria was a complete 2 year clinical and radiographic follow-up examination.

Results: Group A included 14 patients (female: n=7; Ø=65 years). Group B included 22 patients (female: n=9; Ø=69 years). Both groups showed preoperatively comparable cohort characteristics in terms of distribution of gender and dominance of treated shoulder as well as function with regards to preoperative CS, pain levels, external and internal rotation.

Patients in group A (mean CS of 57 points (32-88), forward flexion of 135° (70-180), external rotation of 18° (0-80)) improved statistically significant in CS, SSV, active flexion, abduction (p<0.01) and internal rotation (p=0.03) compared to preoperatively. External rotation did not improve significantly (p=0.09).

Patients in group B (mean CS of 67 points (36-88), forward flexion of 150° (80-170), external rotation of 13° (0-70)) improved statistically significant in CS, SSV, active flexion and abduction (p<0.01) and internal rotation (p=0.03) compared to preoperatively. Internal (p=0.56) and external rotation (p=0.06) did not improve significantly

There were no statistical significant differences in clinical results between both groups.

The complication rate (A: infection n=1, glenoid avulsion n=1, instability n=2)(B: periprosthetic fracture humerus n=2; periprosthetic fracture scapula n=1; axillary paresis n=1) was comparable in both groups.

Radiologically, SN grade 1 (A: n=1; B: n=4) was observed in 5 patients. There were no signs of early loosening.

Conclusions: RSA provides reliable clinical results as revision procedure for failed prior shoulder replacement and is associated with a low rate of scapular notching. Glenoid lateralization shows a trend towards better clinical results and lower rates of scapular notching. Complication, such as postoperative instability, remain a problem.

EP.06.163

RISK FACTORS FOR ABDUCTION NOTCHING AFTER REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: Scapular notching is a well-known complication after reverse total shoulder arthroplasty (RTSA). However, abduction notching (AbN), a subacromial erosion brought on by repeated abduction impingement after RTSA, has not been previously reported in a clinical setting, to the ' knowledge. Therefore, we designed this study to assess risk factors and functional outcomes of AbN after RTSA.

Methods: We retrospectively reviewed the medical records of 125 patients who underwent RTSA of the same design and had at least two years of follow-up between March 2014 and May 2017. AbN was defined as subacromial erosion that was observed at the final follow-up but was not seen on the X-ray three months after the surgery. Using X-rays at pre- and postoperative three months, radiologic parameters representing the patient's native anatomy and degrees of lateralization and/or distalization during surgery were evaluated. The visual analog scale of pain (pVAS), active range of motion (ROM), and American Shoulder and Elbow Surgeons (ASES) score were assessed at preoperative workup and final follow-up to evaluate the functional outcomes of AbN.

Results: During the study period, AbN occurred in 12.8% (16/125) of enrolled patients. Preoperative relative lateral protrusion of acromion (CAD) ($p = 0.009$), and postoperative humerus lateralization offset (HL) which evaluated the degree of lateralization after RTSA ($p = 0.003$) were the risk factors of AbN. The cutoff value of preoperative CAD and postoperative HL was 14.0 mm and 19.0 mm, respectively. pVAS ($p = 0.01$) and ASES score ($p = 0.04$) at final follow-up were significantly worse in patients with AbN.

Conclusions: Abduction notching was correlated with anatomical characteristics of the patient, and the degree of lateralization during RTSA. To prevent abduction notching, surgeons should adjust the degree of lateralization of the implant according to the anatomical characteristics of the patient.

EP.06.164

THE EFFECT OF STEM LENGTH AND WIDTH ON PROXIMAL HUMERUS STRESS SHIELDING IN UNCEMENTED PRIMARY REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: To preserve bone during RTSA, stems have become shorter and cement is avoided whenever possible. With the upcoming of uncemented RTSA, a conspicuous phenomenon called stressshielding has been described for the proximal humerus. It was the aim of this study to investigate the influence of stem length and width on stressshielding effects after uncemented RTSA in non-fracture cases.

Methods: After starting with a new uncemented standard stem in 2017, a short stem version became standard for primary non-fracture RTSA in 2019. The prospective institutional shoulder arthroplasty database was reviewed for all primary uncemented RTSAs from 2017 to 2020. Exclusion criteria were all other indications than omarthritis and cuff-tear-arthropathy and < 2 years follow-up. We compared the clinical and radiographic 2 years outcome of the short and standard stems of the same prosthesis model of 50 patients. We assessed the effect of stem length and width on stressshielding effects on the proximal humerus and defined a new cut off value for the filling ratio to prevent stress shielding.

Results: Of 50 included patients, 19 were in the short stem group (SHORT) and 31 in the standard stem group (STANDARD). The groups showed no differences in age, gender or bone quality. After two years, SHORT showed a relative Constant score of 91.8% (23 - 120) and STANDARD of 98.3%(74 - 118) ($p = 0.256$). Stressshielding was found in 4 patients (21%) in SHORT and in 16 patients (52%) in STANDARD ($p = 0.03$) and occurred more frequently in patients with higher humeral filling ratios. ($p < 0.01$). The calculated cut off value to prevent stress shielding was 0.675 for the metaphyseal and 0.725 for the distal filling ratio to reduce stressshielding effects by 10 times.

Conclusions: While short stems and standard stems for RTSA have the same good clinical results after 2 years, we found a significant negative effect of higher stem length and width in regard of stressshielding effects of the proximal humerus. Although the final clinical effect of this radiographic finding is yet to be assessed, uncemented stems should be chosen short with a filling ratio below 0.7 (+/- 0.025).

EP.06.165

RETURN-TO-WORK AFTER ARTHROPLASTY OF THE SHOULDER AND ITS PROGNOSTIC FACTORS IN ADULTS DIAGNOSED WITH OSTEOARTHRITIS

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Background: Anatomic total shoulder arthroplasty (aTSA) and hemiarthroplasty (HA) have demonstrated significant improvement in shoulder function and pain relief. Work-related outcomes have become increasingly important, whilst the current literature lacks evidence related to return-to-work (RTW) and which factors might have an influence on it.

Methods: We performed a retrospective query in employed patients diagnosed with primary osteoarthritis of the shoulder, who received either an aTSA or HA between 2006 and February 2021. Pre-operative and postoperative work and sports participation was assessed.

Results: Forty-four patients participated in this study (98% compliance). Forty patients (90.9%) were able to return to work at a median time of 2 (IQR: 2-4) months postoperatively. Patients with a medium/high intensity occupation RTW at a significantly lower rate (78.9%) than those with light intensity occupations (100%) ($p = 0.03$). Although only one patient reported a reason related to the shoulder for the inability to return to work. There is a statistically significant association between return to full employment and patients' expectation to fully return, absence of pre-operative work adjustments and pre-operative sick-leave (OR: 16.92 (3.06-93.48); 18.34 (2.10-160.35); 0.09 (0.02-0.59)). Nonetheless, there seems to be no association for age at the time of surgery and pre-operative sports activity.

Conclusions: aTSA and HA facilitate excellent return to work rates for patients diagnosed with osteoarthritis of the shoulder. Patients with medium/high intensity occupation return at a significantly lower rate. The ability to RTW seems to be multifactorial and the results found might not be attributed to shoulder arthroplasty only.

EP.06.166

UTILIZING RAND/UCLA APPROPRIATENESS CRITERIA TO EXAMINE OUTCOMES OF PRIMARY ANATOMIC TOTAL SHOULDER ARTHROPLASTY IN A US MULTICENTER RETROSPECTIVE COHORT

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Background: There has been limited quality evidence regarding efficacy or validated guidelines to determine appropriateness of total shoulder arthroplasty (TSA). A recent study used the RAND/UCLA method to determine appropriateness of TSA across a range of clinical characteristics and develop a decision tree to assist in clinical decision-making. The purpose of this study is to characterize prevalence rates of TSA surgeries, and to determine if outcomes following TSA vary across the three appropriateness classification groups.

Methods: Clinical data from a multicenter prospectively collected cohort were used. Patients were classified as either "appropriate," "inconclusive," "inappropriate," using a modified version of a validated appropriateness algorithm. Pre- and post-operative ASES, SST, VAS Pain Score, Constant score, UCLA, SPADI, and SAS score were examined using IBM SPSS Statistics to determine differences in outcome variable changes.

Results: 286 patients that underwent primary anatomic TSA, of which 107 had minimum 2- years follow-up, were included. The prevalence rates of appropriate, inconclusive, and inappropriate were 22.4%, 57.3%, and 20.3% respectively. There was a statistically significant difference in both pre-operative outcome measures and improvement in outcome measures across groups that demonstrated worse symptomatology and greater improvement in the appropriate group versus the inappropriate group. There was no significant difference in post-operative outcomes amongst all included patients or patients with an average of 2 years follow-up.

Conclusions: There was statistically significant improvement in outcome measures across groups that demonstrated worse symptomatology and greater improvement in PROMs the appropriate group versus the inappropriate group regardless of time point. These data provide a convincing argument for consensus-building efforts to delineate eligibility criteria for anatomic TSA particularly in modern debates in surgical decision making for anatomic TSA versus Reverse TSA candidates. This may allow for a reduction in variability in patient selection and optimize outcomes, implant survivability, and cost-effectiveness.

EP.06.167

COMPUTED TOMOGRAPHY VERSUS SIMPLE RADIOGRAPHS FOR DETECTING AND CLASSIFYING HETEROTOPIC OSSIFICATION AFTER REVERSE SHOULDER ARTHROPLASTY

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Background: Heterotopic ossification (HO) is difficult to characterize and classify on simple radiographs. Therefore, we attempted to evaluate intraobserver and interobserver reliability of simple radiography and CT for detecting and classifying the HO after reverse shoulder arthroplasty (RSA). It was hypothesized that CT would provide more reliable results than simple radiography.

Methods: This retrospective study reviewed 30 patients who underwent RSA by a single surgeon. Patients were included if had both postoperative simple radiographs and CT images immediate after surgery and at 1 year after surgery, and if had completed clinical assessment at least 1 year after surgery. We first evaluated the intra-observer and inter-observer reliability for the presence of HO and Modified Brooker's classification both on simple radiographs and CT scans with the use of Kappa statistics. Then, we analyzed the correlation of HO in simple radiographs and CTs with clinical outcomes. All radiographic evaluations were performed by two independent reviewers in random orders with 3 weeks interval.

Results: The intraobserver reliability outcomes by both reviewers in simple radiographs and CT images were almost perfect or perfect for the presence of HO and the classification. However, CT images improved the interobserver reliability for the presence of HO (KXR=0.6018 and KCT=0.8316) and for the classification (KXR=0.5300 and KCT=0.6964). At mean follow-up period of 25 months (range, 12-54), clinical scores were not significantly different according to presence of HO based on simple radiographs. However, when CT images were used, the UCLA score and physical component score of SF-36 were significantly lower in patients with HO than patients without HO (27.0 versus 30.4, $p=0.0435$ and 57.6 versus 70.7, $p=0.0335$, respectively).

Conclusions: Both simple radiographs and CT images provided an excellent intraobserver reliability for detecting and classifying the HO after RSA. Compared with simple radiographs, CT images tended to improve the interobserver reliability and defined the presence and severity of HO more clearly than simple radiographs did. CT-based evaluation of HOs might be useful to detect clinically significant HOs that are better associated with clinical outcomes.

EP.06.168

SHORT TERM OUTCOMES OF A NEW STEMLESS TOTAL SHOULDER ARTHROPLASTY FOR PRIMARY OSTEOARTHRITIS

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Background: 2017 saw the release in Europe of a newly designed stemless total shoulder replacement (TSR), the GLOBAL ICON (DepuySynthes, Warsaw, USA). This new implant consists of a humeral baseplate with 4 hydroxyapatite coated prongs, arranged circumferentially around the periphery of the resected humeral metaphysis, engaging the subcortical bone. The glenoid is replaced using the Anchor Peg Glenoid with established Joint Registry data. No peer reviewed data exists for this implant at the time of submission.

We reviewed the radiographic, patient reported outcomes and complications of all patients with this novel implant, in a single institution.

Methods: All cohort data was collected prospectively, including demographics, pre- and post-operative Oxford Shoulder Score (OSS), Quick DASH, EQ-5D-5L. Radiographic evaluation at latest follow up performed with standard glenohumeral AP and axial lateral imaging. All complications were recorded. Minimum follow up was 1 year.

Results: Between 2017 to present, 71 patients underwent TSR with the ICON. Mean age was 71 (SD 8.9) years, 45/71 (64%) were female. Mean follow up was 31 months (range 12-60). >90% were not frail (MFI-5 of 0 or 1)

OSS improved from 13.9 (SD 7.1) to 41.1 (SD11.0) ($p<0.05$), Quick DASH from 64.1 (SD 19.0) to 22.6 (SD23.4) ($p<0.05$), EQ-5D-5L from 0.66 to 0.79 (NS) while the EQ-VAS improved from 63.9 to 70.0 (NS).

There were no signs of loosening or lysis around the humeral implant, 3 patients had base plate prong breaching the lateral humeral cortex.

No revisions were undertaken, hence the survivorship at 5 years was 100%. 1 patient underwent arthroscopic arthrolysis. Using pain as criterion of failure, the survivorship at 5 years was 96% (SEM 85-99%).

Conclusions: The early data shows that the GLOBAL ICON is a safe implant to use, with few complications, excellent patient reported outcomes and a 100% survivorship in the short term.

EP.06.169

EFFECTIVENESS OF LATERAL OFFSET PERFORMED IN REVERSE SHOULDER ARTHROPLASTY WITH TENDON TRANSFER

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Background: Reverse shoulder arthroplasty (RSA) is an effective treatment for improving active elevation (AE) after severe rotator cuff tears. If active external rotation (AER) is lacking, RSA with latissimus dorsi and teres major tendon transfer (modified L'Episcopo) can achieve good shoulder function, including AER. Several clinical studies suggest that lateralized RSA may increase the rotation function; however, the effectiveness of this method for RSA with modified L'Episcopo (LRSA) is unclear.

Methods: We prospectively followed patients with massive irreparable rotator cuff tears, shoulder pseudoparalysis, AER < 0°, and severe fatty infiltration of the external rotators, such as Infraspinatus (ISP) and Teres minor (Tm), who were treated with RSA and subscapularis (SCC) restoration. Thirty-one patients were enrolled and followed for at least 2 years. The patients were divided into groups as follows: 22 patients were treated with LRSA (10 in the In-LRSA group were treated with inlay humeral components and 12 in the On-LRSA group were treated with onlay humeral components) and 9 patients in the In-RSA group were treated with RSA without modified L'Episcopo. The ASES scores and the range of motion (ROM) of the shoulder were examined before and after the operation. The ROM of the active internal rotation motions (IR) were evaluated according to the Constant score for the functional internal rotation.

Results: AER measured at the final follow-up was significantly worse in the In-RSA group (-7.7°) than AER in the In-LRSA group (21.0°) or the On-LRSA group (25.0°) ($p < 0.01$). The mean IR scores in the In-LRSA group (3.8) was significantly worse than the mean IR scores in the In-RSA (6.4) and On-LRSA (5.3) groups ($p < 0.01$). The activities of daily living (ADL) item of the ASES score was significantly worse in the final follow-up in the In-RSA (26.4) group compared with the ADL in the In-LRSA (31.5) and On-LRSA (31.6) groups ($p = 0.02$).

Conclusions: LRSA may result in worse internal rotation function due to partial loss of the internal rotators, even with restored subscapularis. In this situation, LRSA and increased lateral offset may improve postoperative shoulder function to conserve internal rotation function.

EP.06.171

CONCOMITANT SUBSCAPULARIS TENDON REPAIR IN REVERSE TOTAL SHOULDER ARTHROPLASTY AND ASSESSMENT OF HANDLING OPTIONS: A CADAVERIC BIOMECHANICAL STUDY

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Background: The study aimed to evaluate the effect of subscapularis (SSC) repair (repair at native insertion, repair at the superiorly migrated position, and non-repair) on the glenohumeral arc of motion following reverse total shoulder arthroplasty (RTSA).

Methods: RTSA was performed on 8 cadaveric shoulders in 6 testing conditions as follows: non-repaired SSC/intact teres minor (TM); intact SSC/intact TM; superiorly repaired SSC/intact TM; non-repaired SSC/deficient TM; intact SSC/deficient TM; and superiorly repaired SSC/deficient TM. An increasing load (2.5 N increments) was applied to the middle deltoid (anterior, posterior; 10 N each, middle; 10–20 N). The resulting abduction and rotation positions were measured. Biomechanical parameters were compared using repeated-measures analysis of variance (ANOVA) and a post hoc test with Bonferroni correction using a Student t-test ($p < 0.05$).

Results: Non-repaired SSC showed more glenohumeral abduction and less internal rotation than the repaired SSC models. Superiorly repaired SSC had higher glenohumeral abduction and internal rotation than the original SSC repair. SSC repair caused excessive internal rotation (IR) in TM deficiency seen with massive rotator cuff tears.

Conclusions: Concomitant SSC repair in lateralized RTSA decreased glenohumeral abduction and increased IR. Concomitant SSC repair at the original and superiorly migrated footprints should be carefully considered following lateralized RTSA.

EP.06.172

OUTCOMES OF TOTAL SHOULDER ARTHROPLASTY IN PATIENTS WITH A HISTORY OF SOLID ORGAN TRANSPLANT

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Background: Currently, there is limited literature investigating shoulder arthroplasty outcomes in patient with prior solid organ transplant (SOT). In this series, we present the largest case series to date on this topic. SOT recipients are commonly prescribed immunosuppressive therapies, which have been implicated in causing avascular necrosis (AVN). AVN prior to shoulder arthroplasty may result in a difference in outcomes when compared to SOT recipients who lack AVN pre-operatively.

Methods: Institutional records were obtained for patients who underwent SOT prior to shoulder arthroplasty between 2010-2020. Patient medical records were reviewed to determine indication of surgery, pre- and post-operative range of motions (ROM) and strength, type and date of solid organ transplant, immunosuppressive therapy used, and any surgical complications and revisions. Wilcoxon ordered logistic regression, Rank-Sum test, and Chi-Squared test were used to analyze ordinal, continuous, and categorical variables, respectively.

Results: 39 patients (19 female, 20 male) were included and the mean follow-up was 2.5 years. There was significant improvements in range of motion: external rotation (ER) ($34^{\circ} \pm 22^{\circ}$ to $45^{\circ} \pm 16^{\circ}$; $p=0.030$), forward elevation (FE) ($90^{\circ} \pm 42^{\circ}$ to $138^{\circ} \pm 26^{\circ}$; $p<0.001$), internal rotation (IR) (Sacrum to L3; $p=0.001$), and supraspinatus strength (4/5 to 4+/5; $p=0.028$). There was no significant difference in preoperative ROM between AVN and non-AVN patients, but strength differed: ER (AVN: $44^{\circ} \pm 9^{\circ}$; non-AVN: $32^{\circ} \pm 23^{\circ}$; $p=0.160$), FE (AVN: $8^{\circ} \pm 20^{\circ}$; non-AVN: $93^{\circ} \pm 45^{\circ}$; $p=0.437$), IR (AVN: Ls; non-AVN: Sacrum; $p=0.567$), and strength (AVN: 5/5; non-AVN 4/5; $p=0.078$). Similarly, there was no significant difference in postoperative ROM, but strength differed: ER (AVN: $52^{\circ} \pm 19^{\circ}$; non-AVN: $45^{\circ} \pm 14^{\circ}$; $p=0.339$), FE (AVN: $138^{\circ} \pm 17^{\circ}$; non-AVN: $140^{\circ} \pm 26^{\circ}$; $p=0.551$), IR (AVN: L4; non-AVN: L3; $p=0.094$), and strength (AVN: 4/5; non-AVN: 5/5; $p=0.028$). 3/39 (8%) of patients were surgically revised. The 10-year Kaplan-Meier survival estimate was 94%.

Conclusions: Individuals that undergo shoulder arthroplasty after SOT gain significantly better function post-operatively compared to pre-operatively. Individuals with pre-operative AVN produce similar results to those without AVN on external rotation, forward elevation, internal rotation, but display a significant difference in strength.

EP.06.173

CLINICAL AND RADIOLOGICAL OUTCOMES AFTER TOTAL SHOULDER ARTHROPLASTY USING CUSTOM-MADE GLENOID COMPONENTS

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Background: Reverse total shoulder arthroplasty presents itself sometimes as challenging when it comes to addressing massive bone loss, either in primary or revision settings. Custom components recently have made their way into shoulder prosthetics and are meant to help in the case of extensive glenoid bone destruction. Because of strict indication and the fairly recent introduction of these implants, the usage of custom-made glenoid implants is not very common yet. However, the early results are promising. The purpose of this review was to summarize and analyze the available literature.

Methods: Therefore, a systematic review was performed according to PRISMA guidelines. A comprehensive search of the databases PubMed, Cochrane, and Livivo was performed to screen for studies reporting on clinical and radiological outcomes of custom glenoid implants.

Results: Four studies with a total of 46 shoulders were included in this review. The mean patient age was 68.8 years and the mean time of follow-up was 24.3 months. The weighted means showed an increase in CMS (32.7 points), in ASES (39.8 points), in anteversion (67.4 degrees), and in abduction (51.9 degrees) and a decrease in VAS (5.4 points).

Conclusions: Custom-made glenoid implants are therefore a viable option in cases of large combined glenoid bone loss, both in primary and revision shoulder arthroplasty.

EP.06.174

DOES HUMERAL STEM SIZE AFFECT RANGE OF MOTION AND OUTCOMES FOLLOWING REVERSE SHOULDER ARTHROPLASTY?

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Background: Several humeral stem sizes are available for reverse shoulder arthroplasty (RSA) but the stem size chosen is typically determined intraoperatively. Previous studies support the use of shorter stems due to their stability within the humerus, comparable bone stresses to intact humeri, and decreased risk of revision. Yet, little is known in the literature about the effect of humeral stem length on range of motion (ROM) and patient reported outcome measures (PROMs) following RSA. This study aims to analyze the impact of stem length on outcomes and function.

Methods: A retrospective review of patients that underwent RSA from 2007-2020 by a single fellowship trained orthopedic shoulder surgeon was performed. Demographics, humeral stem length, and ROM were collected. The outcome scores assessed were the SST, Constant Score, UCLA Shoulder Score, SPADI, Shoulder Arthroplasty Smart score (SAS) and ASES Score. These were collected preoperatively and postoperatively at the last follow-up visit. Logistic regressions and Kruskal-Wallis Tests were used to determine the relationship between humeral stem length and outcomes. Clinical improvement was defined as meeting the minimum clinically important difference (MCID) using the anchor-based method as illustrated by Simovitch et al.

Results: The cohort comprised of 603 RSA patients with a mean age of 73 years, BMI of 29.43 kg/m². Mean follow up was 23.5 months and 63.3% were female. Patients with longer stem lengths were found to have significant clinical improvement in active abduction ($p=0.03$; odds ratio=1.082, C.I 1.008-1.162). No other significant differences were found between stem lengths and outcomes.

Conclusions: The current literature landscape remains inconclusive as to whether short or long humeral stems are better for RSA and as such, little is known about the influence of stem length on shoulder function. This study has demonstrated that longer stem lengths can be correlated with improved shoulder function. Future studies should determine the relationship between humeral stem length, radiographic outcomes, long term complications, and time to recovery.

EP.06.175

RATE OF RECOVERY FOLLOWING REVERSE SHOULDER ARTHROPLASTY

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Background: Reverse shoulder arthroplasty (RSA) has significantly grown over the last two decades due to its expanding indications. Given this increase, it is essential for the orthopedic surgeon to communicate the expected postoperative recovery timing to patients. The purpose of this study was to determine the rate of recovery following RSA and factors influencing this rate.

Methods: A retrospective review of 2132 patients who underwent RSA by a single surgeon was conducted. Data was collected preoperatively and postoperatively at intervals of 3-, 6-, 12-, and 24-months. At each follow-up period the cohort was divided into either a recovered or still recovering group. Patients with an American Shoulder and Elbow Score (ASES) of 70 or greater were defined as recovered, based on previously validated studies, compared to those with a score of less than 70 being defined as still recovering. Both the demographic and range of motion data was compared between the cohorts at each follow-up period.

Results: The recovered group included 36.4% at 3-months, 56.7% at 6-months, 71.8% at 12-months, and 70.5% at 24-months. At 6 months, the recovered and still-recovering groups had significantly more females (70.0% and 56.3% respectively; $p=0.02$). At 24-months, there was a significant higher preoperative BMI for the recovered group compared to the still recovering group (30.15 versus 28.14 respectively, $p=0.04$). Previous shoulder surgery, preoperative injection, and subscapularis repair were comparable between groups at each follow up period. Postoperative abduction was significantly greater in the recovered group at 12-months. Active forward elevation and external rotation were not significantly greater in the recovered group at 6-, 12-, and 24 months.

Conclusions: It appears that perhaps female patients and those patients who gain postoperative abduction are more likely to reach recovery slightly faster than other cohorts. This information can allow clinicians to inform their patients of expected recovery times more accurately where more than a third of patients reach the recovery threshold by 3 months, and a majority by 12 months postoperative. Patients who had previous injections, variations in subscapularis management or prior shoulder surgery did not see an impact in their overall recovery rates for RSA.

EP.06.176

MODIFIABLE LIFESTYLE FACTORS CRITICALLY INCREASE POSTOPERATIVE COMPLICATIONS AFTER TSA

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Background: Studies suggest that modifiable lifestyle risk factors can influence postoperative complications. The purpose of this study was to determine the impact of modifiable lifestyle risk factors on postoperative medical and surgical complications following total shoulder arthroplasty at a large national healthcare system.

Methods: A retrospective chart review of a large health care provider was performed to identify 1,721 patients who underwent TSA between 2017 and 2021. Modifiable lifestyle risk factors were defined as narcotic drug abuse, tobacco use, diabetes mellitus, and hypertension. Postoperative medical complications included sepsis, infection, disruption of the surgical wound, procedure-related complications, and embolism and thrombosis. Postoperative surgical complications included instability, dislocation, aseptic loosening, periprosthetic joint infection, periprosthetic fracture, hardware failure, revision, and wear and osteolysis. Demographic data and comorbidities were also collected. Descriptive statistics were used.

Results: Of the 1,721 patients identified, 61.35% were female (n = 1,056) with an average age of 71 years and an average BMI of 29.47. We found that 3.43% (n = 59) had used narcotics, 8.71% (n = 150) were past or current smokers, 24.06% (n = 414) had diabetes, and 61% (n = 1,050) had hypertension. The average length of hospital stay was 3.43 days, with 5.46% (n = 93) experiencing postoperative medical complications and 6.45% patients (n=111) experiencing postoperative surgical complications. Moreover, patients with narcotic drug abuse and diabetes were more likely to have postoperative medical and surgical complications. Similarly, patients with tobacco use were 65% more likely to have postoperative medical complications but this did not hold true for developing postoperative surgical complications. There was no significant association between patients having hypertension and experiencing postoperative medical or surgical complications.

Conclusions: Our results demonstrate critical rates of increased postoperative medical and surgical complications after TSA for patients with narcotic abuse, tobacco use, or diabetes mellitus. By implementing preoperative interventions and strict guidelines, orthopedic surgeons would be able to optimize the health of patients and in doing so, may decrease preventable postoperative complications after TSA.

EP.06.177

COMPLICATIONS AFTER REVISION REVERSE SHOULDER ARTHROPLASTY FOR INFECTION

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Background: In comparison to primary reverse shoulder arthroplasty (RSA) procedures, revision surgery is a longer and more complex procedure. The reported rates of infection in primary RSA range from 1%-19% and the impact of diagnosis of infection in revision surgery is significant. The purpose of this study was to investigate the impact of revision RSA (rRSA) due to infection compared to outcomes for revisions due to non-infectious causes.

Methods: A retrospective review rRSA was performed, patients were categorized based on pre-revision diagnosis: infection revision group (IRG) versus other revision group (ORG). Patient demographics, preoperative patient reported outcomes (PROs) (including SST, Constant, ASES, UCLA, and SAS scores) and range of motion (ROM) were collected and compared. Postoperative PROs, ROM, total number of revision operations, postoperative complications were also compared between groups.

Results: The cohort consisted of 93 revision RSA patients with 50.5% female, average age of 68 and an average BMI of 29.7. Nineteen patients classified as IRG and 74 patients classified as ORG. Baseline demographics were comparable between groups, except IRG had less females (28% v. 57%; $p=0.027$) and Caucasians (78% v. 97%; $p=0.003$), while having more Hispanics (11% v. 0%; $p=0.004$). Preoperatively, PROs and ROM were comparable between groups. All postoperative PROs were lower for IRG. However, only the UCLA and SAS scores were considered significantly lower in the IRG compared to the ORG. All postoperative ROM trended lower for IRG, however, only active external rotation was considered significantly lower compared to the ORG. The IRG was significantly more likely to have more than three revision operations (11% v 1%; $p=0.047$), while the postoperative complication rates were comparable between the groups.

Conclusions: Our results demonstrate that revision RSA due to infection correlates with poorer patient reported outcome scores and function. While there is an increased risk of infection for subsequent reoperations for IRG, complications are comparable to other revision RSAs. This creates an opportunity for orthopedic surgeons to educate patients undergoing revision for infection of the increased risk for poorer postoperative outcomes and additional measures such as increased physical therapy and decreased opioid use should be emphasized in this subset population.

EP.06.178

INVESTIGATING A POTENTIAL LIMIT TO ACCESS TO CARE: PREOPERATIVE CUT-OFF VALUES FOR MASS INDEX FOR SHOULDER ARTHROPLASTY

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Background: The primary purpose of this study was to determine the number of patients who would be denied a complication-free total shoulder arthroplasty (TSA) based on implementation of mass index (BMI) eligibility cutoffs.

Methods: The National Surgical Quality Improvement Program database was queried to identify all patients who underwent primary TSA. Patient demographics and 30-day postoperative complications were compared according to BMI stratification using the Pearson chi-square test and binary logistic regression analysis adjusted for age and modified Charlson comorbidity index. A BMI eligibility criterion of (greater/equal) 40 kg/m² was used to calculate the positive predictive value (PPV) to assess the number of complication-free TSAs that would be denied to avoid a complication in a single patient.

Results: A total of 23,284 patients who underwent TSA met inclusion criteria. The overall complication rate was 7.2%. Using a BMI cutoff of (greater/equal)40 kg/m² would yield a PPV of 7% for all Major Complications. This means that 14 complication-free procedures would be denied to avoid a Major Complication. In addition, BMI (greater/equal)40 kg/m² served as an independent risk factor for acute renal failure, pulmonary embolism, ventilator use >48 hours, and readmission. The PPV for these clinically significant complications using BMI (greater/equal)40 kg/m² as a cutoff was 4.9%. This translates into 20 patients being denied a complication-free procedure to avoid a single clinically significant medical complication. If this policy was enforced on the 2,426 patients who exceeded BMI (greater/equal)40 kg/m² in this study, nearly 2,307 patients would be denied the potential benefit of surgery to prevent 119 complications.

Conclusions: The use of eligibility criteria for primary TSA or RSA based solely on BMI threshold values presents a potential limitation in access to care to these patients who otherwise would have a complication-free procedure.

EP.06.179

TOTAL SHOULDER REPLACEMENT STEMS IN OSTEOARTHRITIS - SHORT, LONG OR REVERSE? AN ANALYSIS OF THE IMPACT OF CROSS-LINKED POLYETHYLENE

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Background: The 2022 Australian Orthopaedic Association National Joint Replacement Registry report indicated that total shoulder replacement using both mid head (TMH) length humeral components and reverse arthroplasty (RTSA) had a lower revision rate than stemmed humeral components in anatomical total shoulder arthroplasty (aTSA) - for all prosthesis types and diagnoses. The aim of this study was to assess the impact of component variables in the various primary total arthroplasty alternatives for osteoarthritis in the shoulder.

Methods: Data from a large national arthroplasty registry were analysed for the period April 2004 to December 2021. The study population included all primary aTSA, RTSA, and TMH shoulder arthroplasty procedures undertaken for osteoarthritis (OA) using either cross-linked polyethylene (XLPE) or non-cross-linked polyethylene (non XLPE). Due to the previously documented and reported higher revision rate compared to other anatomical total shoulder replacement options, those using a cementless metal backed glenoid components were excluded. The rate of revision was determined by Kaplan-Meier estimates, with comparisons by Cox proportional hazard models. Reasons for revision were also assessed.

Results: For a primary diagnosis of OA, aTSA with a cemented XLPE glenoid component had the lowest revision rate with a 12-year cumulative revision rate of 4.7%, compared to aTSA with cemented non-XLPE glenoid component of 9.0%, and RTSA of 8.5%. The revision rate for TMH was lower than aTSA with cemented non-XLPE, but was similar to the other implants at the same length of follow-up. The reason for revision for cemented aTSR was most commonly component loosening, not rotator cuff deficiency.

Conclusions: Long stem humeral components matched with XLPE in aTSA achieve a lower revision rate compared to shorter stems, long stems with conventional polyethylene, and RTSA when used to treat shoulder OA. In all these cohorts, loosening, not rotator cuff failure was the most common diagnosis for revision.

EP.06.180

QUANTIFYING SUCCESS AFTER TOTAL SHOULDER ARTHROPLASTY: THE SUBSTANTIAL CLINICALLY IMPORTANT PERCENTAGE OF MAXIMAL POSSIBLE IMPROVEMENT

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Background: The percent maximal possible improvement (%MPI) as a means to assess patient outcomes after total shoulder arthroplasty (TSA) was introduced to mitigate ceiling effects, which limit the ability to differentiate success among high-functioning patients. However, score- and population-specific thresholds have not been defined and may not equal the 30% threshold first proposed. Our purpose was to (1) compare the percentage of patients achieving the substantial clinical benefit (SCB) and 30% MPI and (2) define %MPI thresholds associated with substantial clinical improvement following primary TSA.

Methods: We retrospectively reviewed a multicenter database for primary TSAs performed using a single implant system with minimum 2-year follow-up between 2003 and 2020. Pre- and postoperative outcome scores were evaluated. %MPI was calculated for each patient and outcome score as described by Matsen et al. The proportion of patients achieving the previously-reported SCB and 30% MPI were determined for each score. The substantial clinically important %MPI (SCI-%MPI) was determined using an anchor-based method comparing patients describing their treatment as “much better” compared to “worse” or “unchanged”. Calculations were stratified by outcome score, prosthesis, age, and sex.

Results: 4,166 shoulders (1,593 aTSA, 2,573 rTSA) were evaluated at a mean age of 69 years (range, 27-96) (aTSA=66, rTSA=71, $p < 0.001$). Average follow-up was 52 months (range, 24-217). Scores without ceiling effects (i.e., Constant and SAS) had a higher rate of patients achieving the SCB, but not the 30% MPI when compared to ceiling effect scores (SST, ASES, UCLA, SPADI). The SCI-%MPI thresholds for aTSA and rTSA by score were: SST: aTSA=47%, rTSA=48%; Constant: aTSA=35%, rTSA=39%; ASES: aTSA=50%, rTSA=53%; UCLA: aTSA=52%, rTSA=55%; SPADI: aTSA=47%, rTSA=50%; SAS: aTSA=45%, rTSA=42%. While the SCI-%MPI increased with age for aTSA, estimates were similar amongst patients ≥ 60 years old for rTSA. The SCI-%MPI for all scores was greater for females except with the Constant score for aTSA and the Constant and SPADI scores for rTSA.

Conclusions: The %MPI judged relative to patient-reported substantial clinical improvement offers a simple method to quickly assess improvements in outcome scores. Given considerable variation, we recommend utilizing score-specific SCI-%MPI to gauge success when evaluating patients undergoing primary TSA.

EP.06.182

SHOULDER REPLACEMENT IN THE ELDERLY, ANATOMIC VERSUS REVERSE TOTAL PROTHESIS? A PROSPECTIVE 2-YEAR FOLLOW-UP STUDY

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Background: In older patients, with an intact rotator cuff, requiring a total shoulder replacement (TSR) there is, at present, uncertainty whether an anatomic TSR (aTSR) or a reverse TSR (rTSR) is best for the patient. This comparison study of same age patients aims to assess clinical and radiological outcomes of older patients ($= > 75$ years) who received either an aTSR or a rTSA.

Methods: Consecutive patients with a minimum age of 75 years who received an aTSR (n=44) or rTSR (n=51) were prospectively studied. Pre- and postoperative clinical evaluations included the ASES score, Constant score, SPADI score, DASH score, range of motion (ROM) and pain and patient satisfaction for a follow-up of 2 years. Radiological assessment identified glenoid and humeral component osteolysis, including notching with a rTSR.

Results: Postoperative improvement for ROM and all clinical assessment scores for both groups was found. Patient reported outcome scores (PROMs) were significantly better in the aTSR group compared with the rTSR patients ($p < 0.001$). Both groups had only minor osteolysis on radiographs. No revisions were required in either group. The main complications were scapular stress fractures for the rTSR patients and acromioclavicular joint pain for both groups.

Conclusions: This study of older patients ($= > 75$ years) demonstrated that an aTSR for a judiciously selected patient with good rotator cuff muscles can lead to a better clinical outcome and less early complications than a rTSR.

EP.06.184

COMPLEX SHOULDER PERIPROSTHETIC INFECTION. AN UNIQUE MICROBIOLOGICAL ANALYSIS: CASE REPORT AND LITERATURE REVIEW

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Background: This complex clinical case is about a 56-year-old woman who suffered a radical resection of the left proximal humerus due to a malignant chondrosarcoma in 2006. She is a type 2 diabetic, former alcoholic and current heavy smoker.

Methods: Reviewing a clinical case and previous publications made with a fungal shoulder periprosthetic infection

Results: Since reconstruction surgery made after the tumoral resection, instability and infection of the implant have led her to many revision surgeries. Most of them done on another center, so, surgical records are not available. In 2018 she was referred to our department. She came to clinic with pain, and clinical signs of infection. She was diagnosed of septic loosening of the implant, and a 2-stage revision surgery was proposed. *S. epidermidis* and *C. Acnes* was cultured on surgical samples. Then, she appeared on clinic with exposition of the shoulder spacer, so, 2 reconstructive surgeries were necessary: joint debridement and spacer replacement and a dorsal muscle graft. Again, cultures were positive to *S. epidermidis* and *C. Acnes*. On reimplantation surgery, with a reversed tumoral megaprosthesis, *Candida parapsilosis* was cultured on some samples. Then, i.v. antifungal treatment with fluconazole and voriconazole lasted for 3 months. In 2021, patient appeared on clinic with implant dislocation, so, a new surgery was done. Again, cultures of samples and sonication fluid were positive to *C. parapsilosis*. I.v. treatment with antifungal drugs (fluconazole and voriconazole) for 2 months, followed by 3 months of oral antifungal treatment was established. Clinical status of the patient is correct.

Conclusions: *Candida* spp periprosthetic joint infection is an uncommon infection, especially if located at the shoulder. To our knowledge, only 3 shoulder PJI cases have been previously reported, none of *Candida parapsilosis*. Risk factors for *Candida* spp infection includes immunosuppression, systemic diseases, fungemia or previous long term antibiotic treatment. Given the paucity of cases published, there are no guidelines regarding the best medical and surgical management strategies. Medical treatment was chosen, given the high risk of surgical complications on her, but possibly, a new surgical debridement might be necessary if the clinical status worsens in time.

EP.06.185

IS THE INSTABILITY RATE OF REVERSE SHOULDER ARTHROPLASTY IN TYPE 3 FRACTURE SEQUENCES REALLY UNACCEPTABLY HIGH?

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Background: Raiss et al. reported a high complication rate (41%) of reverse shoulder arthroplasty (RSA) in type 3 fracture sequelae. The most common (34%) was instability, followed by infection (13%). We evaluated therefore retrospectively the complication rate of this group in our patients' series. we focused primarily on the dislocation rate.

Methods: From December 2009 to December 2019, we implanted RSA in 131 patients who had a failed treatment of a proximal humerus fracture. Of these, 55 patients could be assigned to type 3 fracture sequences according to Boileau classification. The mean age at the operation was 69.8 years. The Follow up (average 53.3 months) was collected retrospectively from the medical record and by telephone (due to the Covid-19-related restrictions). In addition, a validated questionnaire (DASH and Constant Scores) was collected from 47% of the patients.

Results: In 9 patients (16.4%) we recorded 12 postoperative complications. Reoperation was performed in 7 patients (12.7%). The spectrum of complications included 2 infections (one early and one late), a superficial wound healing disorder, rupture of the cerclage with dislocation of the tubercles in 2 patients, loosening of the glenosphere, fracture of the spine scapulae, a fatal postoperative gastrointestinal bleeding, and reversible brachial plexus paresis and 3 periprosthetic fractures as a result of repeated falls. However, in our series there was no single dislocation or instability. With a mean constant score of 32.25 points and mean DASH score of 41.18 points.

Conclusions: The treatment of type 3 fracture sequences using RSA offers acceptable complication rates. The dislocation rate can be reduced through Precise preoperative planning using a CT scan to restore the arm length and correct the glenoid deformity and the intraoperative mobilization of the tubercles and (always, if possible) also solid refixation.

EP.06.186

THE ROLE OF ACROMIOPLASTY AND TUBEROPLASTY IN SHOULDER REVERSE ARTHROPLASTY

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Background: Reverse shoulder arthroplasty has been a good solution for many shoulder pathologies over these last years. Several complications observed as "scapular notching" or instability have been solved by changing prosthesis design introducing "lateralization" concept.

However, impingement between the greater tuberosity and the anterolateral part of the acromion decreases acromiohumeral distance which may affect the range of motion (ROM). Three-dimensional (3D) preoperative planning studies the range of impingement-free abduction and forward flexion after RSA and where impingement takes place.

The goal of the study is to determine if different acromion/tuberosity morphologies could limit ROM due to early anterolateral impingement and if acromioplasty and/or a tuberosity during RSA should be considered without risk of acromion fracture.

Methods: A prospective study from October 2020 to April 2022 was performed with a minimum follow-up of 6 months. Removal osteophyte was performed in patients over 65 years old with cuff tear arthropathy whose range of impingement-free abduction was under 80° in the virtual 3D preoperative planning. Two groups were made: Group A (RSA + acromioplasty) and Group B (RSA + acromioplasty & tubero-plasty). After virtual study surgery was performed in those patients. Virtual and clinical ROM variables (abduction and forward flexion), radiological measurements and subjective values (EVA, SSV) were assessed

Results: 22 patients were reviewed at an average 12 months postoperatively. 68.2% were women with a mean age of 71,8 years old and 31.8% were men with a mean age of 78,1 years old.

Group A: Virtual results: abduction 91° ; forward elevation 132,82°. Clinical results: abduction 162° +/- 5,3 and forward elevation: 168° +/- 8. Subjective values: EVA 0,54 +/- 2. SSV 87,02 +/- 11. Radiological angles: LSA 82° +/- 7,73. DSA 55° +/- 4,36.

Group B: Virtual results: abduction 93,23°; forward 137,64 °. Clinical results: abduction 156° +/- 5 and forward elevation: 166° +/- 5. EVA. 0,70 +/- 3 SSV 87,41 +/- 4. Radiological angles: LSA 81.9° +/- 5.86. DSA 57,64° +/- 3,84.

No acromion fractures in both groups.

Conclusions: Acromioplasty and tubero-plasty associated to RSA improve range of motion in preoperative planning software and in clinical short follow-up. These techniques can be easily performed without higher risk of acromion fracture.

EP.06.187

CLINICAL AND RADIOGRAPHIC OUTCOMES FOLLOWING GLENOID BONE GRAFTING IN PRIMARY REVERSE TOTAL SHOULDER ARTHROPLASTY: A CASE SERIES

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Background: Glenoid bone grafting in reverse total shoulder arthroplasty (RTSA) has emerged as an effective method of restoring bone stock in the presence of complex glenoid bone loss, yet there is limited published evidence on efficacy. The aim of this study was to conduct an analysis of clinical and radiographic outcomes associated with glenoid bone grafting in primary RTSA.

Methods: Patients who underwent a primary RTSA with glenoid bone grafting were retrospectively identified from the databases of two senior shoulder surgeons. Inclusion criteria included a minimum of 12 months clinical and/or radiographical follow up. Patients underwent preoperative clinical and radiographic assessment. Graft characteristics (source, type, preparation), range of movement (ROM), patient-reported outcome measures (Oxford Shoulder Scores [OSS]), and complications were recorded. Radiographic imaging was used to analyse implant stability, graft incorporation, and notching by two independent reviewers.

Results: Between 2013 and 2021, a total of 53 primary RTSA procedures (48 patients) with glenoid bone grafting were identified. Humeral head autograft was used in 51 (96%) of cases. Femoral head allograft was utilised in two cases. Depending on the morphology of glenoid bone loss, a combination of structural (corticocancellous) and non-structural (cancellous) grafts were used to restore glenoid bone stock and the joint line. All grafts were incorporated at review. The mean post-operative OSS was significantly higher than the pre-operative OSS (40 vs. 22, $p < 0.001$). ROM was significantly improved post-operatively. One patient experienced scapular notching resulting in the fracturing of the inferior screw. This patient underwent revision due to glenoid baseplate failure. One patient experienced recurrent dislocations but was not revised.

Conclusions: Overall, at short term follow up, glenoid bone grafting was effective in addressing glenoid bone loss with excellent functional and clinical outcomes when used for complex bone loss in primary RTSA. The graft incorporation rate was high, with an associated low complication rate.

EP.06.188

RELATIONSHIP BETWEEN THE PROSTHESIS SCAPULAR NECK ANGLE AND CLINICAL OUTCOMES IN REVERSE SHOULDER ARTHROPLASTY

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Background: Optimal glenosphere positioning in reverse shoulder arthroplasty (RSA) remains highly debated. We aimed to characterize the association between the prosthesis scapular neck angle (PSNA) and postoperative clinical outcomes including range of motion (ROM), functional scores, and complications.

Methods: A retrospective review of 284 RSAs using a single medialized glenoid lateralized humeral component design with minimum 2-year follow-up was performed. Glenosphere tilt was measured postoperatively using the PSNA- the angle between the intersection of vertical axis of glenosphere and the straight line along the inferior scapular neck. ROM and functional outcome scores were assessed preoperatively and at latest follow-up. The PSNA was dichotomized to inferior or superior groups (greater than 90° vs. less than or equal to 90°, respectively) and stratified into quartiles; ROM and outcome score measures were compared between groups controlling for inferior glenosphere overhang.

Results: PSNA between inferiorly inclined and neutral or superiorly inclined inferior glenosphere tilt was significantly different between groups ($95.6 \pm 4.5^\circ$ vs. $85.8 \pm 3.6^\circ$, respectively, $P < .001$). Inferiorly inclined glenosphere tilt demonstrated more external rotation postoperatively when compared to superiorly inclined glenosphere tilt ($31 \pm 18^\circ$ vs. $26 \pm 19^\circ$, $P = .047$). No range of PSNA was consistently associated with clinically important differences in ROM, clinical outcome scores, or rates of complications including scapular notching. Superiorly inclined glenosphere tilt did demonstrate more preoperative to postoperative improvement in active forward elevation (FE) when compared to inferiorly inclined glenosphere tilt ($53 \pm 35^\circ$ vs. $37 \pm 33^\circ$, $P = .005$), and glenospheres with PSNA in the first quartile ($85.1 \pm 3.5^\circ$) had the greatest improvement in active FE ($57 \pm 35^\circ$, $P = .004$) compared to the rest of the quartiles. However, these findings can likely be attributed to significantly worse preoperative active FE scores in this cohort, as active FE at final follow-up did not differ between inferiorly inclined or superiorly inclined glenosphere tilt groups ($125 \pm 23^\circ$ vs. $125 \pm 26^\circ$, respectively, $P = .824$).

Conclusions: Though small differences in ROM were found between superior and inferior PSNA, a lack of significant differences between clinical outcome scores suggests negligible clinical significance as long as glenosphere tilt falls within the distribution studied herein ($92.6^\circ \pm 6.2^\circ$). These findings suggest that the PSNA is likely a minor contributor to differential short-term outcomes; however, longer follow-up is needed to ascertain the impact on long-term outcomes and complications.

EP.06.189

THE EFFECT OF SMOKING ON RANGE OF MOTION AND PATIENT-REPORTED OUTCOMES FOLLOWING REVERSE TOTAL SHOULDER ARTHROPLASTY AT MINIMUM TWO-YEAR FOLLOW-UP

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Background: OStudies evaluating total hip and total knee arthroplasty have shown that tobacco use has a negative impact on outcomes. However, this trend has not been effectively evaluated in reverse shoulder arthroplasty (RSA), where bony ingrowth/ongrowth of the glenoid component is critical for patient function. We sought to assess whether smokers and nonsmokers have differences in outcomes scores and range of motion (ROM) in a larger cohort of patients.

Methods: A single-institution prospectively-collected shoulder arthroplasty database was reviewed. All patients who underwent RSA with preoperative and postoperative ROM measures and outcome scores with minimum 2-year follow-up were included. Analysis was performed comparing outcomes between three cohorts: nonsmokers, former smokers (defined as having quit smoking at least 1 month prior to undergoing RSA), and current smokers.

Results: 47 current smokers, 98 former smokers, and 478 nonsmokers were included in analysis. All groups had significant improvements in outcomes scores and ROM. Subgroup analysis found current smokers had less improvement than nonsmokers in SPADI (-32.4 ± 27.4 vs -44.0 ± 22.1 , $p=0.002$), UCLA shoulder score (10.1 ± 13.0 vs 16.0 ± 8.6 , $p<0.001$), normalized Constant score (23.7 ± 35.1 vs 34.8 ± 23.6 , $p=0.006$), and active abduction ($27.8^\circ \pm 58.4^\circ$ vs $40.9^\circ \pm 38.1^\circ$, $p=0.04$). Similarly, former smokers had less improvement than nonsmokers in UCLA shoulder score (8.6 ± 13.0 vs 16.0 ± 8.6 , $p<0.001$), normalized Constant score (16.9 ± 38.0 vs 34.8 ± 23.6 , $p<0.001$), active external rotation ($7.3^\circ \pm 26.1^\circ$ vs $13.1^\circ \pm 23.2^\circ$, $p=0.03$), active elevation ($12.4^\circ \pm 63.4^\circ$ vs $45.6^\circ \pm 36.3^\circ$, $p<0.001$), and active abduction ($9.7^\circ \pm 62.5^\circ$ vs $40.9^\circ \pm 38.1^\circ$, $p<0.001$). Between smokers and former smokers, the only difference found was in SPADI score (-32.4 ± 27.4 vs -45.4 ± 24.0 , $p=0.006$).

Conclusions: We believe this is the largest cohort study looking at the effect of smoking on outcomes following RSA. Overall, all patients had improvement in outcome scores and ROM following RSA despite smoking history, but active smokers had less improvement than nonsmokers. Interestingly, even former smokers had less improvement compared to nonsmokers, suggesting that the detrimental effects of smoking on RSA outcomes may not be fully reversible after cessation of smoking.

EP.06.190

DOES THE PROXIMAL HUMERAL BONE QUALITY INFLUENCE THE ALIGNMENT AFTER REVERSE TOTAL SHOULDER ARTHROPLASTY WITH SHORT HUMERAL STEMS?

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Background: Compared to standard-length humeral stem in reverse total shoulder arthroplasty (RTSA), short humeral stems in RTSA require good proximal humeral metaphyseal bone quality to gain proper and secure fixation during prosthetic implantation. Shorter humeral stems potentially carry the risk of varus/valgus malalignment. The hypothesis was that malalignment of the stem is influenced by regional bone quality.

Methods: RTSA with a short curved humeral stem (145° Neck Shaft Angle) was reviewed. The study group included 36 cases at a mean age of 75.97 (\pm 6.23) years. Deltoid-tuberosity index (DTI) was measured to evaluate proximal humeral bone quality. The deltoid tuberosity index was measured at immediately above position of the upper end of the deltoid tuberosity. The DTI equals the ratio between the outer cortical and inner endosteal diameter. Stem alignment was given by the angle measured in degrees between the intramedullary humeral shaft axis and the axis of the humeral implant stem. The humeral stem alignment was defined as neutral if the value fell within \pm 5° of the longitudinal humeral axis. Angular values $>$ 5° in valgus or varus were defined as malalignment.

Results: Twelve humeral stems (33.3%) were placed in the neutral position and 24(66.7%) in the valgus after RTSA. There was a moderate correlation between malalignment and DTI ($r = -0.47$; $p=0.004$) However, there is no correlation between malalignment and functional outcomes ($p>0.05$).

Conclusions: The malalignment of the short curved humeral stem frequently occurs. Although humeral bone quality influences malalignment after RTSA with a short humeral stem, it does not affect functional outcomes for midterm follow-up. Further long-term follow-up studies are needed to confirm its clinical relevance.

EP.06.193

A LEARNING CURVE BASED ON SURGICAL TIME, BLOOD LOSS, AND INTRAOPERATIVE COMPLICATIONS FOR COMPARISON OF POSTOPERATIVE COMPLICATIONS AND OTHER CLINICAL OUTCOMES OF REVERSE SHOULDER ARTHROPLASTY

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Background: When a new technology is introduced, it is important to know the learning curve period to master the procedure. This study aimed to define the learning curve period for reverse shoulder arthroplasty and analyze postoperative complications and other clinical outcomes in the first 50 cases that underwent this operation.

Methods: We retrospectively evaluated the 50 first shoulders, which underwent reverse shoulder arthroplasty between April 2014 and February 2016. Patients were divided into five groups (n=10 each). The average patient age at the time of operation was 78 (range, 70-86) years. Surgical time, intraoperative blood loss, and intraoperative complications were analyzed to define the learning curve period. Patients were divided into two groups (during vs. after learning curve) for comparing range of motion, constant score, and postoperative complications with a minimum of 2-year follow-up.

Results: Mean surgical times (108, 94, 99, 85, and 79 minutes in each group, from the first 1-10 to the last 41-50 cases, respectively) gradually decreased, and their standard deviations also decreased after 30 shoulders. Among the groups, there were six intraoperative complications, with no difference in intraoperative blood loss. Using surgical time analysis, we compared postoperative complications and other clinical outcomes of the first 30 cases (during learning curve) and the last 20 cases (after learning curve). Active elevation, abduction, and constant score improved from before operation to the last follow-up, with no differences in clinical outcomes between the groups. Four postoperative complications in the first 30 cases and one in the last 20 cases were observed.

Conclusions: By surgical time analysis, we considered the first 30 cases of reverse shoulder arthroplasty as the learning curve period of this procedure. There was no significant difference in postoperative complications and other clinical outcomes at 2-year follow-up in this procedure during and after the learning curve period.

EP.06.194

BONY INCREASED-OFFSET REVERSE SHOULDER ARTHROPLASTY FOR EXTREME GLENOID BONE WEAR

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Background: Reverse shoulder arthroplasty (RSA) of the Walch type B3 and C glenoids are challenging. Failure to correct posterior glenoid erosion can lead to decreased range of motion and scapular notching. Techniques to address glenoid morphology include eccentric reaming, glenoid bone grafting, both reaming and grafting, and augmented base-plating. Angled bone graft from the humeral head in bony-increased offset-reverse should arthroplasty (BIO-RSA) has been described to facilitate intraoperative modification and customization of the graft to best fit the structure of the deformed glenoid while preserving the ability to lateralize the center of rotation. Results of use in extreme glenoid erosion has not been well reported. The purpose of this study was to report results after a wedge-shaped autologous bone graft with extreme glenoid erosion.

Methods: All patients with pre-operative glenoid retroversion of greater than 30° who underwent primary angled BIO-RSA were included. Planned two-stage arthroplasties and revisions were excluded. Data collected included degrees of retroversion, intraoperative and postoperative complications, reoperations, and time to follow-up.

Results: Twenty-five angled BIO-RSAs in 24 individuals (15 men and 9 women, 13 right shoulders and 12 left shoulders) were included. Mean age at surgery was 65.9 years and mean mass index was 27.6. Surgical indications included osteoarthritis (23), rotator cuff arthropathy (1), and post-traumatic injury (1). Mean preoperative retroversion was 37.5° (range: 30° - 51°). Mean follow-up was 48.4 months (range: 7.7 - 94.0 months). The subscapularis was completed in 14 of 25 surgeries. There were no intraoperative complications. Active and passive shoulder flexion and abduction was significantly increased at last follow-up. One patient developed a shoulder hematoma postoperatively and 1 patient had a fracture of the inferior glenoid screw at 11 months and underwent a revision at one year postoperatively. Eleven of 25 individuals had a mean American Shoulder and Elbow Surgeons Shoulder Score with of 87.19 and mean Shoulder Subjective Value of 88.7%.

Conclusions: Patients with severe glenoid erosion who underwent angled BIO-RSA demonstrated significant improvements in range of motion and functional status without substantial complication and revision rates.

EP.06.195

SINGLE-STAGE REVISION FOR PERI-PROSTHETIC SHOULDER INFECTION. RESULTS AT 2 YEARS FOLLOW-UP

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Background: Reinfection rates have been shown to be similar between single and two stage revision for treatment of prosthetic joint infection of the hip and knee in numerous studies. The main objective of our study was to evaluate the rate of recurrence of prosthetic infection after revision of a one-stage revision of total shoulder arthroplasty. We hypothesized that single-stage revision for periprosthetic shoulder infection allows good control of the infection and satisfactory functional results

Methods: Thirty-four consecutive patients who underwent single-stage revision for periprosthetic infection of the shoulder between 2014 and 2020 with a minimum 2 year-follow-up were included in this study. The diagnosis of periprosthetic joint infection was confirmed by culture results of intraoperative specimens. Patients who had not undergone a bipolar change were excluded. All patients were followed for a minimum of 2 years. Outcome measures included infectious recurrence (confirmed by peri-prosthetic samples under radiographic control). Functional clinical results and complications were also reported.

Results: The mean follow-up was 40.4 months ($24-102 \pm 21.6$). Three patients out of 34 had an infectious recurrence (8.8%). The mean Constant score at last follow-up was 49 ($42-57 \pm 21.83$). Eight patients had a complication, i.e. an overall complication rate of 23.5%, with 8.8% septic complications and 14.7% mechanical complications. Four of them required at least one revision surgery.

Conclusions: Single-stage revision for periprosthetic shoulder infection provides satisfactory functional results with a low rate of septic recurrence at short-term follow-up

EP.06.196

CONCENTRIC VS. ECCENTRIC TRAY OPTIONS IN REVERSE TOTAL SHOULDER ARTHROPLASTY - COMPARISON WITH SHORT-TERM CLINICAL AND RADIOLOGICAL OUTCOMES

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Background: The purpose of current study is to evaluate the clinical relevance of concentric or eccentric humeral tray options in RTSA by comparing short-term outcomes before and after applying tray options.

Methods: We retrospectively reviewed 112 patients who underwent RTSA using a single type of 'lateral' implant. Our indications of using concentric tray are in patients 1) whose critical shoulder angle (CSA) was greater than 32° or 2) with positive external rotation lag sign (ERLS) even if CSA was less than 32°. For an eccentric tray, they are in patients 1) whose CSA was less than 32° or 2) CSA was greater than 32° and center of rotation to acromion distance (CAD) was greater than 1.4 cm at the same time, or 3) in patients with pseudoparalysis. As the eccentric tray option was available in the ' institution from December 2019, we enrolled 14 patients with the eccentric tray and 8 patients with the concentric tray after this time point as Group I and Group A, and 23 patients who were suitable for using eccentric tray and 10 patients with conventional concentric tray before this time point as Group II and Group B. Clinical outcomes and radiological outcomes including humerus lateralization (HL) and acromiohumeral distance (AHD) were compared at postoperative 1 year.

Results: At postoperative 1 year, forward flexion ($143.9^\circ \pm 9.3^\circ$ vs $131.3^\circ \pm 13.9^\circ$; $P = 0.032$) and AHD (3.8 ± 0.4 cm vs 2.9 ± 0.5 cm; $P < 0.001$) were statistically greater in Group I than Group II, and HL was significantly narrower in the Group I than in the Group II (1.4 ± 0.4 cm vs 2.0 ± 0.4 cm; $P = 0.022$). No statistical difference was found in clinical outcomes and radiological outcomes between Group A and Group B.

Conclusions: In the current clinical comparison study, it is confirmed that the position of humerus would be less lateralized and more distalized by using an eccentric tray than concentric tray. The optimized tray option would be selected to improve clinical outcomes according to CSA, CAD, the presence of pseudoparalysis and ERLS before surgery of RTSA.

EP.06.197

GLENOID INCLINATION AND VERSION MEASUREMENT TECHNIQUES USED FOR 3D PREOPERATIVE PLANNING IN TOTAL SHOULDER ARTHROPLASTY

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Background: Preoperative measurements of glenoid inclination and version influences the choice of prosthesis (reverse or anatomic) and the glenoid component positioning in total shoulder arthroplasty. The purpose of this study is to evaluate three different measurement techniques for glenoid version and inclination in total shoulder arthroplasty.

Methods: CT-based 3D scapula models of 23 consecutive patients with arthritic shoulders were analyzed by three independent observers using Mimics and 3-Matic (Materialise). Scapular landmarks (2 definitions for the glenoid center), planes (2 definitions for the glenoid plane) and reference axes (transverse and supraspinatus fossa axis) were manually defined. A script was consequently used to calculate glenoid version and inclination by three methods each: between the supraspinatus fossa axis and the axis through the glenoid plane defined by all points on the glenoid (method 1), between the axis through the glenoid center (most medial point) and the trigonum scapula and the axis through the inferior-superior (inclination) and anterior-posterior (version) points on the glenoid (method 2) and between the axis through the glenoid center (the crossing of the inferior – superior and anterior – posterior lines) and the trigonum scapula and the axis through the glenoid plane defined by three points (anterior, posterior and superior) (method 3).

The results were statistically analyzed in SPSS to determine the interobserver reliability (ICC) and differences between the methods (pairwise comparisons).

Results: The interobserver reliability was good for glenoid inclination method 3 (ICC = 0.877) and excellent for all other evaluated methods (ICC: 0.922-0.995).

For glenoid inclination there was no significant difference between the first and the second method, but the third method showed significantly different measurements compared to the first and second method ($p < 0.001$). For glenoid version, there was no significant difference between the second and the third method, but the first method resulted in significantly different measurements compared to the second and the third method ($p < 0.001$).

Conclusions: This study shows significant differences between the glenoid inclination and version measurements techniques widely used for 3D preoperative planning in total shoulder arthroplasty. The interobserver reliability showed no significant differences concerning the inclination and version measurement techniques.

EP.06.199

REVERSE SHOULDER ARTHROPLASTY WITH ISOLATED LATISSIMUS-DORSI OR COMBINED WITH TERES-MAJOR TRANSFER FOR LACK OF EXTERNAL ROTATION: A COMPARATIVE STUDY

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Background: RSA associated with isolated LD transfer or in combination with TM transfer had been confirmed to effectively overcome the expected external rotation deficit in patient with posterosuperior massive cuff tear and teres minor deficiency. The objective of this study was to evaluate the clinical and radiological outcomes of RSA associated with two techniques: L'Episcopo procedure (combined Teres-major and Latissimus dorsi transfer) and Modified L'Episcopo procedure (isolated Latissimus dorsi transfer).

Methods: A retrospective review of 36 RSAs (mean age 69.8 years; SD 8.9) associated with either L'Episcopo procedure (Group 1, 21 cases) or modified L'Episcopo procedure (Group 2, 15 cases) was performed between 2007 and 2020. Clinical outcome measures included range of motion (ROM), SSV, VAS, and Constant-Murley scores were compared between the two groups. Radiographs were assessed for transfer site bony lesions.

Results: With a mean follow-up of 40.8 months (6-98; SD 28.8), no significant differences were revealed in clinical outcomes: Constant score, SSV, VAS, ROM. The entire study group demonstrated a significant improvement in post-operative functional outcome scores and ROM parameters compared to pre-operative state, with IR being the only exception ($p=0.26$). Radiographs demonstrated transfer site bony lesions in 60% of the patients (18/30). Three complications (8.3%) were noted in the study

Conclusions: At the short-term follow-up, RSA combined with either LD transfer in isolation or in association with TM, proved to be equally effective in restoring external rotation in the settings of a irreparable postero-superior cuff tear treated with RSA. Although the LD transfer group displayed a tendency towards superior ROM, this was not supported statistically. Post-operative radiographs confirmed the presence of bony lesions at the transfer fixation sites in both groups of patients (52% vs. 72%).

EP.06.200

THE USEFULNESS OF THE INTRAOPERATIVE ZERO-POSITION ASSESSMENT AS A CRITERION FOR SOFT TISSUE BALANCE IN REVERSE SHOULDER

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Background: Reverse total shoulder arthroplasty (RSA) reliably improves pain and function associated with rotator cuff deficient shoulder by the shoulder anatomical change. Therefore, soft tissue balance in RSA is important, however, it remains largely unclear. The "zero-position" of the shoulder joint, that is the position the axis of the humerus is in line with the axis of the spine of the scapula, is reported as a well-balanced position in the shoulder elevation. We investigated whether intraoperative zero-position acquisition can be a good criterion for RSA setting.

Methods: Fifty shoulders forty-nine patients were included this study. After setting RSA we elevated patients arm in scapula plane with grasping at patient's wrist. We defined zero position as the position that humeral axis is fit with the scapula spine. We divided into two groups according to intraoperative zero-position acquisition or not. In addition, we compared characteristic data, alignment of RSA, and active shoulder range of motion between two groups.

Results: 28 of 50 shoulders were achieve intraoperative zero-position. There was no significant difference in sex, age, affected side, follow-up term between two groups. There was also no significant difference in Maker, beta angle, humeral retroversion, and glenosphere size. Both groups were significantly improved shoulder elevation after surgery. However, the zero-position acquisition group was significantly larger in flexion and abduction than the zero-position impossible group at 3, 6, 12 and last visit. Moreover, Significant improvement in elevation angle was obtained even after 3 months after surgery only in the zero-position possible group.

Conclusions: It was reported that intraoperative motion can be a powerful decision-making tool. Intraoperative zero-position acquisition can guarantee the glenohumeral motion early after surgery and can help to obtain a good elevation after RSA. Additionally, intraoperative zero-position confirmation using fluoroscopy is an objective assessment that does not require special equipment. Therefore, our findings suggest that intraoperative zero-position check using fluoroscopy can be a good criterion for the RSA setting.

EP.06.201

DO THRESHOLDS OF PREOPERATIVE FUNCTION PREDICT ACHIEVEMENT OF CLINICALLY-IMPORTANT BENCHMARKS OF IMPROVEMENT AFTER REVERSE TOTAL SHOULDER ARTHROPLASTY?

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Background: The purpose of this study was to determine if there is a threshold of preoperative function that is predictive of achieving clinically-important success at minimum 2-year follow-up after reverse total shoulder arthroplasty (RTSA).

Methods: We retrospectively reviewed a multicenter database for patients that underwent primary RTSA. Outcomes evaluated were abduction, forward elevation, external and internal rotation, SST, Constant, ASES, UCLA, SPADI, and SAS scores. Clinically-important benchmarks (CIBs) evaluated include: Minimum Clinically Important Difference (MCID), Substantial Clinical Benefit (SCB), Patient Acceptable Symptomatic State (PASS), and the Minimal and Substantial Clinically Important Percent Maximal Possible Improvement (MCI-%MPI and SCI-%MPI); RTSA-specific CIBs were adopted from prior studies. Multivariable logistic regression was first performed to assess whether preoperative outcomes predicted achieving CIBs independent of age, sex, and BMI. Next, a ROC analysis was performed to determine the preoperative thresholds predictive of achieving CIBs per the Youden index; identified thresholds were applied to create contingency tables and compared with Fisher's Exact test.

Results: 3,205 RTSAs were included. Poorer preoperative ROM was associated with greater odds of achieving the MCID and SCB for all ROM measures except the MCID for forward elevation ($P \leq 0.014$), but lower odds of achieving the PASS ($P \leq 0.001$). More favorable preoperative scores were associated with greater odds of achieving the PASS for all scores, but only for a few scores for other CIBs. Thresholds of preoperative ROM and outcome scores identified on ROC analysis were significant predictors of achieving the MCID, SCB, and PASS for all outcomes ($P < 0.001$), but not the MCI-%MPI and SCI-%MPI. Preoperative thresholds that predicted achieving CIBs for ROM were lowest for the PASS and highest for the MCID, while for outcome scores they were lowest for the PASS and similar between the MCID and SCB. Preoperative ROM thresholds better-differentiated whether patients would achieve CIBs compared to outcome score thresholds. Variability in identified thresholds, respective AUCs, and predictiveness of achieving CIBs was minimal when stratified by age and sex.

Conclusions: Preoperative ROM and outcome scores can be utilized to predict the likelihood of achieving absolute CIBs of success (MCID, SCB, PASS) after RTSA, but not relative CIBs (MCI-%MPI and SCI-%MPI).

EP.06.203

DETERMINING THE PREVALENCE OF APPROPRIATE PRIMARY ANATOMIC TOTAL SHOULDER ARTHROPLASTIES USING A VALIDATED RAND/UCLA ALGORITHM

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Background: A recent study used the RAND/UCLA method to generate and validate appropriateness guidelines for primary anatomic TSA. There have been no clinical studies to our knowledge that specifically stratify real-world clinical TSA patient cases into appropriateness categories and characterize appropriateness classification groups. Given the rise in utilization, appropriateness criteria for TSA have the capability to be an exceptionally compelling tool for enhancing quality of care and controlling costs. Thus, we used a modified RAND/UCLA appropriateness classification scheme to calculate prevalence rates of appropriate, inconclusive, and inappropriate total shoulder arthroplasties (TSA) and to characterize patients within each group.

Methods: Baseline demographic information and pre-operative outcome scores from a multicenter, prospectively-collected cohort of patients undergoing primary anatomic TSA were examined using IBM SPSS Statistics. Patients were classified as either "appropriate," "inconclusive," or "inappropriate," using a modified version of a validated appropriateness algorithm.

Results: Data from 377 patients that had undergone TSA were assessed. 22.5% (95% CI [18%, 27%]) of patients were classified as appropriate, while 20.7% (95% CI [17%, 25%]) were classified as inappropriate. 56.8% (95% CI [52%, 62%]) were classified as inconclusive. The appropriate group demonstrated statistically significantly worse pre-operative pain and functional outcomes scores versus the inconclusive and inappropriate groups.

Conclusions: There was considerable variation in the characteristics of patients undergoing TSA, largely driven by age, symptomatology, and Walch classification. Approximately one-fifth of primary anatomic TSAs were determined to be inappropriate. A significant number of patients may be classified as "inconclusive." This may be secondary to worsening glenoid morphology and/or history of prior rotator cuff repair, which is consistent with modern debates to determine appropriateness for primary anatomic TSA versus reverse TSA candidates. Appropriate patients tended to have worse pre-operative function and pain scores than inconclusive and inappropriate patients. This study demonstrates the importance of further consensus development to address variation in patient demographics and to evaluate the relationship between pre-operative appropriateness and post-operative outcomes.

EP.06.204

POSTOPERATIVE ELEVATION LIMITING FACTORS IN REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: RSA has been reported to have good clinical outcomes for cuff tear arthropathy and irreparable rotator cuff tear, but there are also cases with poor outcomes. The purpose of this study was to evaluate the clinical outcomes of patients who performed RSA in our department and to identify factors affecting postoperative range of motion.

Methods: 68 shoulders in 66 patients who undergone RSA at our department from November 2014 to August 2021 and had a follow up of at least 6 months were included in this study. The average age was 75 years and the mean follow up period was 31 months. The following preoperative factors were evaluated: gender, age, side, diagnosis, primary or revision surgery, smoking, alcohol consumption, diabetes, RA, height, weight, BMI, and preoperative shoulder ROM. In addition, operative time, intraoperative blood loss, number of tear cuff, presence of subscapularis suture, model (Inlay or Onlay), flexion ROM on intraoperative EUA, and postoperative ROM, clinical scores, lateral humeral offset, and the placement angle of glenoid component. The correlation between each item and flexion ROM at final follow up was evaluated to identify factors associated with limitation of elevation.

Results: The results of this study showed that postoperative ROM was significantly negatively correlated with age($r=-0.27$, $p=0.02$), cases of revision surgery($r=-0.21$, $p<0.05$), history of RA($r=-0.21$, $p<0.05$). And preoperative flexion($r=0.24$, $p<0.05$) and abduction ROM($r=0.36$, $p<0.01$), subscapularis suture were positively correlated($r=0.25$, $p=0.04$). History of arthroplasty($r=-0.21$, $p<0.05$), fracture surgery($r=-0.24$, $p=0.24$) were also significantly negative correlated, while history of ARCR and ORCR surgery had no correlation. .

Conclusions: This study investigated factors that affect range of motion after RSA. Previous surgery influenced postoperative ROM. But ARCR,ORCR had no influence for postoperative ROM. In contrast, previous shoulder arthroplasty and fracture surgery had significantly influenced. This may be due to adhesions and joint contractures of the deltoid and subscapularis muscles caused by surgical invasion. Differences of implant type, placement angle, and flexion range of motion in the intraoperative had no influences.

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CLINICAL OUTCOME AFTER SMALL-HEAD HHR AND ROTATOR CUFF RECONSTRUCTION USING SCR WITH REROUTED LHB FOR CUFF TEAR ARTHROPATHY

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Background: We have treated rotator cuff reconstruction and humeral head replacement (HHR) using smaller humeral prostheses for cuff tear arthropathy from 2001 and reported good clinical outcomes of our strategy before. However, there were any cases that be not able to yield outcomes to be satisfied, so we have modified our strategy combined with superior capsular reconstruction (SCR) using rerouted long head of biceps (LHB) to yield better clinical outcomes from 2019. The aim of this present study was to investigate clinical outcomes of our modified strategy.

Methods: 34 shoulders with cuff tear arthropathy, were treated with cuff reconstruction and HHR from February 2019 to March 2021. We investigated 17 shoulders (Group SCR) added SCR using rerouted LHB, and 17 shoulders (Group O) without SCR. LHB was transferred posterior and fixed to the greater tuberosity using sutures. The average age at the time of surgery (Group SCR/O) was 69.9(56-84)/71.4(56-84) years and average follow-up period was 20.6(12-38)/20.2(12-31) months. Clinical outcomes were assessed with the ROM, JOA score, exist of symptoms related LHB (include Popeye sign), complications and AHI by X ray.

Results: Active forward flexion (Group SCR/O) has improved from an average of 124/118.3° to 149/133.2°, and ER improved from an average of 24.1/20° to 32.9/40.9°.

The preoperative JOA score (Group SCR/O) were 60.4/58.7 respectively, improving to 88.4/85.9 respectively, after surgery. No symptoms related LHB and complications occurred after surgery in both groups. The mean preoperative AHI (Group SCR/O) increased from 5.8/5.4 mm to 8.2/6.9 mm. All cases in Group SCR and 13 cases in Group O have yielded more than 120° for active forward flexion.

Conclusions: Clinical outcomes after cuff reconstruction and HHR that added SCR using rerouted LHB were good and stable outcomes. This technique is not able to treat for the cases that LHB tendon defected preoperatively. Furthermore, we need to investigate the level of degeneration of LHB tendon that we can use, and biomechanical study (include tension and position transferred LHB tendon).

EP.06.206

THE EFFECT OF RSA LATERALIZATION ON ABDUCTION AND ADDUCTION

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Background: Lateralization may help preventing scapular notching of RSA. But the effect and the best pattern of lateralization are unclear. The purposes of this study were to evaluate impingement-free ROM for abduction and adduction in a virtual 3D RSA model and to determine the effect of lateralization.

Methods: Preoperative CT scans obtained in 30 patients with primary osteoarthritis or cuff tear arthropathy without glenoid bone defect were analyzed using three-dimensional templating software for RSA. We classified into 4 groups as follows; group N: no lateralization (inlay type humeral implant), group G: glenoid lateralization (inlay + BIO-RSA), group H: humeral lateralization (onlay type humeral implant) and group G+H: glenoid and humeral lateralization (onlay + BIO-RSA). The impingement-free ROM for abduction and adduction were simulated and compared between each group.

Results: The average abduction was 89.4 degrees in group G, 79.1 degrees in group N, 74.4 degrees in G+H group and 70.6 degrees in group H. Significant difference was observed between each group. The average adduction was 23.1 degrees in group G+H, 11.1 degrees in group G, 9.6 degrees in group H and 1.8 degrees in group N. Significant difference was observed between each group except between group G and H.

Conclusions: Interestingly abduction was larger in group G+H, which had the largest lateralization, than in group H. In group G+H group, the humeral insert penetrated deeper into the joint and acquired abduction due to lateralization by grafting. The adduction increased with lateralization. This result might be useful for selecting the pattern of lateralization.

EP.06.207

THE USE OF NON-OPIOID MULTIMODAL ANALGESIA FOR TOTAL SHOULDER ARTHROPLASTY: A RETROSPECTIVE STUDY

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Background: The purpose of this study was to compare the pain level and the amount of opioid consumed in postoperative total shoulder arthroplasty (TSA) patients who were treated with a standard opioid-including regimen versus a non-opioid multimodal analgesia regimen.

Methods: We retrospectively reviewed two consecutive cohorts who underwent TSA—either anatomic or reverse—by a single surgeon. The opioid cohort included patients from early 2016 to late 2020 and were given 80 tablets of Percocet 5 mg/325 mg that followed a dose reduction plan to 60, 40, and 20 tablets for consecutive refills (max of 3 refills). The non-opioid cohort included patients from late 2020 to mid 2022 and consisted of preoperative oral analgesics (Celecoxib, Pregabalin, and Tramadol); intraoperative IV Dexamethasone and Acetaminophen, and local infiltration of Ropivacaine, Epinephrine and Ketorolac; and postoperative oral Dexamethasone and oral analgesics (Pregabalin, Tizanidine, Magnesium, Ibuprofen, and Acetaminophen). Visual Analog Scale (VAS) scores for pain (preoperative, and 10-days, 6-weeks, 3-months, and 6-months postoperative) and opioid consumption (preoperative, and 10-days, 6-weeks, and 3-months postoperative) using Morphine Milligram Equivalents (MME) were compared and analyzed using the nonparametric Wilcoxon rank-sum test for both cohorts. Total MME was calculated as max consumption.

Results: There were 249 patients in the opioid cohort and 127 in the non-opioid cohort. No between-group differences were found in demographic factors—including age, sex, race, BMI, smoking status—or anatomic versus reverse TSA. Patients treated with the non-opioid protocol had lower mean VAS scores at preoperative (6.4 vs 7.4, $p < 0.05$), 10-day (3.5 vs 4.2, $p < 0.05$), and 6-week postoperative time points (2.1 vs 2.8, $p < 0.05$). Opioid consumption was lower in the non-opioid multimodal cohort at all time periods ($p < 0.005$). Complications such as 90-day hospital readmissions and revision surgery at one-year were not significantly different between the groups.

Conclusions: A non-opioid multimodal postoperative regime is reliable and well tolerated by patients undergoing Total Shoulder Arthroplasty. They have lower early postoperative VAS scores (10-days and 6-weeks) and a significant reduction in opioid utilization. One-year postoperative complications between both groups were similar indicating that a non-opioid regimen is effective in safely controlling postoperative pain.

EP.06.209

EARLY ACTIVE RANGE OF MOTION VS. CONSERVATIVE INITIAL IMMOBILIZATION FOLLOWING REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: Reverse total shoulder arthroplasty (RSA) surgery has increased over the years. Despite this, there is a scarcity of data regarding the benefits and risks of different postoperative rehabilitation protocols, especially as it pertains to initiation of active range of motion following surgery. The purpose of this study is to compare two different postoperative rehabilitation protocols with respect to their allowance of early active range of motion following reverse total shoulder arthroplasty.

Methods: Patients undergoing RSA by 4 fellowship trained orthopaedic surgeons were included. Patients were placed in the early active (EA) or conservative (CON) cohort, depending on their surgeon's preferred protocol. CON patients were immobilized in an abduction sling for 6 weeks post-operatively with formal therapy starting at 6 weeks. EA patients were in an immobilizer sling for 1 week with therapy starting at 1 week. Patient-Reported Outcomes Measurement Information System (PROMIS) Upper Extremity (-UE), Pain (-PI), Depression (-D), visual analog scale (VAS), range of motion (ROM), and strength were recorded pre-operatively and at 6-week (6W), 3-month (3M), 6-month (6M), and 12-month (12M).

Results: A total of 95 patients were included with 58 patients in the EA group and 37 in the CON group. Significant differences were seen active forward flexion favoring the EA group, 116.89 vs 85.89 at 6W ($p=0.0001$), 132.11 vs 110.08 at 3M ($p=0.0004$), 138.33 vs 116.79 at 6M ($p=0.0288$), and 158 vs 120.4 at 12M ($p=0.0012$). Similarly, statistically significant differences were observed in active abduction favoring the EA group, at 104.19 vs 75.43 at 6W ($p=0.0011$), 119.52 vs 96.38 3M ($p=0.0014$), 129.17 vs 99.39 at 6M ($p=0.0008$), and 152 vs 113.6 at 12M ($p=0.0036$). No difference was seen in VAS at the 3-month mark and beyond. PROMIS-UE favored the early active ROM group at both the six-week ($p=0.003$) and 12-month ($p=0.005$). There was no significant difference in complication rate.

Conclusions: Early active range of motion is safe and demonstrates improved ROM in flexion and abduction compared to conservative postoperative management as well as improved patient reported outcomes at early and late timepoints. There was no increased risk of complication with early active motion.

EP.06.210

ON THE CONCERNING EARLY FAILURE OF A SHORT STEM PRESS-FIT HUMERAL COMPONENT

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Background: Our institution has a registry of all shoulder arthroplasties performed between 2004 and present and an ongoing shoulder implant retrieval study. Concern was elevated for a specific implant with multiple early failures due to aseptic humeral loosening and unique radiographic characteristics. These cases were analyzed.

Methods: A specific short stem for anatomic TSA and hemiarthroplasty was evaluated. Of the 117 stems of this type implanted over a 3-year period, 13 (11.1%) required revision to reverse TSA due to radiographic loosening and pain at an avg. of 23.8 mn (range 1.8-92.5 mn). Clinical and radiographic evaluations were performed. Tribological and histological analyses were performed on retrieved implants and periprosthetic membranes, respectively.

Radiographic loosening was defined as a >2mm radiolucent line in more than two zones, lucency progression, or implant shifting. Component damage was graded using a stereomicroscope. Periprosthetic membranes were stained with H&E and evaluated for cellular response. The presence of particle-laden macrophages, foreign giant cells (FBGCs), lymphocytes, and neutrophils was graded. Debris presence was recorded.

Results: A unique radiographic loosening pattern was noted with expanding lucent lines, but with lateral humeral component subsidence and lateral, proximal humeral endosteal cortex thinning in 9 of 13.

67% of membranes had marked macrophage responses. 50% had marked FBGC responses. These implants also had marked hinge damage and moderate polyethylene and metal bearing surface damage. Metal particles, polyethylene, cement, and suture were present in all patients. Overall evaluation revealed moderate hinge damage and mild stem and head taper damage.

Conclusions: Recently, shorter humeral stems have become more common. Aseptic humeral loosening is rare. This implant has no in-growth material and multiple metal-on-metal surfaces. This specific short stem had a high rate of early failure and a unique radiographic loosening pattern.

Further analysis is necessary, but an 11% revision rate due to aseptic humeral loosening at an average of 23 months is cause for concern. Wear debris caused a marked macrophage and FBGC response in the periprosthetic tissues of patients with failed implants. Cases with the most severe tissue response had the most damage seen at the hinge and bearing surfaces.

EP.06.211

CLINICAL, FUNCTIONAL AND RADIOGRAPHIC OUTCOMES OF INVERTED-BEARING REVERSE SHOULDER ARTHROPLASTY AT MINIMUM TWO YEAR FOLLOW-UP.

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Background: Inverted-Bearing Reverse Shoulder Arthroplasty (IB-RSA) is an alternative reverse bearing construct characterized by an ultra high molecular weight polyethylene glenosphere combined with a CoCr metallic humeral liner. This concept was designed both to minimize bearing wear as well as reduce the potential for scapular notching seen with more traditional-bearing RSA systems. This study reports on clinical outcomes, functional scores, pain scores, and radiographic incidence of scapular notching in a series of IB-RSA at a minimum of two year follow-up.

Methods: A retrospective study of patients who underwent primary IB-RSA between 2016-2019 was performed. At two years minimum follow-up, patients were evaluated clinically for DASH score (DS), American Shoulder and Elbow score (ASES), EQ-5D Health Questionnaire (EQ-5D), Global Rating of Change score (GRC), Single Assessment Numeric Evaluation score (SANE), pain, and active range of motion. Presence and grade of radiographic scapular notching was assessed using the classification of Sirveaux.

Results: Overall, 56 consecutive patients were assessed at a mean post-operative followup of 36.8 months (range, 24.0-72.0 months). IB-RSA exhibited high overall outcome scores including DASH (12 +/-6), ASES (86 +/- 15), GRC (4 +/-1), and SANE (84 +/-11). Scapular notching was radiographically present in 20 (38%) patients (fourteen grade 1, six grade 2), with all cases showing evidence of mechanical notching while no (0) grade 3 or 4 cases were observed. The presence of scapular notching did not influence on clinical outcome scores including DASH, ASES, EQ-5D, GRC, and SANE ($P=>0.05$). Pain scores ($P= .73$) and active range of motion ($P= .86$) did not significantly differ between groups.

Conclusions: IB-RSA demonstrates high patient-reported and functional outcome scores at a minimum of two years follow-up. The additional lower incidence of advanced scapular notching may indicate an advantage of this implant's design as well as the inversion of bearing composition in our series.

EP.06.212

TREATMENT OF TRAUMATIC PERIPROSTHETIC HUMERAL FRACTURES IN REVERSE TSA

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Background: Increased use of reverse total shoulder arthroplasty (rTSA) in aging population, with their tendency to fall, presents an increased incidence of traumatic periprosthetic humeral fractures (TPHF). This complication occurs in 1.0–3.0% in literature, represents a challenge for surgeons as frequently requires revision surgery. This study reports clinical and radiological outcomes of a series of late TPPHF around a stemless metaphyseal rTSA (SLMrTSA).

Methods: A retrospective analysis of prospectively collected database identified 16 cases of TPHF out of 891 (1.8%) patients treated with SLMrTSA. Demographics, radiographs, complications and revision surgery data were analysed. Range of motion, subjective shoulder value (SSV), Pain Score and Constant Score (CS) recorded preoperatively, routinely preinjury and at final follow-up.

Results: 16 patients (12F/4M) with SLMrTSA sustained a late TPHF. Mean age 77 years (range, 57-88). Mean follow-up 44 months (range, 6-100m). Initial indications included: cuff arthropathy (9), primary osteoarthritis (2) and rheumatoid arthritis (5). In 2 cases the SLMrTSA was implanted as revision: 1 from resurfacing and 1 from stemmed TSA. 13 treated conservatively. 3 patients with severely displaced fractures had to be revised. In all 13 patients treated conservatively the fractures healed. No lucencies, loosening, subsidence or bone resorption noticed. CS improved from 17.9 preop to 47.4 in last FU. (Adjusted CS 25.8 to 71.1); SSV from 1.5 to 7.5/10; Pain decreased from 11/15 to 2.9/15; Elevation from 66.3 to 104.4 degrees; respectively. Improvement in rotations with only slight loss of external rotation to 22.8 degrees.

Conclusions: SLMrTSA allows for conservative treatment in most cases of TPHF, with good healing of the fracture, restoration of good shoulder function, comparable to the preinjury levels and avoids the need for complex revision surgery in these mostly elderly frail patients.

EP.06.213

THE ONLAY GRAMMONT - METAPHYSICAL FIXATION WITH UNDERSIZED STEMS REDUCES HUMERAL STRESS SHIELDING IN REVERSE SHOULDER REPLACEMENT

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Background: Reverse shoulder replacement (RSA) has become the dominant arthroplasty globally. The Australian Joint Registry reveals that 54% of the revision cases in the RSA are because of the humeral side. Press fit diaphyseal fixation especially in modular implants results in proximal humeral bone stress shielding resulting failure as a result of prosthesis instability. The aim of this study is to demonstrate a low fill ratio Grammont implant in an onlay fashion along with proximal humeral impaction bone grafting to avoid stress shielding in the humerus. Clinical and radiological results are evaluated.

Methods: Prospective single centre study of consecutive patients who underwent RSA for degenerative changes (OA and cuff tear arthropathy) of the shoulder with the onlay grammont technique were included from 2018 to 2020. Range of motion, clinical and functional outcomes were recorded preoperatively and at 6-, 12- and 24-months using VAS-pain, Simple shoulder test, Constant Murley Score and ASES score. Radiological outcomes were postoperatively compared at 6, 12 and 24 months measuring the fill ratio in the metaphysis and diaphysis, the stress shielding, notching and stem alignment.

Results: Fifty patients were evaluated with a minimum of 2 years follow up. None or mild stress-shielding was observed in 92% of the cases. The mean metaphyseal fill ratio (metFR) was maintained from 0.508 preoperatively to 0.517 at final follow up. The diaphyseal fill ratio (diafFR) remained at from 0.581 to 0.579. There was no notching noted, and stem alignment was maintained at under 5 degrees of varus valgus malalignment.

The mean final Constant score was 79 (64 to 88), the mean final ASES score was 91.2 (70 to 100) and the mean final Simple shoulder test was 87.9 (75 to 100). The mean VAS-pain score improved from 6.4 to 0.83. The forward elevation improved from 97 degrees to 159. There were no cases of instability or periprosthetic fracture.

Conclusions: The onlay grammont technique with bone graft and low fill ratio stem had significantly low stress shielding and excellent clinical results without compromising the stem fixation and avoiding notching in primary reverse shoulder replacement and is a viable method to preserve humeral bone stock.

EP.06.215

VOLUME DISTRIBUTION OF SHOULDER ARTHROPLASTY AMONG LOW AND HIGH-VOLUME SURGEONS

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Background: Surgical procedures performed by high volume surgeons have been shown to lead to improved outcomes and decreased complication rates across many surgical specialties. Prior literature suggests that most shoulder arthroplasties performed in the United States of America are performed by lower volume surgeons. However, much of this data is outdated, and does not account for the dramatic recent increase in shoulder arthroplasty volume. The purpose of this study was to identify and compare shoulder arthroplasty practice patterns and volume distributions among a representative sample of surgeons within the United States of America.

Methods: The Iowa Hospital Association Databank was queried using ICD-10 procedure codes for primary total shoulder arthroplasty during 2019. Surgeon and hospital volume were stratified according to procedures performed as: low volume < 15 arthroplasties yearly, medium volume 15-49, and high volume > 49 arthroplasties yearly. Proportion of surgeon and hospital volume, and number of procedures performed by each group were assessed. Distance traveled by patients to visit high versus low-volume surgeons was compared.

Results: In 2019, a total of 1,926 primary shoulder arthroplasties were performed by 144 surgeons, across 49 institutions. In 2019, 74% of surgeons were considered low volume, 20% medium volume, and only 6% were considered high volume. However, 44% of shoulder arthroplasties were performed by high volume surgeons, and only 18% were performed by low volume surgeons. Regarding hospital volume, even though only 20% of hospitals were considered high volume, 68% of procedures were performed at high volume hospitals, and only 5% were performed at low volume hospitals. There was a significant difference in median distance traveled for patients to visit high volume surgeons (34 miles) versus low-volume surgeons (14 miles), ($p < 0.0001$).

Conclusions: In the state of Iowa, while only a small portion of surgeons are considered "high volume", almost half of primary shoulder arthroplasties are performed by high volume surgeons. Additionally, most arthroplasties are performed at high volume hospitals. This data suggests a shift in the perception that most shoulder arthroplasties in the USA are performed by low volume surgeons and provides a glimpse into the evolution of practice patterns.

EP.06.216

RATE OF INCIDENTAL FINDINGS ON ROUTINE PREOPERATIVE COMPUTED TOMOGRAPHY FOR SHOULDER ARTHROPLASTY

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Background: Patients undergoing shoulder arthroplasty routinely receive preoperative computed tomography (CT) studies for preoperative planning. These studies often allow for visualization of portions of the lung, mediastinum, neck, axilla. Incidental findings unrelated to the indication for the study may be noted by the reading radiologist. Consequently, orthopedic surgeons may find themselves addressing patient questions/concerns or counseling on management, and the need for further follow-up of these incidental findings. The purpose of this study was to determine the rate of incidental findings on preoperative CT scans for shoulder arthroplasty.

Methods: We performed a retrospective review of patients undergoing total shoulder arthroplasty, reverse total shoulder arthroplasty, or hemiarthroplasty at a single academic institution between 2015 and 2021. We identified 617 patients with preoperative CT scans of the shoulder for the above procedures. Demographic factors were analyzed, and radiology reports of preoperative CT scans were reviewed for incidental findings.

Results: Demographic factors such as gender and age did not differ significantly between those with and without incidental CT findings. However, trends in smoking status did differ significantly between these two cohorts. In the group of patients with incidental findings 22.6% of patients were current smokers, whereas in the group of patients without incidental findings only 14% of patients were found to be smokers, ($p=0.021$). There was a total of 173 incidental findings noted in 146 of 617 patients (23.7%). These findings ranged from pulmonary (59.0%), thyroid (12.7%), vascular (9.2%), and skin/soft tissue (15.6%). More rarely, incidental findings involving the abdomen (1.2%) or spine (2.3%) were noted. The most noted pulmonary findings were pulmonary nodules (50.0%) and granulomatous disease (47.1%). Of note, further follow-up was recommended for 73 of the 146 patients (50.0%) with incidental findings.

Conclusions: Incidental findings on preoperative CT scans for patients undergoing shoulder arthroplasty are quite common, occurring in almost 25% of this patient population. Based on existing criteria, up to 50% of these patients require further work-up or evaluation for these incidental imaging findings. This data provides valuable information to orthopedic surgeons when counseling patients with an incidental finding on preoperative CT for shoulder arthroplasty.

EP.06.217

DO OPERATIVE TIMES AND INTRA-OPERATIVE TOTAL BLOOD VOLUME LOSS DIFFER BETWEEN STEMLESS AND SHORT-STEM ANATOMIC SHOULDER ARTHROPLASTY? A SINGLE INSTITUTION'S EXPERIENCE

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Background: There has been increasing interest in using stemless humeral components for total shoulder arthroplasty compared to short-stem (SS) and standard-length (SL) implants. There is a paucity of literature comparing surgical time and blood loss for stemless versus SS implants.

Methods: A retrospective review of consecutive anatomic shoulder arthroplasty cases (aTSA) performed by a single shoulder surgeon was conducted from January 2016 through January 2022. Demographic patient and surgical data, including age, gender, mass index (BMI), American Society of Anesthesiologists (ASA) score, age-adjusted Charlson Comorbidity Index (CCI), operative time, pre-and post-operative hematocrit, hospital length of stay (LOS), and both POD#1 and discharge visual analogue score (VAS). The use of a stemless or SS implant was recorded. Intra-operative total blood volume loss (TBVL) was calculated, in addition to the need for either intra- or post-operative transfusions. Non-parametric analysis of covariance was used to examine the effects of stemless versus SS aTSA on operative time and intra-operative TBVL adjusted for demographic, clinical, and surgical variables.

Results: There were 47 SS and 83 stemless anatomic implants, of which 74 (57%) patients were women. The median operative time for the stemless cohort was 111 minutes (IQR 96,130) versus 137 minutes (IQR 113,169) for the SS cohort. ($p < 0.00001$) The median intra-operative TBL for the stemless cohort was 298.3 ml (IQR 212.6,402.8) versus 359.7 ml (IQR 253.9,415.0) for the SS cohort. ($p = 0.05$) Following multivariable regression analysis, the use of stemless humeral components was independently associated with decreased surgical time and intra-operative blood loss. ($p < 0.001$ and $p = 0.005$, respectively) There was a shorter median hospital LOS in the stemless group (2 days (IQR 1,2) versus 2 days (IQR (2,3), $p = 0.03$). The VAS pain score at discharge was lower amongst the stemless cohort (0 (IQR 0,3) versus 4 (IQR 2,6), $p < 0.00001$). Increased surgical time was found to be associated with intra-operative TBVL. ($r = 0.340$, $p < 0.0001$)

Conclusions: Stemless aTSA is associated with a significantly decreased surgical time and total intra-operative blood loss compared to a SS aTSA. Furthermore, stemless implants result in shorter hospital LOS and discharge pain scores.

EP.06.218

INFLUENCE OF AGE AND SEX ON RECOVERY FOLLOWING REVERSE SHOULDER ARTHROPLASTY

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Background: Patient reported outcome measures (PROMs) are used to assess efficacy of reverse shoulder arthroplasty (RSA). Previous studies have assessed differences between age and gender following RSA. However, it is unknown if these differences are clinically significant. Thus, this study aimed to use the minimal clinically important difference (MCID) to determine the clinically relevant difference in outcomes between age and sex following RSA

Methods: A retrospective review of 227 RSA patients from 2007-2020 by a single fellowship trained orthopedic surgeon was performed. Demographics, ROM, and PROMs were collected preoperatively and at 1.5-, 3-, 6-, 12-, and 24-months postoperatively. Logistic regressions determined the relationship between age and sex on reaching recovery at each time point. Recovery was defined as meeting MCID using the anchor-based method as illustrated by Simovitch et al. Significance was deemed as $p < 0.05$.

Results: With every 1 unit increase in age, the odds of meeting MCID for Shoulder Pain and Disability Index (SPADI) was 3.9% and 4% at 6 weeks and 6 months, respectively. At 3 months, patients were 4% more likely to meet MCID for Simple Shoulder Test (SST), American Shoulder and Elbow Surgeon score (ASES), University of California at Los Angeles Shoulder score (UCLA), SPADI, and Shoulder Arthroplasty Smart score (SAS) for a one unit increase in age. Regarding ROM, patients were 95.7% less likely to reach MCID for forward elevation at 6 weeks for each one unit increase in age. Similarly, patients were 95% less likely to meet MCID for external rotation at 1 year. At 2 years for males, meeting MCID was 17% more likely for active abduction and 3.8% more likely for forward elevation.

Conclusions: We determined that with every one unit increase in age, patients are more likely to experience less pain from 6 weeks to 6 months postoperatively. In addition, these patients were more likely to experience better PROMs at 3 month follow up. Males were more likely to experience better abduction and forward elevation. These findings add to the literature by quantifying the clinically relevant differences in outcomes based on patient age and sex after undergoing RSA.

EP.06.219

WHAT IS THE OPTIMAL POSTOPERATIVE SUBSCAPULARIS MANAGEMENT AND REHAB FOLLOWING REVERSE SHOULDER ARTHROPLASTY?

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Background: Reverse Shoulder Arthroplasty (RSA) has experienced exponential growth over the last two decades. Given its trajectory, it is important to identify and optimize factors impacting outcomes, such as postoperative rehabilitation and intraoperative surgical techniques. More specifically controversy has existed in management of the subscapularis in RSA. The purpose of our study was to assess and better understand trends amongst the members of the American Shoulder and Elbow Surgeons (ASES) for intraoperative subscapularis repair as well as optimal approaches for postoperative management of RSA.

Methods: An eight-question survey was distributed to 1,217 members of the American Shoulder and Elbow Surgeons, inquiring about subscapularis management and rehabilitation practices following RSA. The survey included multiple-choice questions that evaluated characteristics of surgeon approach to rehabilitation and perspectives of formal supervised outpatient therapy programs. The cohort was divided based on yearly RSA case volume and whether subscapularis is routinely repaired during RSA.

Results: More than one third of surgeons (35.3%) reported ordering formal rehabilitation due to patient expectations and do not believe it is critical, and only 8.9% believed formal rehabilitation to be critical component in patient strength and recovery. Almost two-thirds (60.7%) of surgeons did not place a limitation on internal rotation. Of those that repaired the subscapularis, 49.7% restricted external rotation. When separating the cohort based on surgical volume, surgeons who performed more than 100 cases were significantly more likely to immobilize patients for more than 4 weeks postoperatively ($p=0.041$), however were not more likely to repair the subscapularis. Surgeons who repaired the subscapularis were significantly more likely to immobilize patients for more than 4 weeks compared to surgeons who did not repair the subscapularis ($p<0.001$).

Conclusions: Repair of the subscapularis and surgical volume are critical factors in restrictions and use of postoperative rehabilitation after RSA. Surgeons and patients need to be aware of these critical factors causing delays in their recovery and potential restrictions in the early recovery phase after RSA. Perhaps surgeons may consider a more standardized approach and evidence based guidelines thru better understanding of the impact of subscapularis repair and postoperative immobilization/rehabilitation on patient reported outcomes and satisfaction scores.

EP.06.220

USE OF LONG PEG AXIOMA METAL BACK FOR VERSION AND INCLINATION CORRECTION

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Background: B and C glenoid with posterior bone erosion and E1, E3 glenoid with upward tilt represent risks factor for uncorrect glenoid component positioning. Different surgical techniques have been proposed to correct glenoid version and inclination. Anterior and inferior glenoid reaming, metal augmentation or asymmetric bone graft have different indications and results in different published studies. Author's hypothesis is that the use of a long trabecular metallic central peg will create an intrinsic scapular stability even with a small glenoid surface contact area allowing the correction of complex multiplanar glenoid deformity.

Methods: 34 patients with a B2, B3 or C glenoid or a E1, E3 glenoid operated with a long peg axioma reverse shoulder prosthesis were included in the study. Mean patient's age was 72,9. 13 patients suffered from concentric osteoarthritis, 9 from rotator cuff tear arthropathy, 3 from proximal humerus fracture sequela, 4 from locked posterior chronic dislocation, 5 from proximal humerus fracture. All patients have a preop and a postop CT- scan to evaluate 3D glenoid version and inclination. 17 patients were clinically evaluated at a medium follow-up of 26 months (3-45) with DASH score and Constant score.

Results: According to Friedman method on 3D CT scan, preop and postop mean version degree were $-19,9^{\circ}$ and $-5,8^{\circ}$ respectively, with a statistically significative difference ($p 0.03$). According to RSA method, preop and postop mean inclination degree were $16,3^{\circ}$ and $4,5^{\circ}$ with a slight, but not significant association ($p 0,18$). 17 out of 13 patients clinically evaluated, 13 showed very good results (DASH score <40 , CS >70), 3 patients good results (DASH score <70 , CS >40) and 1 patient poor results (DASH >80 , CS <40)

Conclusions: The stability of axioma metal back allows the correction of glenoid deformity on both coronal and axial planes. Clinical results of patients with severe glenoid erosions are worst than other patients. Nevertheless, we observed satisfactory results in 95% of patients. Longer follow-up and control groups, with a differently treated group of patients, will be necessary to better understand the best option for the treatment of wide glenoid defect.

EP.06.221

SUPERIOR HUMERAL HEAD OSTEOPHYTES ARE ASSOCIATED WITH ROTATOR CUFF INSUFFICIENCY IN GLENOHUMERAL OSTEOARTHRITIS CONCOMITANT ROTATOR CUFF TEARS (RCTS) AND GLENOHUMERAL ARTHRITIS CAN ALTER PREOPERATIVE I

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Background: Rotator cuff tears (RCTs) in patients with primary glenohumeral arthritis (OA) is often used as a decision point for arthroplasty type. Superior humeral head osteophytes (SHO) impinge on the rotator cuff and may affect its integrity. There is a paucity of information regarding effect of SHOs on the superior rotator cuff. This study aimed to determine the relationship between presence and size of a SHO and incidence of rotator cuff insufficiency.

Methods: All patients with a radiographic diagnosis of OA and a concurrent shoulder MRI within 1 year of the radiographs from two institutions (2009-2020) were retrospectively reviewed. Radiographic glenohumeral OA was graded using the Samilson-Prieto classification. The SHO was measured on both MRI and the Grashey radiograph. MRIs evaluated for RCT presence, type, and size; supraspinatus tendon thickness; and fatty infiltration (FI) (Fuchs classification).

Results: 461 patients (mean age 62.7 ± 11.6 years) were evaluated. The mean size of the SHO was 1.93mm (95%CI: 1.75-2.10) on radiographs and 2.13 mm (95%CI: 1.96-2.30) on MRI. Risk ratios for the incidence of RCT were 1.14 (95%CI: 0.91-1.43) and 1.26 (95%CI: 0.96-1.63) for SHO presence on radiograph and MRI, respectively. For each 1-mm increase in SHO size on radiograph and MRI, risk ratios for RCT incidence were 1.01 (95% CI: 0.96-1.06) and 1.02 (95%CI: 0.96-1.07), respectively. Each 1-mm increased size of the SHO on radiograph and MRI was associated with a decrease in supraspinatus tendon thickness of 0.20 mm (95%CI: 0.12-0.28) on radiograph and 0.17 mm (95%CI: 0.08-0.260) on MRI. The presence of a SHO on radiographs and MRI was associated with moderate-to-severe fatty atrophy of the supraspinatus (risk ratio of 3.16 (95CI: 1.67-5.98) and 3.47 (95%CI: 1.63-7.35), respectively). Grade 3 glenohumeral OA was associated with 1.95mm (95%CI: 1.65-2.25) and 1.84mm (95%CI: 1.55-2.13) increase in SHO size on radiograph and MRI, respectively, compared with Grades 1 and 2 combined

Conclusions: SHOs were not associated with RCTs, but presence and size were associated with higher risk of supraspinatus FI and decreased tendon thickness, indicating possible rotator cuff insufficiency. Osteophytes seen on radiographs should prompt better evaluation of the rotator cuff with MRI before anatomic total shoulder arthroplasty.

EP.06.222

COMPARISON STUDY OF PATIENTS OLDER AND YOUNGER THAN 70 YEARS OF AGE WITH THE SAME STEMLESS ANATOMIC TOTAL SHOULDER REPLACEMENT

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Background: Common surgical treatment of patients with painful and debilitating osteoarthritis of the glenohumeral joint is a total shoulder replacement (TSR). Anatomic TSR (aTSR) is usually performed when there is an intact good functioning rotator cuff, however when the patient reaches the 8th decade there is an increased tendency in these cases to do a reverse prosthesis. This study compares outcomes of patients with the same aTSR below and over the age of 70 years.

Methods: Consecutive patients with glenohumeral arthritis managed with the same stemless aTSR below (n=86) and above (n=75) the age of 70 years were prospectively studied. Pre- and postoperative clinical evaluations included the ASES score, Constant score, SPADI score, DASH score, range of motion (ROM) and pain and patient satisfaction for a minimum follow-up of 2 years. Radiological assessment identified glenoid and humeral component osteolysis.

Results: A total of 161 patients were initially included in this study. Thirty-one cases were lost to follow-up, withdrew or deceased during the follow-up process. The average follow-up time was 6.5 years with a maximum follow-up of 9 years. Similar postoperative improvement for ROM and all clinical assessment scores was seen in both age groups. Constant scores were 77 in both groups at two-year follow-up. At last follow-up, ASES and SPADI scores were 96.4 vs. 95 (p > 0.05) and 3.5 vs. 7.1 (p > 0.05) for the below 70 and above 70 years of age groups, respectively. Two cases in the <70 group had to be revised to a reverse TSR and one case in the >70 group had a supraspinatus failure, but did not need a revision. At latest follow-up, both groups had only minor osteolysis on radiographs.

Conclusions: This study demonstrates that patients \geq 70 years of age with the same aTSR have as good clinical and radiological outcomes as patients younger than 70 years of age when carefully selected for good rotator cuff muscle function.

EP.06.223

LIMITED RANGE OF MOTION AND ANTERIOR SHOULDER PAIN FOLLOWING REVERSE SHOULDER ARTHROPLASTY CAN BE IMPROVED WITH SHOULDER ARTHROSCOPY IN SELECT CASES

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Background: Limited range of motion and persistent anterior shoulder pain following reverse shoulder arthroplasty (RSA) are difficult to manage and lead to poor patient satisfaction. The purpose of this study was to examine the use of shoulder arthroscopy in the management of stiffness and anterior shoulder pain following RSA.

Methods: A retrospective review was conducted to identify patients who had undergone arthroscopy following RSA for non-infectious indications with a minimum 1-year follow-up. Arthroscopies were performed by a single surgeon and consisted of systematic lysis of adhesions and a coracoplasty if indicated. Data collected included pre- and postoperative range of motion, patient-reported outcomes (American Shoulder and Elbow Surgeons score [ASES], Visual Analog Score [VAS] for pain, Veterans Rand 12 [VR-12], Single Assessment Numeric Evaluation [SANE]), and satisfaction.

Results: Twelve patients with an average age of 75.2 years were available for follow-up at a mean of 23.8 months postoperative. The most common indication of arthroscopy was stiffness alone (61.5%), followed by stiffness with anterior shoulder pain (30.8%) and anterior shoulder pain alone (7.7%). Arthroscopic lysis of adhesions led to significant improvements in range of motion (ER increased from an average of 16 to 31 [$p = 0.038$], forward flexion from 87 to 112 [$p=0.005$], and internal rotation from hip to S1 [$p=0.044$]). Improvements in patient-reported outcomes did not meet statistically significant differences with the numbers studied. At final follow-up, 83.3% reported being satisfied with the arthroscopic intervention. Although VAS pain scores did not reach statistical differences, half of patients (58.3%) reported significant improvement in pain. The majority of patients (69%) were able to return to activities of daily living.

Conclusions: Shoulder arthroscopy can lead to modest improvements in ROM following RSA. While improvements in patient-reported outcome measures were marginal, most patients reported improvements in pain and satisfaction with the procedure. There may be a role for shoulder arthroscopy post-RSA in select patients with postoperative stiffness or anterior shoulder pain.

EP.06.224

HIGHER SURGEON VOLUME IS ASSOCIATED WITH LOWER RATE OF SUBSEQUENT REVISION PROCEDURES FOLLOWING TOTAL SHOULDER ARTHROPLASTY: A NATIONAL ANALYSIS

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Background: Studies assessing the relationship between surgeon volume and outcomes have shown mixed results based on the specific procedure analyzed. This volume relationship has not been well studied in patients undergoing total shoulder arthroplasty (TSA). The purpose of this study was to assess the association between increasing surgeon volume and decreasing rate of revision at 2 years for (1) anatomic (aTSA) and (2) reverse TSA (rTSA) in the United States.

Methods: This is a retrospective study that utilized Centers for Medicare and Medicaid Services (CMS) fee-for-service (FFS) inpatient and outpatient data from 2015-2021 to study the association between annual surgeon aTSA and rTSA volume and 2-year subsequent revision shoulder procedures after initial surgery. We studied the variables associated with subsequent procedure rate through a generalized linear model, controlling for confounders. The regression was fitted with standard errors clustered at hospital-level both combining all TSAs, and within the aTSA and rTSA groups. Hospital and surgeon yearly volumes were calculated by including all TSAs, primary procedure and subsequent, during the study period. CMS-Hierarchical Condition Category (HCC) risk score was controlled for and we then converted the regression coefficients to percentage change in odds of having a subsequent procedure.

Results: After controlling for confounding variables like patient age, comorbidity risk score, surgeon and hospital volume, surgeon graduation year, hospital size and teaching status, we found that an annual surgeon volume of ≥ 10 aTSAs was associated with a 27% decreased odds of revision within 2 years (95% CI 13% to 39%, $P < 0.001$) while surgeon volume of ≥ 29 aTSAs was associated with a 33% decreased odds of revision within 2 years (95% CI 18% to 45%, $P < 0.001$) compared to annual volume of < 4 aTSAs per year. Annual surgeon volume of ≥ 29 rTSAs was associated with a 26% decreased odds of revision within 2 years (95% CI 9% to 39%, $P < 0.001$).

Conclusions: Surgeons should consider modalities such as virtual planning software, templating, or enhanced surgeon training to aid lower volume surgeons performing aTSA and rTSA. More research is needed to assess the value of these modalities and their relationship to subsequent revision rates.

EP.06.225

DOES THE NUMBER OF SCREWS ON THE BASEPLATE AFFECT CLINICAL RESULTS? A RETROSPECTIVE STUDY

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Background: Currently, indications for reverse arthroplasty have increased significantly. Over time, the initial model, designed by Grammont underwent modifications in order to reduce the considerable rates of complications. In order to evaluate and decrease the incidence of complications with the glenoid baseplate, a lot of in vitro biomechanical studies has been done, but we consider there is a gap in the literature regarding in vivo studies evaluating the number of screws for fixing the baseplate. However in vitro biomechanical studies are important, these types of studies cannot clearly demonstrate whether there is a significant clinical or radiological impact. Therefore, our study aims to verify whether there is a difference between clinical complications and radiological changes from baseplate fixation using 3 or 4 screw

Methods: A retrospective study was carried out in one group of shoulder surgeons, from 2015 to 2022, which identified 73 patients who underwent primary reverse shoulder arthroplasty performed with lateralized implants. In the end, 35 patients were referred for statistical analysis. The variables analyzed were: number of screws, age, gender, follow-up time, prosthesis model, laterality and presence or absence of complications, and presence of "problems". Events that did not affect the final result were considered "problems", such as: radiolucency in the glenoid, reabsorption of the greater tuberosity and notching

Results: Of the 35 patients, the evaluation was performed with a follow-up average of 20 months. 83% were female, 68.5% were 70 years old or older, 71% (25) had baseplate fixation with 4 screws, while 29% (10) used 3 screws. Complications were found in 7 patients (20%), while problems were evident in 8 patients (22.84%). However, none of the complications was related to the number of screws ($p=1$), also no statistical difference in relation to the number of screws in their fixation ($p=0.48$). The most prevalent alterations were: notching 4 (11.5%), greater tuberosity resorption 3 (8.5%), acromion fracture 3 (8.5%) and dislocation 2 (5.7%).

Conclusions: There was no significant difference between the number of screws in the baseplate fixation of the reverse shoulder arthroplasty and the number of complications or problems evidenced in the postoperative period.

EP.06.227

SUBSCAPULARIS FAILURE AFTER ANATOMIC TOTAL SHOULDER REPLACEMENT: RESULTS AND TREATMENT ALGORITHM.

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Background: Subscapularis failure is a well-documented complication after anatomic total shoulder replacement (TSR) being reported as high as 9% in some series. The failure can be the result of insufficient healing of the intra-operative repair or due to post-operative traumatic injury. Treatment options include primary repair, tendon transfer and conversion to reverse shoulder arthroplasty. We report on the results of different treatment options after subscapularis rupture after TSR with the goal of helping define a treatment algorithm.

Methods: This was a retrospective review of 22 patients who underwent one or more procedures to treat subscapularis failure after anatomic total shoulder. There were 11 men and 11 women with average age of 67 years old (r: 52-77). The pre-operative diagnosis was primary osteoarthritis in 20 shoulders and RA in 2 others. Subscapularis tenotomy was used in 16 patients, peel in 5 and lesser tuberosity osteotomy in 1. 16 patients identified a specific traumatic event prior to subscapularis failure. Diagnosis was made by ultrasound (n=3) or MRI (n=12). The average follow-up of 33 months (12-78 mos.) Outcomes were assessed by clinical exam, ASES score, and UCLA Score.

Results: Six open and 5 arthroscopic repairs were carried out was successful in 7. Each of these patients regained stability and Full ROM. The UCLA Score averaged 26/30 and ASES 72. In each case, the failures were in patients who had the attempted repair more than 6 weeks after index TSA. One patient, because of his age and activity demand underwent a second attempted repair with graft augmentation. Four patients ultimately underwent a second revision to RSA. Eleven patients underwent revision to RSA as index treatment (as well as 4 failures) were satisfied. The average UCLA Score was 24.6/30 and ASES 73.

Conclusions: The results of our small patient group indicate that primary repair may be considered early (less than 6 weeks) after the injury occurs. In situations when the failure is more chronic in nature or there is a delay in treatment, RSA provides successful outcomes. However, the patient expectations and activity may be less than expected with the primary TSA.

EP.06.228

A COMPARISON OF INTRAOPERATIVE DETAILS AND POSTOPERATIVE OUTCOMES IN STEMMED AND STEMLESS HUMERAL COMPONENTS IN TOTAL SHOULDER ARTHROPLASTY

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Background: Stemless humeral components were developed for total shoulder arthroplasty (TSA) with numerous theoretical advantages including bone stock preservation, reduced intraoperative time and risk of periprosthetic fracture, compared to stemmed humeral components. Our goal was to compare the intraoperative details, postoperative outcomes (PROMIS and ASES scores), postoperative range of motion (ROM), and implant-related complications between stemmed and stemless humeral components.

Methods: We included patients who underwent TSA and completed preoperative and 1 or 2-year PROMIS Upper Extremity (UE), Physical Function (PF), Pain Interference (PI), and Depression (DEP) scores, as well as ASES and ASES-P scores. These scores were recorded 2 weeks, 7 weeks, 3 months, 12 months, and 24 months postoperatively. ROM was recorded as forward flexion (FF) and external rotation (ER) at the 7-week and 3-month marks. Patient demographics, intraoperative surgical time, intraoperative blood loss, postoperative ROM, and postoperative complications were recorded by chart review. A negative binomial regression was used to analyze surgical time and blood loss, while a mixed effects regression was used to analyze the PROMIS and ASES scores.

Results: We included 56 patients (27 stemless, 29 stemmed). Demographic data was similar between the two groups. Surgical time was significantly greater in the stemmed cohort by 18% (95% CI 9.5% - 27.2%, $p < 0.001$). Intraoperative blood loss was significantly greater in the stemmed cohort by 64.0% (95% CI 18% - 127.5%, $p = 0.003$). ASES and ASES-P scores were significantly different between the stemmed and stemless groups preoperatively, and PROMIS UE scores were significantly different at the 2-week mark. There were no significant differences between any PROMIS or ASES scores at any other timepoint. The stemless cohort had 12.7 degrees greater ER at the 7-week mark (95% CI 4.2 - 21.2, $p = 0.003$), however there were no differences in FF or ER at 3 months. There were no humeral component-related complications in either group at 2 years postoperatively.

Conclusions: Compared to stemmed humeral components in TSA, stemless components offer similar improvements in postoperative PROMIS scores, ASES scores, and range of motion, with a reduced intraoperative time and blood loss, with no significant difference in implant-related complications.

EP.06.230

A 135 DEGREE SHORT INLAY HUMERAL STEM LEADS TO COMPARABLE RADIOGRAPHIC AND CLINICAL OUTCOMES COMPARED WITH A STANDARD-LENGTH STEM FOR REVERSE SHOULDER ARTHROPLASTY

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Background: Humeral stem length in reverse total shoulder arthroplasty (RTSA) has decreased in recent years in an attempt to preserve more bone and facilitate stem removal in the revision setting. The purpose of this study was to compare the clinical and radiographic outcomes of a short- to standard-length stem RTSA. The hypothesized that there would be no difference in radiographic or clinical outcomes at short-term follow-up.

Methods: Patients who underwent RTSA using a press-fit standard- or short-length humeral component with a consistent geometry (Univers Revers, or Revers Apex; Arthrex, Inc., Naples, FL, USA) were evaluated in a multicenter retrospective review. The minimum clinical follow-up was 2 years. Immediate postoperative radiographs were used to assess initial alignment and filling ratios. In addition, radiographs at 2 years were evaluated for signs of stress shielding and/or loosening. Clinical outcome scores and range of motion were evaluated at the final follow-up and compared between groups.

Results: A total of 220 patients with short-stem RTSA and 357 patients with standard-length stem RTSA were analyzed. There was no difference in baseline function between short- and standard-length stem patients. Patients in the short stem group had higher postoperative American Shoulder and Elbow Surgeons (84.6 vs. 80.8; $P = .014$) and Western Ontario Osteoarthritis of the Shoulder (86.5 vs. 82.7; $P = .025$). Patients in the short stem group also had greater postoperative active forward flexion (139° vs. 132° ; $P = .003$) and internal rotation with the arm at 90° of abduction (43° vs. 32° ; $P < .001$) than patients in the standard-length group. Radiographically, there was a higher metaphyseal ($P = .049$) and diaphyseal ($P < .001$) fill ratio in the short stem group, although there was no difference in postoperative alignment, radiographic signs of loosening, or revision for loosening between groups (all $P > .05$).

Conclusions: A short inlay stem leads to comparable radiographic findings and revision-free survival compared with a standard-length stem when placed with a press-fit technique for RTSA. Clinical outcomes are also equivalent or slightly improved with a short stem compared with a standard-length stem.

EP.06.231

CHRONIC DISLOCATION OF REVERSE SHOULDER ARTHROPLASTY - PROGNOSTIC OUTCOME FACTORS FOR A SUCCESSFUL REVISION.

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Background: Instability is the most common complication of reverse shoulder arthroplasty. The success rates were reported to depend on delay, morbidity of the patient, number of prior revisions and underlying pathology. The purpose of this retrospective analysis was the evaluation of prognostic parameters and development of treatment algorithm.

Methods: Within 153 revisions of RSA, operated on between 2010 and 2020 (mean age 69 years, 57-84) we identified 27 patients in which the main indication was chronic dislocation (> 3 months). 67% could be followed up for more than > 2 years clinically and radiologically (DASH and Constant score). Multi-morbidity was present in the majority (78% at least of ASA 3 health status). More than one component was exchanged at first revision in n=17 (6x complete stem, 2x baseplate, 4 custom made components, 15 modular components / e.g. lengtheners or higher liners).

Results: We observed in 12 patients major complications, including 8 re-dislocations (29%) leading to 12 re-revisions. One patient had even 4 recurrences. One revision was required for a persisting LG infection with stem loosening. All complications occurred after 6 weeks and showed a strong association to neurological disorders (partial palsy of axillary nerve or brachial plexus and, Parkinson's disease n=8), to LG-infections (n=3), use of crutches (n=8), scapula spine fractures (n=2). Re-revision required in 4 cases additional stem exchange and in 1 case 2-staged exchange of the baseplate. 21/27 patients experienced a moderate improvement of function (mean CS score from 29 to 43). Isolated humeral lengthening was rarely successful, but fixation in a brace was last resort in 2 cases.

Predictive factors for successful outcome were <2 prior revisions, < 2° humeral bone loss, no significant loss of delta muscle (<40%), absence of LG infection or scapular spine fracture and no use of crutches or wheel walking frame.

Conclusions: Chronic dislocation represents an entity with limited success rate and considerable complication rate. It requires proper pre-OP analysis including bilateral CT scans of complete humerus. The algorithms already published in literature are strongly influenced by the type and modularity of the implants used primarily and were in our hands only of limited benefit.

EP.06.232

CLINICO-MICROBIOLOGICAL ANALYSIS OF SHOULDER JOINT INFECTIONS OVER TWO YEARS AT A PUBLIC TERTIARY CARE HEALTH CENTRE IN QUEENSLAND, AUSTRALIA

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Background: Shoulder joint infections (SJIs) affecting both native and prosthetic joints pose a large burden on the healthcare. Native shoulder joint infections are common in the elderly with co-morbidities, while prosthetic SJIs are a complication of arthroplasty. SJIs need multiple surgeries, prolonged antibiotics and extended hospital stay. We aim to compare the clinical, microbiological and treatment outcomes between shoulder joint infections which were surgery naïve or had previous surgery.

Methods: A retrospective observational analysis of 64 adult patients on whom microbiology samples were received in the Microbiology laboratory were included. The clinical and microbiological data was analysed using SPSS v28. Treatment and episode outcomes over 1, 6 and 12 months were collated.

Results: Patients mean age was 63.9 years (SD 13.9). Twenty-seven (42.2%) patients had a native joint, 27 (42.2%) had implants and 10 (15.6%) were prosthetic joints. Common presenting complaints were pain (86%) and reduced range of motion (64%). Rotator cuff arthropathy, trauma, pain or infection were the main clinical presentations with co-morbidities in 50%. Thirty-eight (60%) patients were culture-positive, with *Cutibacterium acnes* (*C. acnes*) being the most common pathogen (37.3%). Native joints had higher infection rates with *Staphylococcus aureus* (30.4%), whilst joints with previous surgery isolated *C. acnes* (45.5%) by day seven. *S. aureus* were 80% resistance to penicillin and Coagulase negative *Staphylococcus* with 35% resistance to clindamycin.

Native joints had high inflammatory markers, Total white cell count and C-RP ($p < 0.001$). Treatment mainstay was surgery with antibiotics (68.7%) or surgery only (29.7%). Follow-up duration was 10 months (IQR, 2.5-15) in acute and 12 months (IQR, 9.75-15.69) in chronic infections. Median duration of follow-up was higher with previous surgery, 13.8 months compared to 6.8 months with native joints ($p=0.012$). Fifty-two patients (81.3%) recovered while 10 (15.7%) developed complications.

Conclusions: Our institutional SJI microbiological profile shows predominately *C. acnes* in joints with previous surgery and *S. aureus* in acute or native joint infections. Most SJIs were managed by surgery with or without antibiotics and matched clinico-microbiologically (83%). This tertiary centre manages complex shoulders and recommends multi-disciplinary team management as key.

EP.06.233

DO SOCIOECONOMIC FACTORS AFFECT OUTCOMES FOLLOWING TOTAL SHOULDER ARTHROPLASTY?

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Background: There is a lack of comprehensive research on socioeconomic factors affecting TSA outcomes. The purpose of this study is to determine the effects of socioeconomic factors on patient outcomes following aTSA and rTSA.

Methods: All aTSA and rTSA cases from the National Inpatient Sample (NIS; N=128,376) database from 2011-2019 as well as the Nationwide Readmission Database (NRD; N=103,023) from 2010-2019 were analyzed. Ethnicities included Caucasian (C), African American (AA), and Hispanic (H). NRD cases were assessed by insurance status (Medicare, Medicaid, and private) and zip code income Quartiles. Demographic data, quantitative variables, and binary categorical variables were analyzed using Chi-square test of independence, one-way ANOVA with Tukey-Kramer post hoc analyses, and binary logistic regression, respectively.

Results: For NIS, AA had the highest percent Q1 and comorbidities of all ethnicities ($p < .001$), increased lengths of stay and hospital stay extensions (both $p < .001$). The majority of H were Q1 ($p < .001$) with increased comorbidities ($p < .001$), lengths of stay ($p < .001$), and complications ($p = .043$). In Q1 patients, H retained increased comorbidities ($p = .001$) and hospital stay extensions ($p = .029$) compared to C. Medicare patients had significantly higher mean comorbidity score and increased risk of complication, readmission, revision, hospital stay extension, and discharge to a new facility. Similarly, Medicaid patients had significantly increased mean comorbidity score, and the highest risk of adverse outcomes. Additionally, they had an increased risk of discharge to a new facility. Comparing TSA patients in the Q1-3 to Q4, first quartile income was significantly predictive for increased risk of hospital stay extension ($p = .043$), complication ($p < .001$), and readmission ($p < .001$). Second and third quartile patients had increased risks of any complication.

Conclusions: The socioeconomic factors studied - ethnicity (C, AA, H), zip code income (Q1, Q2, Q3), and insurance status (Medicare, Medicaid, or self-pay) - had significantly increased risk for adverse outcomes following TSA, including comorbidities, complication rates, readmission rates and revision rates, discharge to another facility, increased length of hospital stay and mortality. Private insurance status, C and zip code income Q4 were all predictive of significantly less adverse outcomes. Further study is needed to determine the cause of these disparities.

EP.06.234

HOW DOES PREOPERATIVE SHOULDER FORWARD ELEVATION STIFFNESS INFLUENCE THE RATE OF MOTION RESTORATION AFTER TOTAL SHOULDER ARTHROPLASTY?

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Background: Although both aTSA and rTSA reliably improve pain and function, a subset of patients lag behind their peers in regaining overhead motion. We compared the rate of recovery in motion after aTSA and rTSA in preoperatively stiff (passive forward elevation [FE] $\leq 105^\circ$) versus non-stiff (passive ER $> 105^\circ$) shoulders.

Methods: A retrospective review of a single-institution shoulder arthroplasty database was performed between 2007 and 2020. We identified 400 aTSAs and 193 rTSAs performed for primary cuff-intact OA with 2-year minimum follow-up that met inclusion criteria. Patients were excluded for preoperative diagnosis of nerve injury, infection, or fracture. Postoperative complications that would affect motion were also eliminated. Included patients at minimum had a follow-up between 1.5-6 months, minimum 2-year follow-up, and a third visit at any timepoint. Our primary outcome was the rate and period of recovery in ROM. Secondarily, strength in ER and FE were assessed.

Results: Non-stiff aTSAs regained ROM faster than stiff aTSAs for abduction (11.1 vs. 9.8 $^\circ$ /month), FE (10.4 vs. 8.3 $^\circ$ /month), IR (0.32 vs. 0.27 points/month), and ER (7.0 vs. 4.7 $^\circ$ /month). However, stiff aTSAs continued to improve over a longer period compared to non-stiff aTSAs for abduction (6.1 vs. 5.7 months), FE (7.8 vs. 6.2 months), IR (8.1 vs. 6.6 months), and ER (6.2 vs. 4.7 months). Non-stiff rTSAs regained ROM faster than stiff rTSAs for active FE (17.3 vs. 16.6 $^\circ$ /month) and IR (0.39 vs. 0.30 points/month). However, stiff rTSAs continued to improve over a longer period compared to non-stiff rTSAs for active FE (4.8 vs. 4.4 months) and IR (8.9 vs. 7.2 months). Rate of improvement was similar for abduction (16.4[16.2-16.6] and 16.5[16.2-16.7] $^\circ$ /month) and ER (9.6[9.5-9.7] and 9.8[9.7-10.0] $^\circ$ /month), but duration of improvement was slightly longer for stiff rTSAs for abduction (4.4 vs. 4.1 months) and ER (4.2 vs. 3.9 months). For aTSA and rTSA, strength in ER and FE improved faster in non-stiff shoulders, but over a longer period in stiff shoulders.

Conclusions: Preoperatively stiff versus non-stiff shoulders had a slower rate of recovery over a longer period for all outcomes after aTSA and for FE, IR, and strength after rTSA.

EP.06.235

PREOPERATIVE PLANNING OF CUSTOM GLENOID IMPLANTS FOR COMPLEX SHOULDER ARTHROPLASTY: A DESCRIPTIVE STUDY

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Background: Severe glenoid bone loss in reverse total shoulder arthroplasty (rTSA) can be a challenge to manage. Custom 3D-printed implants matching the glenoid defect have become popular. This technology allows for precise planning and execution of surgery. It is unclear where the joint line should be placed in these cases. The aim of this study was to review the planned amount of lateralisation and distalisation of the centre of rotation (COR) in a high-volume shoulder arthroplasty centre with significant expertise in custom 3D-printed implants. A secondary aim was to correlate this plan with post-operative radiographic parameters.

Methods: Consecutive patients undergoing primary or revision reverse shoulder arthroplasty with custom glenoid implants (Lima Corporate, Italy) for severe bone loss were identified. The degree of planned lateralisation, defined as the distance between the coracoid base point (CBP) to the COR, was extracted. Post-operative lateralisation and distalisation shoulder angles (LSA, DSA) were collected from post-operative radiographs.

Results: 150 planned between 2016 and July 2022 were included in this study. Mean age at time of plan was 70 ± 11.9 years. 61.5% were female. 49% were revision cases. Mean lateralisation (CBP to COR) was 12.6 ± 3.8 mm. 103 of the 150 planned cases had been implanted at the time of this study. Postoperative LSA and DSA was 48 ± 14 degrees and 77 ± 18 degrees respectively.

Conclusions: Custom rTSA cases require input from experienced arthroplasty surgeons and design engineers. The placement of the COR in this cohort was consistent. However, the optimal location of COR has yet to be determined.

EP.06.236

EVALUATION OF BONE MINERAL DENSITY AROUND CEMENTLESS SHORT STEM AFTER REVERSE SHOULDER ARTHROPLASTY

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Background: Bone resorption around stem in reverse shoulder arthroplasty (RSA) has been one of the major complications in cementless stems. Proximal bone resorption is a common problem caused by stress shielding in cementless long stems. However, there is not well known about bone mineral density (BMD) in cementless short stems. In this study, we measured BMD around short stem of RSA using dual energy X-ray absorptiometry (DEXA) and investigated changes over time from 1 to 2 years postoperatively and relationship with filling ratio and stem alignment.

Methods: Forty-two patients (76.4 ± 4.7 years) after RSA using cementless short stems were involved in this study. We used cementless short stem of Aequalis Ascend Flex (Stryker GmbH, Selzach, Switzerland) in all the cases. Evaluation with DEXA at 1 and 2 years postoperatively were performed by using GE LUNAR prodigy orthopaedic scanner (GE Medical Systems Lunar, Milwaukee, WI, USA) in the supine position with forearm in neutral position. BMD around stem was measured according to 5 zones based on the report of Schnetzke et al. In addition, X-ray evaluations were also performed to measure filling ratio and stem alignment based on the report of Raiss et al. Relationship among BMD, filling ratio and stem alignment was statistically analysed. The level of significance was set at $p < 0.05$.

Results: BMD was significantly lower in the zone under the tip of the stem (US). Filling ratio was $76.3 \pm 9.4\%$ at the metaphysis and $63.7 \pm 10.1\%$ at the diaphysis, and stem alignment was $5.9 \pm 3.2^\circ$ valgus. In the relationship among BMD, filling ratio and stem alignment, BMD was significantly lower in medial-proximal zone (M1) when the filling ratio at the metaphysis was greater than 75%. Similarly, BMD in M1 was significantly lower when the valgus stem alignment was greater than 6.5° .

Conclusions: BMD around the stem was significantly lower in US compared to other zones. BMD in M1 was associated with filling ratio at the metaphysis and stem alignment.

EP.06.237

CLINICAL AND RADIOGRAPHIC OUTCOMES FOLLOWING ANATOMIC TOTAL SHOULDER ARTHROPLASTY UTILIZING AN INSET GLENOID COMPONENT AT 2-YEAR MINIMUM FOLLOW-UP: A DUAL CENTER STUDY

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Background: Anatomic total shoulder arthroplasty (aTSA) is a successful and reproducible treatment for patients with painful glenohumeral arthritis. However, long-term outcomes using traditional onlay glenoid components have been tempered by glenoid loosening. Inset components have been proposed to minimize glenoid loosening by reducing edge-loading and opposite-edge lift-off forces with humeral translation. Successful short and long-term outcomes have been reported while using inset glenoid implants. The current study is the largest study presenting a minimum of two-year follow-up data following aTSA with an all-polyethylene inset glenoid component (Shoulder Innovations, Holland, MI).

Methods: A dual center, retrospective review of patients undergoing aTSA using an Inset glenoid component by two fellowship-trained shoulder surgeons at two separate institutions from August, 2016 to August, 2019 was performed. Minimum follow up was two years. Range of motion (ROM), Visual Analog Pain Scores (VAS), Single Assessment Numeric Evaluation (SANE), and American Shoulder and Elbow Surgeons (ASES) scores were obtained. Radiographic outcomes, including central peg lucency and glenoid loosening, were assessed by three independent reviewers on the postoperative Grashey and axillary radiographs obtained at the final follow-up.

Results: Seventy-five shoulders were included for final analysis. The mean age of the entire cohort was 64 (± 11.4) years. Twenty-one (28%) glenoids were type A1, 10 (13.3%) were type A2, 13 (17.3%) were type B1, 22 (29.3%) were type B2, six (8%) were type B3 and three (4%) were type D. At a minimum follow-up of 24 months (mean 28.7 months), a significant improvement in ROM in all planes was observed. Significant improvements in VAS (5.1 to 0.9, $p < 0.001$), SANE (39.5 to 91.2, $p < 0.001$) and ASES (43.7 to 86.6, $p < 0.001$) scores were observed. There were four (5.3%) cases of central peg lucency about the inset glenoid component and one (1.3%) cases of glenoid loosening. No revisions were performed for glenoid loosening.

Conclusions: At a minimum of two years postoperatively, there were significant improvements in ROM and VAS, SANE, and ASES scores with very low rates of central peg lucency and glenoid loosening in patients undergoing aTSA with an inset glenoid component. Further work is needed to determine the long-term benefit of this novel implant.

EP.06.238

GLENOID WEAR AFTER HUMERAL HEAD REPLACEMENT FOR CUFF TEAR ARTHROPATHY

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Background: Glenoid wear (GW) is a long-term complication after HHR, and one of the major reasons for revision surgery. This study evaluated GW after 5 years or more follow-up after HHR in patients with CTA using a modified classification of GW, to examine the relationship between GW and clinical outcomes, and identify risk factors for GW progression.

Methods: Seventy-nine shoulders in 70 patients who were followed up for a mean of 8.2 years (range, 5.0-13.2 years), including 29 men and 41 women with a mean age at the surgery of 71.1 years (range, 54-87 years), were reviewed. GW was classified using simple X-rays with modified Goya's classification. Clinical outcomes, including range-of-motion (ROM) (active flexion, active external rotation), and postoperative pain scores (Constant score) were compared between grades and subtypes. Atrophy and fatty degeneration of torn cuff muscle, preoperative humeral head displacement (superior translation ratio (STR) and anterior translation ratio, et.al) on preoperative magnetic resonance imaging, and other individual factors were analyzed as possible risk factors.

Results: GW at final follow-up was Grade 0: 5 shoulders, Grade 1: 17, Grade 2: 20, and Grade 3: 37 (3A: 4, 3B: 22, and 3C: 11). Grade 3 had lower pain scores than other grades (Grade 0; 15.0 ± 0.0 , 1; 14.7 ± 1.3 , 2; 13.3 ± 2.4 , 3; 10.0 ± 6.2 , $p < .01$), and limited active flexion (Grade 0; 150.0 ± 10.8 , 1; 137.5 ± 19.5 , 2; 130.5 ± 38.8 , 3; 112.2 ± 37.0 , $p = .02$). In subtype comparison, group 3B (partial erosion of superior glenoid) had lower pain scores (3B; 8.4 ± 6.6 , 3C; 13.2 ± 3.4 , $p = .042$) and limited active flexion (3B; $102.7 \pm 34.5^\circ$, 3C; $133.6 \pm 34.1^\circ$, $p = .013$) compared to 3C (concentric erosion of glenoid). Preoperative higher STR was defined as a risk factor for grade 3 GW (OR 35.5, 95%CI 1.8-693.0 $p = .018$). Comparison among the three subtypes of grade 3 showed that patients with Grade 3B GW had larger STR than 3C (3B; $41.4 \pm 14.2\%$, 3C; $23.5 \pm 13.3\%$ $p = .006$).

Conclusions: Patients who develop concentric glenoid erosion (i.e., grade 3C), often achieve pain relief even without revision surgery, whereas eccentric erosion (i.e., grade 3B) is associated with persistent pain and might require revision surgery. Patients with preoperative high STR is considered to have a risk for grade 3B GW.

EP.06.239

PATIENT SURVIVORSHIP AFTER ANATOMIC TOTAL SHOULDER ARTHROPLASTY: ARE PATIENTS FAILING BEFORE THEIR PROSTHETICS? A 10 YEAR MINIMUM FOLLOW-UP ANALYSIS.

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Background: Since the development of shoulder replacement, focus has been placed on the timeline in which glenoid loosening occurs or rotator cuff integrity fails amongst other surgery specific pitfalls. Longer term patient survival is less researched. One goal of shoulder replacement is to provide an operation that will last the patient their lifetime; therefore the relative timeline of implant to patient survival is an important consideration. This study evaluated patient and implant survivorship after anatomic total shoulder arthroplasty (aTSA) at minimum 10 years.

Methods: This was a single institution, retrospective, cohort study of patients who underwent primary aTSA for glenohumeral osteoarthritis from 2005 to 2011. A patient medical record and national obituary database query were performed to assess for revision surgery or patient mortality. Patients were stratified into groups based on whether they underwent a revision or passed away prior to revision. Analysis of Variance along with Kaplan-Meier survival analysis was performed ($p < 0.05$ was significant).

Results: 362 patients (age 65.4 +/- 10.02 years) met inclusion criteria. 56 patients (15.5%) passed away prior to undergoing revision. Twenty patients (5.5%) underwent revision surgery. Reason for revision included rotator cuff insufficiency (8), glenoid loosening (4), posterior instability (4), infection (3), and culture negative continued shoulder pain (1). Age and higher Charlson Comorbidity Index were associated with increased mortality ($p < 0.001$). Revision cohort patients were significantly younger than patients that did not undergo revision (60.3 years vs 64.3 years, $p = 0.01$).

Conclusions: At minimum 10 years following aTSA, 15.5% of patients passed away with their index procedure implants; 5.5% of patients underwent revision shoulder surgery with rotator cuff insufficiency being the most common reason. Older patients (mean age 72.2) and patients with more medical co-morbidities are more likely to retain their index procedure implants throughout their lifetime than undergo revision surgery. This study provides data to help with shared medical decision making. Furthermore, in cases where a patient's shoulder pathology (glenoid deformity or rotator cuff status) does not definitively dictate the operative indication (anatomic or reverse), this knowledge provides insight to help guide implant selection on the part of the surgeon.

EP.06.240

ERROR IN IMPLANT ORIENTATION IN NOVICE VS EXPERIENCED SURGEONS: THE POSITIVE IMPACT OF HANDS-ON LEARNING

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Background: Glenoid baseplate orientation in reverse shoulder arthroplasty (RSA) influences clinical outcomes, complications, and failure rates. Novel technologies have been produced to decrease performance heterogeneity of low and high-volume surgeons. This study aimed to determine novice and experienced shoulder surgeon's ability to accurately characterise glenoid component orientation in an intra-operative scenario.

Methods: Glenoid baseplates were implanted in eight fresh frozen cadavers by novice surgical trainees. Glenoid baseplate version, inclination, augment rotation, and superior-inferior centre of rotation (COR) offset were then measured using in-person visual assessments by novice and experienced shoulder surgeons immediately after implantation. Glenoid orientation parameters were then measured using 3D CT scans with digitally reconstructed radiographs (DRRs) by two independent observers. Bland-Altman plots were produced to determine the accuracy of glenoid orientation using standard intraoperative assessment compared to postoperative 3D CT scan results.

Results: Visual assessment of glenoid baseplate orientation showed "poor" to "fair" correlation to 3D CT DRR measurements for both novice and experienced surgeon groups for all measured parameters. The average augmented glenoid baseplate orientation measured from 3D CT was 2 degrees anteverted (standard deviation (SD), 9°), 7 degrees (SD, 8°) superior inclination, 17 degrees (SD, 11°) malrotation, and 3.3mm COR superior offset (SD, 1.8). There was a clinically relevant, large discrepancy between intra-operative visual assessments and 3D CT DRR measurements for all parameters in novice and expert groups. Errors in visual assessment of up to 15 degrees of version, 19.2 degrees of inclination, 38 degrees of rotation, and 8mm superior-inferior COR offset occurred. Experienced surgeons had greater measurement error than novices for all measured parameters.

Conclusions: Intra-operative measurement errors in glenoid placement may reach unacceptable clinical limits. Kinesthetic input during implantation likely improves orientation understanding and has implications for hands-on learning.

EP.06.242

THE CHANGE OF ALIGNMENT OF GRAFTED BONE ON THE GLENOID AFTER REVERSE SHOULDER ARTHROPLASTY -MULTICENTER STUDY

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Background: Most reverse shoulder arthroplasty (RSA) studies have shown good clinical results, however, high complications rates such as scapular notch and instability. Though bone graft was also performed for the cases with bone defect of glenoid, many surgeons have added bone graft (angled BIO) for lateralization and inferior tilting of baseplate to prevent these problems. Boileau reported high union rate of bone graft for lateralization. The aim of this study is to evaluate the change of alignment and resorption of the grafted bone on the glenoid, and the rate of scapular notch using angled-BIO.

Methods: The subjects were 50 shoulders with bone graft on glenoid out of 318 shoulders in which Xray could be performed more than 12 months after RSA by multicenter. There were 42 shoulders performed angled BIO to prevent Scapular notch, and 8 shoulders using bone graft for bone defect of glenoid. The average age at the time of surgery was 77.3 years (range, 70 - 88). The change of alignment and resorption of the grafted bone on the glenoid using angle B and Critical shoulder angle (CSA), and the rate of scapular notch were evaluated, so we classified Type 1-4 according to the change of alignment and resorption of the grafted bone using X ray at 1 week, 3 months, 6 months and 12 months after surgery. Type 1: Grafted bone remained completely, or absorbed partially but covered on the baseplate completely, Type 2: Grafted bone on the baseplate absorbed partially, Type 3: Absorption extended widely, and Type 4: Angle B or CSA changed more than 5 degree or displaced the baseplate.

Results: Scapular notch was seen in 22 shoulders (Grade 1/2: 20/2 shoulders in the Sirbeaux classification). Type 1/2/3/4 for the grafted bone on the glenoid were 37/4/2/7 shoulders. 2 shoulders in Type 4 were occurred displacement of baseplate.

Conclusions: It is possible that the alignment of the grafted bone was changed gradually, so we think the augmented implant for the cases of defected glenoid bone should be first choice, and lateralization should be treated by the implant, not BIO.

EP.06.243

MID-TERM RESULTS OF ROTATOR CUFF RECONSTRUCTION AND HHR USING SMALLER HUMERAL PROSTHESES UNDER 65 YEARS OLD WITH CUFF TEAR ARTHROPATHY.- MORE THAN 5 YEARS-

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Background: Most studies of reverse shoulder arthroplasty (RSA) have shown good improvement in arm elevation without improvements in external rotation (ER). However, high rates of complications after long-term RSA have been reported, suggesting that RSA should be limited to elderly patients, especially those who are older than 70 years old by Boileau et al. Since 2001, we have developed and reported a new strategy of rotator cuff reconstruction with muscle transfer and humeral head replacement (HHR) using smaller humeral prostheses for cuff tear arthropathy. The aim of the present study was to investigate clinical outcome of our strategy more than 5 years postoperatively in patients under 65 years of age with cuff tear arthropathy, furthermore compare with short term (average about 24 months) clinical outcome.

Methods: 23 shoulders under 65 years old with cuff tears arthropathy, were treated with HHR and cuff reconstruction before March 2017. We investigated 20 shoulders that excluded 3 shoulders who could not be followed up more than 5 years. The average age and follow-up period were 60.6 years and 96.0 months. Clinical outcomes were assessed with the ROM, JOA score, complications and glenoid wear on postoperative radiographs using Kawamata classification.

Results: Shoulder pain was diminished in all patients after surgery. The preoperative JOA score were 48.6 and 85.5 / 81.5 (short / mid-term) points respectively after surgery. Active forward flexion has improved from an average of 87.8° to 151.3 / 143.5° (short / mid-term), and the ER improved from an average of 11.6 to 34.5 / 27.3 ° (short / mid-term). No complications occurred after surgery. The types of glenoid wear (short / mid-term) included 8 / 3 grade 0, 8 / 4 Grade 1, 3 / 4 Grade 2, 0 / 0 Grade3A, 1 / 4 Grade 3B and 0 / 5 Grade3C.

Conclusions: Anatomical reconstruction using smaller head humeral prostheses yielded favorable results and less complication, compared with RSA. Considering another advantage of ability to retain glenoid bone stock even if 5 years have passed, the current procedure can be a useful option for cuff tear arthropathy under 65 years old.

EP.06.244

COMPARISON OF ANATOMIC VERSUS REVERSE SHOULDER ARTHROPLASTY WITH GLENOID RETROVERSION GREATER THAN 15 DEGREES IN ROTATOR CUFF INTACT PATIENTS

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Background: Severe Glenoid deformity has been associated with inferior outcomes and higher complication rates. In patients with intact rotator cuffs, there is no clear consensus as to whether anatomic (aTSA) or reverse (rTSA) shoulder arthroplasty is the optimal implant to best address this issue. The purpose of this study was to compare outcomes of aTSA versus rTSA in glenoid deformities with greater than 15° retroversion.

Methods: A retrospective review of a large multicenter database was conducted. All patients who underwent either aTSA or rTSA with an intact rotator cuff and glenoid retroversion 15° or greater with minimum 2-year follow-up were included. Range of motion (ROM), revisions, and patient reported outcomes (PROs) including Constant Score, Simple Shoulder test (SST), American Shoulder and Elbow score (ASES), Arthroplasty Smart score (SAS) were collected for all patients pre- and post-surgery.

Results: Overall, 336 patients were included with 187 receiving an aTSA and 149 rTSA. Reverse patients overall had more comorbidities (82% vs 65% $p=0.05$) and were older (71 ± 7 years vs 66 ± 8 years $p < 0.001$). Average follow up for the anatomic group was 63 ± 38 months versus 41 ± 23 months ($p < 0.001$). Preoperative retroversion in the anatomic group averaged 21 ± 6 degrees vs 24 ± 8 in reverse patients ($P < 0.001$). Both groups demonstrated significant improvements in all PROs and ROM from pre- to post-surgery ($p < 0.05$). At final follow-up aTSA patients had significantly better external rotation (50 ± 19 versus 38 ± 18 $p < 0.05$) but worse pain VAS (1.5 ± 2.3 vs 0.9 ± 1.9 $p = 0.016$). There was no significant difference in abduction or forward elevation or PRO's (Shoulder function, SST, Constant, ASES, or SAS). Overall revision rate (7% vs 1% $p = 0.004$) was higher in aTSA.

Conclusions: ATSA and rTSA results in significant improvements patients with severe glenoid deformity. Anatomic TSA patient have better postoperative external rotation but demonstrated no other significant improvement in ROM or PRO. However, there was significantly higher rate of complications and revisions with short to midterm follow-up.

EP.06.245

DO THRESHOLDS OF PREOPERATIVE FUNCTION PREDICT ACHIEVEMENT OF CLINICALLY-IMPORTANT BENCHMARKS OF IMPROVEMENT AFTER ANATOMIC TOTAL SHOULDER ARTHROPLASTY

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Background: The purpose of this study was to determine if there is a threshold of preoperative function that is predictive of achieving clinically-important success at minimum 2-year follow-up after anatomic total shoulder arthroplasty (aTSA).

Methods: We retrospectively reviewed a multicenter database for patients that underwent primary aTSA. Outcomes evaluated were abduction, forward elevation, external and internal rotation, SST, Constant, ASES, UCLA, SPADI, and SAS scores. Clinically-important benchmarks (CIBs) evaluated include: Minimum Clinically Important Difference (MCID), Substantial Clinical Benefit (SCB), Patient Acceptable Symptomatic State (PASS), and the Minimally- and Substantially-Clinically Important Percent Maximal Possible Improvement (MCI-%MPI and SCI-%MPI); aTSA-specific CIBs were adopted from prior studies. Multivariable logistic regression was first performed to assess whether preoperative outcomes were predictive of achieving CIBs independent of age, sex, and BMI. Next, a ROC analysis was performed to determine the preoperative thresholds predictive of achieving CIBs per the Youden index; identified thresholds were applied to create contingency tables and compared with Fisher's Exact test.

Results: A total of 2,041 aTSAs were included. For all ROM measures, poorer preoperative ROM was associated with greater odds of achieving the MCID and SCB, but lower odds of achieving the PASS ($P < 0.001$). More favorable preoperative scores were associated with greater odds of achieving the PASS for all scores, but only for a few scores for other CIBs. Thresholds of preoperative ROM and outcome scores identified on ROC analysis were significant predictors of achieving the MCID, SCB, and PASS for all outcomes ($P < 0.001$ for all), but not the MCI-%MPI and SCI-%MPI. For outcome scores, preoperative thresholds that predicted achieving CIBs were lowest for the PASS and highest for the SCB; no trends were identified for ROM. Preoperative ROM thresholds better differentiated whether patients would achieve CIBs compared to outcome score thresholds. Variability in identified thresholds, respective AUCs, and predictiveness of achieving CIBs was minimal when stratified by age and sex.

Conclusions: Preoperative ROM and outcome scores can be utilized to predict the likelihood of achieving absolute CIBs of success (MCID, SCB, PASS) after aTSA, but not the relative CIBs (MCI-%MPI and SCI-%MPI).

EP.06.246

UNDERSTANDING RELATIONSHIPS BETWEEN REVERSE SHOULDER ARTHROPLASTY DESIGN FEATURES AND PATIENT-SPECIFIC FACTORS TO DETERMINE COMPLICATION RISK: A GAME-THEORY-BASED MACHINE LEARNING APPROACH

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Background: Technological advancements in implant design and surgical technique have focused on decreasing complications and optimizing performance of reverse shoulder arthroplasty (RSA). With so many different RSA implants available, the impact of design features on complications is difficult to study. This investigation utilized a game-theory-based machine learning (ML) approach to understand the interactions between implant design and patient-specific factors when predicting the risk for surgical complications after RSA.

Methods: Over a 16-year period (2004 – 2020), all primary RSA performed at a single institution for elective and traumatic indications with a minimum follow-up of 2 years were identified. Implants were classified according to Werthel et al in regard to glenoid laterization (medialized vs lateralized), humeral lateralization (medialized, minimally lateralized, or lateralized), and global lateralization (medialized, minimally lateralized, lateralized, highly lateralized, or very highly lateralized). Other features analyzed included pivot point location (onlay vs inlay), stem neck shaft angle (NSA), insert NSA, age, diagnosis, and comorbidities. A total of 3,837 RSAs were identified, of which 472 (12.3%) experienced a surgical complication. Machine learning models predicting surgical complications were constructed for each patient and Shapley additive explanation (SHAP) values were calculated to quantify feature importance and understand variable interaction effects between patient- and implant-specific factors.

Results: Overall, those experiencing a surgical complication were younger ($p < 0.001$), required longer surgical time ($p < 0.001$), and were current smokers (odds ratio (OR) = 1.71, $p = 0.003$). Implant features suggestive of complications were inlay humeral design (OR = 1.67, $p < 0.001$), medialized glenoids (OR = 1.43, $p = 0.001$), higher stem NSA ($p < 0.001$), medialized humerus components (OR = 1.48, $p = 0.004$), and a glenohumeral construct classification of lateralized glenoid-medialized humeral (OR = 2.68, $p < 0.001$) or medialized glenoid-lateralized humeral (OR = 1.59, $p < 0.001$).

Conclusions: A game-theory-based ML demonstrated that the risk of surgical complication is multifactorial and dependent on both patient and implant-specific variables. The results of this study must be taken with caution, since it includes the learning curve of surgery and older implants and did not include a radiographic analysis of how implantation was executed.

EP.06.247

OUTCOMES OF REVERSE TOTAL SHOULDER ARTHROPLASTY WERE NOT ADVERSELY AFFECTED BY THE COVID-19 PANDEMIC

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Background: The objective was to investigate differences in reverse total shoulder arthroplasty (RTSA) outcomes between patients affected by the COVID-19 pandemic shutdown and a control group. We hypothesized that patients in 2020 would have decreased access to physical therapy (PT) and worse postoperative outcomes.

Methods: Patients who received RTSA between 1/1/2020 to 3/17/2020 were selected to be included and patients who received RTSA between 1/1/2019 to 3/17/2019 were used as a control group. Retrospective chart review was performed, and patient reported outcomes were recorded at an average of 2.69 ± 0.06 years and a minimum of 1 year postoperatively. Patient data was collected and statistically analyzed using the 2-sample t-test and Chi-square test.

Results: 38 patients in 2020 were included in this study and compared to 31 patients in 2019. RTSA performed in 2020 had improvements in forward elevation (FE) ($111.5^\circ \pm 40.3^\circ$ to $132.8^\circ \pm 30.6^\circ$, $p=0.016$), but not external rotation (ER) ($31.9^\circ \pm 18.2^\circ$ to $35.7^\circ \pm 15.9^\circ$, $p=0.36$) or internal rotation (IR) (S1 to L5, $p=0.13$). Patients in 2020 (FE: 4 to 5-, $p<0.001$; ER: 4+ to 5, $p<0.001$; IR: 5- to 5, $p=0.02$) had significant improvements in strength. There was no significant difference in outcomes between the 2019 and 2020 patients (ROM: FE $p=0.06$, ER $p=0.15$, IR $p=0.40$; Strength: FE $p=0.83$, ER $p=0.12$, IR $p=0.93$). Patients in 2020 initiated PT later (2019: 39.3 ± 27.3 days, 2020: 57.1 ± 35.5 days, $p=0.028$) and completed less PT sessions (2019: 20.7 ± 11.1 , 2020: 12.9 ± 6.6 , $p<0.001$) than patients in 2019. In the 2020 cohort, 10.5% did not complete any PT, 34.2% reported a delay in initiating PT, and 47.4% reported that their recovery was negatively affected by the COVID-19 pandemic. In October 2022, patients in 2020 reported a SANE score of 73.6 ± 17.5 on their affected shoulder, and a mean VAS pain score of 1.68 ± 1.23 .

Conclusions: Despite a delay in initiating PT and completing less PT overall, patients who received RTSA in 2020 experienced significant improvements in ROM and strength at final follow-up and were comparable to patients in 2019.

EP.06.248

PERIPROSTHETIC JOINT INFECTION IN PRIMARY SHOULDER ARTHROPLASTY IN A LATINAMERICAN COUNTRY

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Background: Periprosthetic joint infection (PJI) continues to be a catastrophic complication. It is reported to happen in 3.8 to 10% of cases in shoulder arthroplasty worldwide. Its importance relies on the heavy burden on patient's health and finance once they are diagnosed with this pathology. The most common reported shoulder etiopathogen is Cutibacterium Acnes.

Methods: We included patients from March 2013 to December 2021 who required a primary shoulder arthroplasty (anatomic or reverse) with any diagnosis (fracture or degenerative) with one-year minimum follow-up. We excluded patients with history of shoulder surgery or septic arthritis. We analyzed demographic variables and reported PJI frequency and most frequent isolated pathogen.

Results: We identified 158 patients who fulfilled our inclusion criteria. We had 1.9% (3 patients) PJI infection rate. All PJI patients were younger than 70 years. All patients were male and the left side was the afflicted one in all cases. Two cases were from arthroplasties in fracture-dislocations (1 anatomic and 1 reverse) and 1 case in a degenerative diagnosis (reverse arthroplasty). Two cases were implanted with antibiotic-loaded cement (one anatomic and one reverse), and one case was uncemented. Three different pathogens were identified (one from each case): Enterococcus faecalis, Staphylococcus aureus, and Cutibacterium acnes. The rate of PJI infection secondary to Cutibacterium acnes represented only 0.6% of the whole series.

Conclusions: Our PJI rate is relatively low in comparison to previous reports. Due to the low rate of infection in our series we were not able to identify risk factors. Cutibacterium acnes is an extremely infrequent etiologic agent in our series.

EP.06.250

NEW RADIOGRAPHIC PARAMETERS IN REVERSE SHOULDER ARTHROPLASTY AN INTERNATIONAL RADIOGRAPHIC VALIDATION STUDY

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Background: Lateralization and distalization are core concepts in modern reverse shoulder arthroplasty (RSA). The "lateralization shoulder angle" (LSA) and "distalization shoulder angle" (DSA) are well-established radiographic parameters, yet their clinical significance is still debated. In this study, we introduce new angles for the radiological assessment after RSA: "modified lateralization shoulder angle" (mLSA), "distalization and lateralization shoulder angle" (DLSA), "modified distalization shoulder angle" (mDSA), and "glenoid inferior offset angle" (GIOA). The goal was to validate the new angles radiographically.

Methods: Three experienced orthopedic surgeons analyzed 150 anteroposterior radiographs of patients who underwent RSA. LSA, DSA as well as four new angles were determined. To enhance an international blinded and randomized image analysis by multiple observers, a recently introduced tool, Tyche, was utilized.

Results: Mean values for LSA and DSA were 82.96° and 58.2°, respectively. LSA and DSA showed similar standard deviations (SD) for individual measurements. DLSA had significantly lower SDs for individual measurements compared to LSA. Except for GIOA, all angles showed strong to very strong inter- and intra-rater correlations, ranging from 0.85 to 0.97.

Conclusions: Apart from GIOA, all new angles can be considered radiographically at least as reliable as the established angles, LSA and DSA. Correlations between the established and new angles suggest that mLSA, DLSA, and mDSA capture new geometric patterns. We thus recommend including them in studies and determining their clinical importance.

EP.06.251

DIFFERENTIATION OF SHOULDER FUNCTION BEFORE AND AFTER REVERSE TOTAL SHOULDER ARTHROPLASTY FOR CUFF TEAR ARTHROPATHY USING THE WALCH AND SIRVEAUX CLASSIFICATIONS

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Background: The Walch and Sirveaux classifications are utilized by surgeons to classify glenoid bone loss in cuff tear arthropathy (CTA). While helpful for understanding glenoid morphology, it is unclear if they correlate with patient clinical state.

Methods: A prospectively-collected, multi-center database for a single-platform TSA system was queried for patients with CTA and minimum 2-year follow-up. Differences in active range of motion (abduction, forward elevation[FE], external/internal-rotation[ER and IR]) and outcome scores (SST, Constant, ASES, UCLA, SPADI, VAS pain, Shoulder Function, and Shoulder Arthroplasty Smart[SAS] scores) were stratified by glenoid deformity according to Walch and Sirveaux classifications. Outcomes were evaluated with one-way ANOVA and post-hoc Tukey correction for multiple comparisons.

Results: 210 rTSA (89 A1, 54 A2, 21 B1, 16 B3, 30 B2; 83 E0, 48 E1, 36 E2, 43 E3) were analyzed. Preoperatively, IR ($p=0.007$) differed amongst Walch Glenoid Types. On post hoc analysis, A1 glenoids had significantly more IR than B2 glenoids (3.9 ± 1.8 vs 2.9 ± 1.9 ; $p=0.025$). Postoperatively, Abduction ($p=0.043$; A1>B2 [127 ± 32 vs 121 ± 25 , $p=0.014$]) and FE ($p=0.015$; A1>B1 and A1>B2 [145 ± 24 vs 131 ± 26 and 135 ± 20 , $p=0.024$ and $p=0.009$, respectively]) differed significantly. Regarding improvement after rTSA, only IR ($p=0.002$) differed significantly amongst Walch glenoid types. Post hoc analysis demonstrated B2 (2.0 ± 1.9 vs 0.2 ± 2.1 ; $p=0.039$) and B3 (2.2 ± 1.7 vs 0.2 ± 2.1 ; $p=0.006$) had greater improvement in IR than A1 glenoids. When Sirveaux classification was analyzed preoperatively no differences existed for any outcome metric. Postoperatively, significant differences were found for VAS pain ($p=0.002$; E0>E1 [2.2 ± 2.7 vs 07 ± 1.7 , $p=0.004$]), Shoulder Function ($p=0.007$; E1>E0 [8.7 ± 1.7 vs 7.5 ± 2.1 , $p=0.026$]), and ASES ($p=0.024$; E1>E0 [84.9 ± 16.2 vs 73.7 ± 24.7 , $p=0.038$]) scores. Regarding improvement after rTSA, there were no significant differences between Sirveaux glenoid classification types.

Conclusions: We demonstrate a weak association between preoperative glenoid morphology and clinical state when evaluating patients undergoing rTSA for CTA. Improvement after surgery was greater with more advanced Walch glenoid classification type but only pertaining to IR; however, clinical function was not associated with Sirveaux classification type before or after surgery. Alternative glenoid classification systems or predictive models should be considered to provide more precise prognoses for patients undergoing rTSA for CTA.

EP.06.252

THE COST-EFFECTIVENESS OF TRANEXAMIC ACID FOR PREVENTING PERIPROSTHETIC JOINT INFECTION FOLLOWING TOTAL SHOULDER ARTHROPLASTY: A BREAK-EVEN ANALYSIS

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Background: The use of tranexamic acid has become widespread in orthopaedics to promote hemostasis and has been successfully used to reduce blood loss and infection risk in joint arthroplasty. However, the cost-effectiveness of routine tranexamic acid use for the prevention of periprosthetic infections in total shoulder arthroplasty (TSA) remains unknown.

Methods: The acquisition cost of tranexamic acid (\$5.22) for our institution, along with values from the literature for the average cost of infection-related care (\$55,243) and the baseline infection rates for patients without tranexamic acid use (0.70%), were used to perform a break-even analysis. The absolute risk reduction of infection necessary to justify the prophylactic use of tranexamic acid in shoulder arthroplasty was calculated from the non-treated and break-even infection rates.

Results: Tranexamic acid is considered cost effective if it prevents one infection out of 10,583 TSA's (absolute risk reduction [ARR] = 0.01%). It is economically justifiable with an ARR range of 0.001% at a cost of \$0.50/g to 0.181% at \$100/g. At varying costs of infection-related care (\$10,000 - \$100,000) and varying baseline infection rates (0.50% - 8.00%), routine use of tranexamic acid remained cost effective.

Conclusions: The use of tranexamic acid is an economically viable practice for infection prevention following shoulder arthroplasty if it reduces the infection rate by 0.01%. Future, prospective studies should be conducted to observe whether tranexamic acid reduces the infection rate by more than 0.01%, showing cost-effectiveness.

EP.06.253

REVERSE TOTAL SHOULDER ARTHROPLASTY OUTCOMES BY AGE: ABOVE AND UNDER 65 YEARS OLD

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Background: Increasing number of reverse total shoulder arthroplasties (RTSA) in recent years is due, in part, to expanding indications which have included a broader and younger cohort of patients. The literature remains conflicted regarding impact of age on RTSA outcomes. The purpose of this study is to compare RTSA outcomes in patients younger than (or equal to) 65 years of age to those older than 65 years of age. We hypothesized there would be no difference between groups regarding revision rate or patient reported outcomes (PROs) 1 year postoperatively.

Methods: A retrospective case series was performed, analyzing outcomes of shoulder arthroplasties for patients at a single institution, stratified by age: group 1, aged 51-65 (avg = 60, n=12) and group 2, aged 66-80 (avg = 72, n=35). Primary outcomes were postoperative instability and/or surgical revision. Secondary endpoints included Visual Analog Pain Scale (VAS), American Shoulder and Elbow Surgeons (ASES) score, Single Assessment Numeric Evaluation (SANE), and Patient Reported Outcomes Measurement Information System (PROMIS-10). Data was analyzed with use of Prism GraphPad Version 9.3.1 (Dotmatics, Boston, MA) via a non-parametric Mann-Whitney-U test; significance was alpha level of <0.05.

Results: 47 patients were included in this study. At one-year follow-up, there was no difference between group 1 and 2 in VAS pain score (2.40 ± 2.57 vs 2.01 ± 2.52 , $p=0.77$), SANE (75 ± 23 vs 73 ± 27 , $p=0.57$), or ASES (67 ± 32 vs 75 ± 22 , $p=0.66$). The PROMIS-10 physical score was significantly lower for group 1 when compared to group 2 (38.2 ± 3.76 , 57.77 ± 16.75 respectively, $p=0.009$). No patients in group 1 underwent revisions; three patients in group 2 required revisions within two years of initial arthroplasty ($p=0.56$).

Conclusions: In this single-center cohort of patients, there was no significant difference in 1-year VAS, SANE, or ASES score between patients younger than 65 and those older than 65. Younger patients reported significantly lower PROMIS-10 physical scores. These data challenge the previous supposition that younger patients have worse outcomes than older patients. Longer-term follow-up and increased sample size are necessary to further evaluate if younger age is a risk factor for RTSA.

EP.06.254

HISTORY OF IPSILATERAL SHOULDER SURGERY AFFECTS OUTCOMES AFTER PRIMARY SHOULDER ARTHROPLASTY AND MAY INCREASE COMPLICATION RISK

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Background: Shoulder arthroplasty often is performed in patients with history of prior ipsilateral shoulder surgery, but effect of prior surgery on arthroplasty outcomes is not well understood. The purpose of this study was to evaluate patient characteristics, complications, and clinical outcomes after primary shoulder arthroplasty in patients with a history of ipsilateral surgery.

Methods: A retrospective cohort study reviewed all patients undergoing primary shoulder arthroplasty from January 2015–December 2019 by one surgeon at one institution. Revision arthroplasty patients were excluded. Univariate regression was performed to assess the influence of prior surgery on complications and outcomes (visual analog scale for pain, VAS; American Shoulder and Elbow Surgeons Score, ASES; Simple Shoulder Test, SST; Single Assessment Numeric Evaluation, SANE). Objective gains in active forward elevation (AFE) and supraspinatus strength also were compared between groups.

Results: 514 patients met study inclusion criteria; 377 had no prior surgery; 141 patients had prior ipsilateral shoulder surgery. Patients with prior surgery were younger (65.3 ± 9.4 versus 70.8 ± 9.1 , $p < 0.001$); more likely to be male (51.1% versus 40.1%, $p = 0.032$), more likely to have a history of smoking ($p = 0.002$), and were borderline more likely to use preoperative opioids ($p = 0.058$). Patients with prior surgery had significantly higher VAS at final follow up (1.7 ± 2.4 versus 1.1 ± 1.9 , $p = 0.005$), lower final ASES scores (75.0 ± 21.5 versus 81.7 ± 18.7 , $p = 0.001$), lower final SST (8.1 ± 3.0 versus 8.8 ± 2.8 , $p = 0.017$), and lower final SANE scores (78.1 ± 21.4 versus 82.9 ± 20.5 , $p = 0.007$), despite similar gains in AFE and supraspinatus strength ($p = 0.244$ and $p = 0.896$, respectively). Patients with prior surgery also were borderline more likely to have a complication (OR 1.5 (1.0, 2.3), $p = 0.064$).

Conclusions: Patients with prior surgery were more likely to experience worse subjective clinical outcomes and borderline more likely to experience a complication, despite similar gains in range of motion and strength. These patients were younger, more likely to be male with a history of tobacco and opioid use.

EP.06.255

THE GROWTH OF TOTAL SHOULDER ARTHROPLASTY 2010-2019: PAST TRENDS AND FUTURE DIRECTIONS

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Background: The incidence of total shoulder arthroplasty (TSA) has significantly increased over the past decade. Utilization is expected to increase as a result of an aging population, expanding indications, and implant longevity. Outpatient arthroplasty has the potential to increase patient satisfaction, decrease costs, and free up valuable resources within our medical system. Shoulder arthroplasty has not been as quickly adopted in the outpatient setting. The purpose of this study is to report the nationwide volume and incidence of outpatient TSA over the past decade and describe projections for the coming decade to allow a better understanding for healthcare policy and anticipate the future needs of our population.

Methods: The IBM MarketScan database was searched for patients undergoing primary TSA between 2010 and 2019. Patients were stratified by procedure setting (inpatient vs outpatient), age group, gender, and geographic region. Complex sampling and sample weights were utilized to create volume estimates with 95% confidence intervals representative of the entire US population.

Results: 1,006,954 primary TSA procedures were identified. Annual case volumes increased from 60,000 to 150,000 procedures annually between 2010 and 2019. Outpatient TS increased from 8,000 (13.3%) to 26,500 (17.7%) procedures annually throughout the decade. Inpatient and outpatient volumes rose by 135% and 230%, respectively. There has been a 120% and 209% increase in the per capita incidence of inpatient and outpatient TSA, respectively. By the end of 2019, females comprised 54% of all primary TSA patients. Most TSA procedures were performed in patients aged 65-74. Overall, the annual volume of TSA increased across all age groups, <55 (+74%), 55-64 (+146%), 65-74 (+174%), >75 (+143%).

Conclusions: TSA in the outpatient environment will likely increase in the coming years and surgeons, hospitals, and healthcare legislators must understand the increasing demand to prepare for the changing practice of TSA. Geographic differences exist in the utilization of TSA throughout the US with Southern and Western US regions increasing the most since 2010. The most substantial increases in outpatient TSA were seen in patients younger than 65 years and male gender.

EP.06.256

HUMERAL LENGTHENING AND CLINICAL OUTCOMES AFTER REVERSE SHOULDER ARTHROPLASTY: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Background: While biomechanical studies have demonstrated an improved range of motion (ROM) and a greater risk of acromial fractures and nerve injury with increased humeral lengthening in reverse shoulder arthroplasty (RSA), clinical evidence is variable. We systematically-reviewed the relationship between humeral lengthening and clinical outcomes after RSA with stratification by measurement method and implant design.

Methods: This review was performed per PRISMA guidelines. PubMed, Cochrane Trials, and Embase were queried for articles evaluating the relationship between humeral lengthening and ROM, strength, outcome scores, and pertinent complications (acromial and scapular spine fractures, nerve injury). The relationship between lengthening and outcomes was reported descriptively and stratified by method of assessing humeral lengthening and implant design. Meta-analysis was performed to compare lengthening between patients with and without fractures using a random-effects model.

Results: Of 711 studies screened, 22 studies reporting on 2,393 shoulders were included (weighted mean age=73 years, follow-up=28 months, 66% female). Of studies that assessed forward elevation (n=11), six identified a positive, one identified a negative, and four identified no association with lengthening. The study identifying a negative association utilized an inlay-humerus and globally-medialized design. Of studies assessing internal rotation (n=9), external rotation (n=7), and abduction (n=4), all identified a positive or lack of association with lengthening. Studies assessing outcome scores (n=11) found either a positive (n=5) or no (n=6) association with lengthening. One study assessed nerve injury and identified a positive association with lengthening. Of studies assessing fractures (n=6), two identified a positive, one identified a negative, and three identified no association with lengthening. The two studies that identified a positive association demonstrated a 4.5mm [95%CI=0.7-8.3, p = 0.02] greater acromion-to-deltoid-tuberosity distance in patients with versus without fractures; however, no difference was found for the acromiohumeral distance. No clear trends were found between outcomes and lengthening measures or implant design.

Conclusions: The relationship between humeral lengthening and clinical outcomes after RSA remains unclear. While most studies report either a positive or no association between lengthening and outcomes, a minority present conflicting data showing increased lengthening associated with decreased forward elevation, higher incidence of nerve injury, and increased incidence of acromion fractures.

EP.06.257

INLAY RESURFACING GLENOID WITH STEMLESS SHOULDER ARTHROPLASTY MID TERM EVALUATION

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Background: The association of inlay glenoid component and stemless implants in total shoulder arthroplasties has not yet been reported in large series.

Methods: A continuous cohort of anatomic stemless total shoulder arthroplasties (TSA), with a resurfacing inlay glenoid component is followed since 2014.

Results: The functional and radiological outcomes of such 48 TSA is reported with an average follow-up of 49 months (24-94). The mean raw Constant score improve from 29 to 66 (30-88) [18] (40 to 92% after ponderation) and Quick Dash score improve from 64 to 19 (0-47.7) [18]. At the last follow-up, Shoulder Simple Value reach 80% (30-100) [10] and mean ASES score 76(38-98) [18]. No component loosening was detected.

Conclusions: The association of inlay glenoid component and stemless implants provide good functional outcome without loosening at mid-term evaluation.

EP.06.258

FUNCTIONAL DEFICIENCIES FOLLOWING REVERSE AND ANATOMIC TOTAL SHOULDER ARTHROPLASTY: DETECTING TRUE DIFFERENCES

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Background: While studies to date have not detected differences in patient-reported outcome scores for the treatment of osteoarthritis (OA) between anatomic and reverse total shoulder arthroplasty, the shortcomings of these instruments may limit their ability to detect true differences in post-operative outcomes. This study aims to provide a more comprehensive analysis of the influence of surgery type and indication on patient-reported functional tasks following total shoulder arthroplasty (TSA).

Methods: A single-institution shoulder arthroplasty registry was queried for patients undergoing shoulder arthroplasty for OA, rotator cuff tear arthropathy (CTA), or irreparable rotator cuff tear (RCT) with a minimum of two-year follow-up. SANE score, composite ASES score, and the ability to perform the specific tasks in the ASES questionnaire, were compared by indication and arthroplasty type. To comprehensively assess the effect of arthroplasty type (aTSA vs. rTSA) on the ability to perform specific tasks post-operatively, a multivariate ordinal regression with potential confounding variables was performed.

Results: Four-hundred ninety patients (243 males; 49.6%) with an average age of 67.6 (95% CI: 66.8-68.4) years were available for review. There was no difference in ASES (64.6 v 65.3; $p=0.64$), SANE (77.0 v 80.9; $p=0.21$), or VAS pain (0.7 v 0.8; $p=0.4$) for rTSA versus aTSA for OA, respectively. In the setting of OA, multivariate analysis confirmed rTSA utilization as an independent predictor of worse back washing / strapping bra (OR=1.8; $p=0.03$) and reaching 10 pounds above the shoulder (OR=1.8; $p=0.05$) in treating OA. Patients treated for CTA or RCT had worse post-operative SANE ($p=0.003$), satisfaction ($p<0.001$), and VAS pain ($p=0.02$) than rTSA for OA. Except for performing usual sport and washing behind the back, patients with CTA or RCT indications experienced greater difficulty with all tasks compared to patients with OA in the setting of treatment with rTSA ($p<0.009$).

Conclusions: This analysis provides a deeper understanding of functional outcomes following shoulder arthroplasty. While composite patient-reported scores indicate similar outcomes between rTSA and aTSA for the treatment of OA, nuanced assessment of functional tasks demonstrates notable differences in patients' ability to perform specific tasks, particularly those requiring behind-the-back dexterity or lifting objects above shoulder height.

EP.06.259

POSTOPERATIVE COMPLICATIONS OF REVERSE TOTAL SHOULDER ARTHROPLASTY: A MULTICENTER STUDY IN JAPAN

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Background: Reverse total shoulder arthroplasty (RSA) is a common surgery for cuff tear arthropathy and irreparable rotator cuff tears. RSA has been approved since 2014 in Japan, and the number of RSA cases has been accumulating. However, only short-to mid-term outcomes have been reported, with a small number of case series, because of its short history in Japan. This study aimed to evaluate complications after RSA in hospitals affiliated with our institute, with comparison to those in other countries.

Methods: A multicenter retrospective study was assessed at six hospitals. In total, 615 shoulders (mean age: 75.7 ± 6.2 years; mean follow-up: 45.2 ± 19.6 months) with at least 24 months of follow-up were included in this study. The active range of motion (ROM) was assessed pre-and postoperatively. The 5-year survival rate was evaluated for reoperation for any reason in 137 shoulders with at least 5 years of follow-up using Kaplan-Meier analysis. Postoperative complications were evaluated, including dislocation; prosthesis failure; deep infection; periprosthetic, acromial, scapular spine, and clavicle fractures; neurological disorders; and reoperation. Furthermore, imaging assessments, such as scapular notching, prosthesis aseptic loosening, and heterotopic ossification, were evaluated on postoperative radiography at the final follow-up.

Results: All ROM parameters were significantly improved postoperatively ($P < 0.001$). The 5-year survival rate was 93.4% (95% confidence interval: 87.8 to 96.5%) for reoperation. Complications occurred in 256 shoulders (42.0%), with dislocation in 9 (1.5%), prosthesis failure in 9 (1.5%), deep infection in 16 (2.6%), periprosthetic fracture in 11 (1.8%), acromial fracture in 24 (3.9%), scapular spine fracture in 2 (0.3%), clavicle fracture in 4 (0.7%), neurological disorders in 17 (2.8%), and reoperation in 45 (7.3%). Regarding imaging assessments, scapular notching was observed in 145 shoulders (23.6%), prosthesis loosening in 13 (2.1%), and heterotopic ossification in 80 (13.0%).

Conclusions: This is the first large case series to investigate the complications after RSA in Japan. Scapular notching was the most common complication, as in other studies, and the overall frequency of complications after RSA was similar to those in other countries.

EP.06.260

LEARNING CURVE OF BONY INCREASED-OFFSET REVERSE SHOULDER ARTHROPLASTY

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Background: Angled bony-increased offset-reverse shoulder arthroplasty (BIO-RSA) can correct severe retroversion and bone loss, decrease scapular notching, and improve functionality. However, the learning curve associated with this technically challenging procedure has not yet been described. Understanding changes in proficiency can inform preparedness and help predict complication rates. The purpose of this study was to report the learning curve of angled BIO-RSA and its implications.

Methods: All patients who underwent primary reverse shoulder arthroplasty using an angled BIO-RSA performed by a single surgeon were included between November 2018 and February 2022. The surgeon has already completed his learning curve for anatomic total shoulder arthroplasty (aTSA) and traditional reverse shoulder arthroplasty (RSA). Operative time (incision to closure), intraoperative complications, post-operative complications, same joint reoperations and time to follow-up were all included. Patients were excluded if they underwent a planned two-stage arthroplasty. Linear regression analysis was used to test the relationship between surgical time and time elapsed since the first BIO-RSA.

Results: Thirty-four angled BIO-RSAs were identified. Two patients were excluded as they did not undergo primary arthroplasty. Mean total operative time was 127 minutes. Average operative time for the first five BIO-RSAs was 158 minutes, while the average operative time for the last five BIO-RSAs was 92 minutes. There was a significant decrease in operative time and no intraoperative complications for all 32 procedures. Average follow-up for was 20.8 months. One patient developed a shoulder hematoma postoperatively requiring irrigation and debridement and no revision procedures were reported. Twenty-six of 32 individuals reported an average American Shoulder and Elbow Surgeons ASES Shoulder Score of 79.7. All individuals had a recorded Shoulder Subjective Value with an average of 87.3 %.

Conclusions: Our study demonstrates operative times reduced during subsequent angled BIO-RSA procedures. Operative times had not reached a nadir at the last included procedure, demonstrating that the learning curve has still not been completed after 34 procedures. Surgeons taking on these complex procedures should be aware of the long learning curve and seek ways to expedite efficiency.

EP.06.261

CLINICAL AND RADIOLOGICAL MID-TERM RESULTS OF STEMLESS SHOULDER ARTHROPLASTY

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Background: Through an iteration of various advancements, stemless options for humeral fixation have been proposed and have shown numerous theoretical advantages, including preserved bone stock, reduced rate of intraoperative humerus fracture, and flexibility of anatomic reconstruction. This study evaluated the clinical and radiological results of shoulder arthroplasty using a single type of stemless humeral component with a minimum follow-up of 4 years.

Methods: A retrospective review was conducted of primary shoulder arthroplasties performed with stemless humeral component since 2014. Shoulder arthroplasty using Comprehensive[®] Nano Stemless Shoulder (Biomet[®], Warsaw, IN, USA) was performed in 16 shoulders; 7 underwent hemiarthroplasty (HA), 7 underwent total shoulder arthroplasty (TSA), and 2 underwent reverse total shoulder arthroplasty (RTSA). 15 patients (16 shoulders) who were aged 56.8 years were available for clinically and radiologically at a mean follow-up of 63.2 months. Clinical evaluations were documented using Constant-Murley Score (CMS); American Shoulder and Elbow Society (ASES) score; Korean Shoulder Scoring (KSS) System. Radiological evaluations was based on geometrical joint parameters and the occurrence of radiolucent lines around implants.

Results: Overall survival rate at 4.6 years was 94%. 1 patient who underwent RTSA had revision to cement stem due to immediate operative humeral component displacement. Clinically, CMS improved from 43.9 to 85.3 and ASES score improved from 44.8 to 86.2 and KSS improved from 54.5 to 82.6 (P=0.001). Active range of motion improved significantly for flexion (from 116.5° to 163.5°), abduction (from 95.0° to 158.2°; P=0.001), and external rotation (from 38.5° to 59.6°; P=0.001). Radiologically, most of center of rotation showed superomedial deviation and lateral glenohumeral offset increased significantly after total shoulder arthroplasty. Also radiolucent lines could be detected around humeral component, but none of them have had clinical relevance yet.

Conclusions: The functional and radiologic results of the Comprehensive Nano stemless shoulder system are promising in mid-term follow-up. However, synthetical preoperative evaluation is essential in performing the stemless RTSA.

EP.06.262

FACTORS AFFECTING THE OCCURRENCE OF OSSEOUS LESIONS IN SEPTIC SHOULDER ARTHRITIS AND THE RECURRENCE RATE AFTER ARTHROSCOPIC SURGERY

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Background: The purpose of this study was to determine the incidence of osseous lesions and the recurrence rate after arthroscopic surgery in shoulder septic arthritis patients and evaluate the influencing factors.

Methods: The purpose of this study was to determine the incidence of osseous lesions and the recurrence rate after arthroscopic surgery in shoulder septic arthritis patients and evaluate the influencing factors.

Results: Twenty-one patients had an osseous lesion on MRI, and 12 patients had evidence of bone erosion on radiographs. In univariate analyses, significant ($p < 0.05$) risk factors for the presence of osseous lesions were female sex, lower C-reactive protein levels, and longer duration from symptom onset to MRI. The overall infection recurrence rate was 22.7% (10/44). Culture results and the duration from symptom onset to surgery were significant risk factors for recurrent infection ($p < 0.05$). As the duration from symptom onset to MRI increased by 1 day, the probability of osseous lesions increased 1.31-fold (95% confidence interval 1.08-1.59, $p = 0.007$), and this probability was significantly higher after correcting for other risk factors.

Conclusions: To reduce the severity of septic shoulder infection, timely diagnosis and treatment is essential. Even if osseous lesions are present, good results can be obtained if meticulous debridement is performed through arthroscopic surgery. However, functional and radiologic long-term follow-up studies are needed in patients with osseous lesions.

EP.06.263

SUBSCAPULARIS-SPARING WINDOWED ANTERIOR TECHNIQUE FOR MUSCLE PRESERVING ANATOMIC TOTAL SHOULDER ARTHROPLASTY, A REVIEW OF THE LITERATURE AND PRESENTATION OF TECHNIQUE

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Background: Historically, anatomic total shoulder arthroplasty (TSA) is performed via a deltopectoral approach (DPA), requiring violation of the subscapularis to access the glenohumeral joint. Subscapularis failure/dysfunction is a known early complication of TSA, shown to occur in up to 67% of patients. Subscapularis insufficiency may lead to instability, weakness, and lower patient satisfaction scores. To preserve the subscapularis, techniques have been developed that allow for early postoperative motion and activity without prolonged immobilization.

Methods: Literature review was performed for currently available techniques for anatomic total shoulder arthroplasty that preserve/spare the subscapularis tendon. All currently available techniques were reviewed and compared to the presented technique. Similarities and differences are outlined as well as perceived benefits and disbenefits.

Results: There are several techniques for TSA that aim to preserve the subscapularis. Lafosse et al. described the use of the rotator interval (RI) using a deltoid split (DS) Ransom et al. describes a similar approach through the RI using a DS. Simovitch et al. as well as Savoie et al. describe techniques which utilize DPA with release of half of the inferior subscapularis tendon. Griewe et al. described a posterior approach, splitting the deltoid and utilizing the interval between teres minor and infraspinatus. While all these groups report favorable clinical outcomes, they all also describe a combination of limitations of their selected techniques including poor humeral head visualization, inadequate osteophyte removal, difficulty with implant sizing and/or alignment. The Subscapularis-sparing Windowed Anterior Technique (SWAT) approach utilizes DPA and preserves the deltoid and the subscapularis by performing a window to remove the inferior osteophyte. This technique allows for adequate glenohumeral joint access, bone preparation, and implant selection.

Conclusions: SWAT for anatomic total shoulder is differs substantially from other reported techniques and boasts several benefits including preservation the deltoid and subscapularis, allowance for complete osteophyte removal through the window, and adequate bone preparation, implant sizing, and implantation.

EP.06.264

EFFECT OF UPPER ARM EXTENSION RATE ON DELTOID MUSCLE STIFFNESS AND SHOULDER FUNCTION AFTER REVERSE SHOULDER ARTHROPLASTY

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Background: Deltoid muscle was relaxed preoperatively due to upward migration of humeral head in rotator cuff tear shoulders such as cuff tear arthropathy. Deltoid muscle is stretched and hypertonic after reverse shoulder arthroplasty (RSA), which is thought to increase muscle stiffness. Lower tonus of deltoid muscle might induce shoulder instability or elevation difficulty, higher tonus of deltoid muscle might induce muscle pain or acromion fracture. Proper deltoid muscle tonus is important for postoperative good shoulder function after RSA. We can evaluate muscle tonus by measuring muscle stiffness with Shear Wave Elastography (SWE). Muscle tonus is regulated by upper arm extension after RSA. The purpose of this study was to examine the effect of upper arm extension rate after RSA on deltoid muscle stiffness and postoperative shoulder function.

Methods: Twenty-one patients (76.1 ± 4.6 years) after RSA were involved in this study. The upper arm length was measured by pre- and postoperative radiographic images; upper arm extension ratio was calculated. Muscle stiffness was measured with SWE at the middle portion of the deltoid muscle. Shoulder function was evaluated with active ROM of flexion and abduction at pre-operation and 3 months postoperatively. Relations among deltoid muscle stiffness, upper arm extension rate and shoulder function were statistically analyzed.

Results: A significant correlation between upper arm extension rate and change amount of SWE was observed ($r=0.58$). A significant correlation between postoperative change amount of SWE and ROM of active abduction was also found ($r=0.44$).

Conclusions: We should pay attention to the deltoid muscle stiffness determined by upper arm extension rate to improve postoperative shoulder function after RSA.

EP.06.265

CAN SHOULDER ARTHROPLASTY IN PATIENTS WITH RHEUMATOID ARTHRITIS BE A PREDICTIVE FACTOR IN THE PROGRESSION OF RHEUMATOID ARTHRITIS?

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Background: Aimed to retrospectively investigate the current incidence of joint replacement surgery in patients with RA in South Korea and compared the incidence of joint replacement surgery in each affected joint.

Methods: This retrospective study was based on data from the Korea National Health Insurance (KNHI) claims database, which accounts for 90% of the national data compiled from healthcare providers across South Korea. This study used NHIS-NSC, made by National Health Insurance Service (NHIS). From January 2008 to December 2016, data of patients > 19 years old who received inpatient or outpatient treatment with diagnostic codes for RA were included.

Results: A total of 239,411 patients were newly diagnosed with RA from 2010 to 2016. Of these, 6,189 (2.57%) underwent joint replacement surgery. The incidence rate of joint replacement surgery in patients with RA based on the date of surgery significantly increased from 0.72% in 2010 to 4.03% in 2016.

The relative risk of additional joint replacement surgery for another joint in patients who already underwent joint replacement surgery was highest for the shoulder joint (1.454, 0.763-2.771), followed by the hip, knee, ankle, and elbow; the difference in relative risk was not statistically significant.

The median time from the diagnosis of RA to joint replacement surgery was 836 days for patients during the 5 years of follow-up. The median time from diagnosis to surgery was shortest for the elbow joint (379 days), followed by the ankle (626 days), hip (764 days), and knee (860 days), and longest for the shoulder joint (955 days).

Conclusions: The relative risk of additional joint replacement surgery tended to be higher for the shoulder, followed by the hip, knee, ankle, and elbows. This finding indicates that patients undergoing shoulder joint replacement surgery have a higher risk of requiring additional joint replacement surgery in another joint.

Regardless of whether patients are symptomatic, evaluation of large joints such as the elbow and shoulder should be considered from an early stage.

EP.06.266

ANATOMIC TOTAL SHOULDER ARTHROPLASTY OUTCOMES WERE NOT NEGATIVELY AFFECTED BY THE COVID-19 PANDEMIC

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Background: The purpose was to investigate the difference in anatomic total shoulder arthroplasty (ATSA) outcomes between patients affected by the COVID-19 pandemic shutdown and a control group. We hypothesized that patients in 2020 would have decreased access to physical therapy (PT) and worse postoperative outcomes.

Methods: Patients who received ATSA between 1/1/2020 to 3/17/2020 were selected to be included and patients who underwent ATSA between 1/1/2019 to 3/17/2019 were used as a control group. Retrospective chart review was performed, and patient reported outcomes were recorded at an average of 2.68 ± 0.06 years and a minimum of 1 year postoperatively. Patient data was collected and analyzed statistically using the 2-sample t-test and Chi-square test.

Results: 27 patients in 2020 were included in this study and compared to 24 patients in 2019. ATSA performed in 2020 had improvements in forward elevation (FE) ($120.2^\circ \pm 28.8^\circ$ to $141.1^\circ \pm 25.9^\circ$, $p=0.009$), external rotation (ER) ($32.9^\circ \pm 16.5^\circ$ to $42.0^\circ \pm 13.7^\circ$, $p=0.037$), and internal rotation (IR) (S1 to L3, $p=0.002$). Patients in 2020 did not have significant improvements in strength (FE: 5- to 5-, $p=0.38$; ER: 5- to 5-, $p=0.29$; IR: 5 to 5, $p=0.76$). There was no significant difference in outcomes between the 2019 and 2020 cohort (ROM: FE $p=0.39$, ER $p=0.13$, IR $p=0.42$; Strength: FE $p=0.17$, ER $p=0.18$, IR $p=0.12$). Patients in 2020 terminated PT earlier (2019: 125.8 ± 70.7 days, 2020: 91.1 ± 47.0 days, $p=0.046$) and completed fewer sessions (2019: 21.4 ± 10.8 sessions, 2020: 13.1 ± 8.4 sessions, $p=0.003$) than patients in 2019. Of the 2020 cohort, 7.4% did not initiate PT, 7.4% reported a delay in initiating PT, and 37% reported that the COVID-19 pandemic negatively affected their recovery. In October 2022, patients in the 2020 group reported an average SANE score of 77.0 ± 15.8 on their affected shoulder and a VAS pain score of 1.67 ± 1.1 .

Conclusions: Despite terminating PT earlier and completing less PT overall, patients who underwent ATSA in 2020 had significant improvements in pain and ROM when assessed at final follow-up and were comparable to patients in 2019.

EP.06.267

USE OF 3D PLANNING AND PATIENT-SPECIFIC GUIDES FOR PROXIMAL HUMERUS CORRECTIVE OSTEOTOMY ASSOCIATED WITH SHOULDER PROSTHESIS IMPLANTATION IN PROXIMAL HUMERAL VARUS MALUNION

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Background: Humeral stem prosthesis implantation in case of proximal humerus varus malunion (type 1D fracture sequelae) is often complicated by greater tuberosity fracture and by posterosuperior rotator cuff iatrogenic injury. Moreover, the varus deformity of the humeral head could lead to acromial notching and reduce the range of motion.

Methods: We introduced a new surgical procedure consisting in a proximal humerus osteotomy. The planning is performed with three-dimensional (3D) preoperative virtual surgery, and performed with patient-specific surgical guides, to correct humerus deformity before the implantation of the prosthetic humeral stem. A 3D evaluation of the deformity, based on the comparison to the healthy contralateral side or to anatomical standard values, is firstly performed. Thus the metaphyseal osteotomy is then planned and virtually performed. To accurate reproduce the planned correction, 3D printed surgical guides are prepared.

Results: Preliminary outcomes of this surgical technique are encouraging, but formal studies are warranted to validate its clinical utility and long term results.

Conclusions: A planned corrective osteotomy in humeral head fracture sequelae could be a very helpful instrument to avoid mistakes during the stem implant and the prosthesis function.

EP.06.268

TWO-STAGE EXCHANGE ARTHROPLASTY FOR PERIPROSTHETIC SHOULDER INFECTION PROVIDES GOOD FUNCTIONAL OUTCOMES

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Background: Periprosthetic shoulder infections represent a diagnostic and therapeutic challenge. A definitive diagnostic treatment algorithm has not been clarified yet. Although several preoperative diagnostic tests are currently available, definitive diagnosis and management are commonly dependent on the results of deep intraoperative tissue cultures. A deep shoulder infection is often linked to loss of function. The aim of the present paper was to determine functional outcomes after two-stage exchange procedure for periprosthetic shoulder infection.

Methods: A retrospective study was conducted. Patients affected by periprosthetic shoulder infection and treated by two-stage revision reverse total shoulder arthroplasty following temporary antibiotic-loaded cement spacer were included. Demographics, comorbidities, preoperative diagnosis, surgical details, time to revision and microbiology data were collected. Pre- and postoperative functional evaluation through Subjective Shoulder Value (SSV) and Constant Murley score (CMS) were compared. A paired t-test was conducted. Significance was defined as $p < 0.05$.

Results: Sixteen patients (3 females, 13 males) operated between 2009 and 2021 were included. Mean age at the time of index surgery was $69 + 6.1$ years old. Mean follow up was $50.16 + 3.4$ months. *Propionibacterium acnes* was isolated in 11 cases out of 16 (68%), *Staphylococcus epidermidis* in 3 cases, *Staphylococcus Aureus* in one patient and *Streptococcus Mitis* in one patient. At the most recent follow up, all patients, but one, showed significant functional improvement. Mean SSV changed from $42.90 + 18.85$ preoperatively to $59 + 23.78$ postoperatively ($p = 0.03$). Mean CMS changed from $44.85 + 20.52$ preoperatively to $63.31 + 18.87$ postoperatively ($p = 0.002$). Only one patient showed recurrent infection five years after revision reverse shoulder arthroplasty.

Conclusions: Two-stage exchange arthroplasty for periprosthetic shoulder infection allows appropriate control of the disease and good functional outcomes.

EP.06.270

ALTERATION OF CHRONIC INFLAMMATORY STATUS BY TRANS-ARTERIAL EMBOLIZATION IN FROZEN SHOULDER EVALUATED BY F-18-FDG-PET AND F-18-FMISO-PET/CT, CONTRAST-ENHANCED MRI

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Background: Frozen shoulder (FS) is speculated to have an inflammatory etiology. Abnormal angiogenesis is observed in FS, evoking a possible source of pain. On angiography, abnormal angiogenesis is observed around the affected shoulder, suggesting a possible source of inflammation and pain. The effectiveness and safety of transarterial embolization (TAE) targeting abnormally proliferating blood vessels have been reported. This study investigated changes in chronic inflammatory and hypoxic status before and after TAE in FS by F-18-fluorodeoxyglucose (FDG)-PET and F-18-fluoromisonidazole (FMISO)-PET/CT as a possible mechanism of the therapeutic response to TAE.

Methods: Fifteen patients with unilateral FS, persistent for more than 6 months, who were refractory to conservative treatments, underwent TAE using the temporary embolic agent imipenem/cilastatin. Patients underwent PET/CT with FDG and FMISO (as a biomarker of inflammation and hypoxia, respectively) before and 8 weeks after TAE. Regional uptake was evaluated by the maximum standardized uptake value (SUVmax). The lesion-side to (contralateral-) normal-side uptake ratio (L/C ratio) was also calculated. Pain and functional scales, range-of-motion, and laboratory tests, including WBC, CRP, IL-6, VEGF, and TNF α were evaluated.

Results: Almost all indices of pain, range of motion, activities were improved after TAE, whereas blood tests did not change significantly. On FDG-PET, the average SUVmax of the lesion-side was significantly greater than that of the normal-side (SUVmax before TAE: 3.11 ± 1.25 vs. 1.95 ± 1.15 , $p = 0.0001$; 8-weeks post-TAE: 2.36 ± 0.74 vs. 1.78 ± 0.69 , $p = 0.0002$). The mean L/C ratios before TAE (1.71 ± 0.60) decreased after TAE (1.37 ± 0.29 , $p = 0.011$). The decrease of FDG uptake ($-21.1 \pm 12.2\%$) showed a significant correlation with the change in the pain scale score ($r = -0.56$, $p = 0.039$) and extension score ($r = -0.59$, $p = 0.026$). No obvious FMISO uptake was observed in the bilateral shoulder before and after TAE.

Conclusions: Chronic inflammation in FS, as demonstrated by FDG uptake, was decreased after TAE. Thus, chronic inflammation is likely to be an underlying mechanism that should be targeted for symptomatic improvement of FS. In addition, TAE induced no chronic hypoxia detectable by the FMISO uptake nor exacerbation of inflammation.

EP.06.271

A MIXED REALITY SYSTEM FOR SHOULDER ARTHROPLASTY

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Background: Background: Arthritic deformity of the glenoid and humerus pose significant challenges for successful shoulder arthroplasty reconstruction. Radiographs, MRI, and CT scans are routinely used to plan for these reconstructions. More recently, preoperative planning software and intra-operative navigation have been utilized to integrate 3D models into guidance systems to achieve reproducible results. Surgeons must manage a multitude of systems that display the patients imaging, navigation interfaces, and other relevant information, which are often not integrated with each other and also not able to be manipulated while maintaining sterility. Simultaneous access of and interaction with the information provides greater efficiency. This study proposes the use of a mixed reality to support performing total shoulder arthroplasty.

Methods: Methods: Digital tools were used to provide reference for the humeral osteotomy as well as a 3D model to reference glenoid reconstruction for shoulder arthroplasty. A 3D shoulder bone model was obtained from the patient's 3D imaging (both CT and MRI) and uploaded to a head-mounted mixed reality system (RSQ HOLO, RSQ Technologies, Poznan, Poland). The 3D models as well as a live stream of a CT-based navigation system was ergonomically placed in mixed reality around the patient surrounding the operative field to be in the same field of view and depth of field as the incision.

Results: Results: Total time to setup the mixed reality system and live navigation stream was 5 minutes. Latency of the live feed of the CT navigation interface was undetectable. During the procedure, the surgeon was able to manipulate the mixed reality objects while sterile and place the patient's 3D holographic models around the surgical field in an ergonomic fashion all while maintaining direct view of the surgical incision to ensure safety of the procedure.

Conclusions: Conclusion: Mixed reality creates new possibilities for planning and execution of shoulder arthroplasty for the correction of severe bone deformity. By displaying all of the information necessary for the surgeon to perform the procedure in the same field of view, the surgeon has both more control and understanding of the anatomy, with less distractions from multiple sources of information.

EP.06.272

A NOVEL COMORBIDITY RISK SCORE FOR PREDICTING POST-OPERATIVE 30-DAY COMPLICATIONS IN TOTAL SHOULDER ARTHROPLASTY & ELUCIDATION OF POTENTIAL RACIAL DISPARITIES

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Background: Efficient and effective preoperative identification of those patients with elevated risk may allow for more cost-effective interventions, accurate bundled payment adjustments, and overall improved patient care. Few comorbidity indices have provided clinical utility and adequate discriminative ability in the setting of complications after shoulder arthroplasty (SA).

Methods: The American College of Surgeons National Surgical Quality Improvement Program database was queried for anatomic and/or reverse SA procedures between 2010 and 2019. A subset of comorbidities were utilized including end-stage renal disease, history of hypertension, chronic obstructive pulmonary disease, functional status, history of bleeding disorder, and disseminated cancer.

Results: A total of 25,927 patients with an average age of 69.2 (standard deviation ± 9.5) years were included in the study. Patients with a comorbidity risk score (CRS) at or above 2 were indicated to have at least a 29.6% 30-day postoperative complication rate after undergoing total shoulder arthroplasty, significantly higher than the described average of approximately 15%. The area under receiver operator curve for the novel CRS scoring system was 0.595, indicating fair discriminative ability to predict 30-day postoperative complications after SA. This illustrates a discriminative ability similar to that of the American Society of Anesthesiologists classification (0.584, confidence interval [CI] 0.578-0.589), modified Charlson Comorbidity Index (0.567, CI 0.561-0.573), and modified Frailty Index (0.534, CI 0.529-0.539), each of which are common comorbidity indices used for the National Surgical Quality Improvement Program database. The average CRS for the population was 0.8537 (CI 0.8011-0.8150; $P < .05$) while that for the Black demographic was 1.08 (CI 1.03-1.13; $P < .001$). Our results suggest that if the disparity in CRS among races was corrected, the average complication rate would be decreased by 2.0%.

Conclusions: A higher CRS score resulted in higher rates of 30-day postoperative complications following SA. Black patients had a higher average CRS than all other races illustrating a racial disparity in comorbidity risk. With the rise of bundled payments further increasing the need to preoperatively identify patients at high risk for costly complications, the CRS is based on easily identified, relevant comorbidities that may be an advantageous tool to identify increased risk of complications following SA.

EP.06.274

STRENGTH ASSESSMENT AFTER REVERSE SHOULDER ARTHROPLASTY

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Background: The main objective of this research was to evaluate the anterior flexion force (AFF) and the lateral abduction force (LAF) of patients submitted to reverse shoulder arthroplasty (RSA) and to compare the measured force with a that in a similar-age control group. The secondary objective was to identify prognostic factors for muscle strength recovery.

Methods: Forty-two shoulders that underwent primary RSA for rotator cuff arthropathy between September 2009 and April 2020 met the inclusion criteria and were called the arthroplasty group (AG). The control group (CG) consisted of 36 patients. The mean AFF and the mean LAF were evaluated with a digital isokinetic traction dynamometer. Three consecutive measurements were performed with an interval of 10 s, and the average was considered.

Results: An average AFF was found in the AG at 15 N, while in the CG, the mean AFF was 21 N ($p < 0.001$). An average LAF in the GA of 14 N was verified, while in the CG, the average LAF was 19 N ($p = 0.002$). All prognostic factors studied in the AG showed no statistical significance: dominance (AFF 0.697/LAF 0.883), previous rotator cuff repair surgery (AFF 0.786/LAF 0.821), Hamada radiological classification (AFF 0.343/LAF 0.857), MRI preoperative evaluation of the quality of the teres minor (AFF 0.131/LAF 0.229), suture of the subscapularis at the end of the arthroplasty procedure (AFF 0.961/LAF 0.325) and postoperative complications (AFF 0.600/LAF 0.960).

Conclusions: The mean AFF in patients undergoing RSA for cuff tear arthropathy was 15 N, and the mean LAF was 14 N. The comparison of AFF and LAF with a CG of similar ages showed a 25% reduction in muscle strength. It was not possible to demonstrate prognostic factors for muscle strength recovery after RSA.

EP.06.275

ANATOMIC TOTAL SHOULDER ARTHROPLASTY VS REVERSE TOTAL SHOULDER ARTHROPLASTY IN PATIENTS OVER 70-A SYSTEMATIC REVIEW AND META-ANALYSIS

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Background: The purpose of this study is to assess and review the current literature on the outcomes, revision rate and complications of anatomic Total Shoulder Arthroplasty (aTSA) and reverse Total Shoulder Arthroplasty (rTSA) for primary glenohumeral OA in patients over 70 with intact rotator cuff.

Methods: We performed a systematic literature search for studies published from January 2010-May 2022 from 3 databases: MEDLINE, EMBASE, Cochrane Library according to PRISMA guidelines. Inclusion criteria were studies that referred to primary aTSA or rTSA in patients over 70 years old with glenohumeral osteoarthritis and an intact rotator cuff. Patients were excluded if they had a proximal humeral fracture or staged replacements. Case reports, cadaveric studies and systematic-literature reviews were also excluded.

Results: 10 studies met the inclusion criteria, evaluating a total of 1868 shoulder arthroplasties with a minimum follow-up of two years. Of the 1618 aTSA and 250 rTSA, RSR was associated with a lower revision rate (OR 0.50 95% CI 0.30-0.84, $p < 0.05$). No significant difference was noted between ASR and RSR in post-operative American Shoulder and Elbow Surgeons (ASES) score (OR -2.99 95% CI -17.25, 11.26, $p = 0.09$) and overall complication rate (OR 0.98 95% CI 0.34, 2.86, $p = 0.97$).

Conclusions: ATSA displays equal post operative satisfaction and functional results in patients over 70 with intact rotator cuff. Given the improved clinical outcomes, surgeons should adopt a lower threshold regarding aTSA in elderly patients with glenohumeral osteoarthritis.

EP.06.276

1 PSI GUIDED TOTAL SHOULDER REPLACEMENT PROSTHESIS OSTEOARTHRITIS BASED ON A PSI SHOULDER MODEL AND MEASUREMENTS FROM THE NORMAL OPPOSITE SIDE

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Background: The outcome of the anatomic total shoulder arthroplasty in cases of advanced osteoarthritis in the literature are very controversial.

The aim of this in vivo study was to assess the accuracy of a new technique of PSI (patient specific instrumentation) total shoulder replacement in case of advanced osteoarthritis using measurements from the normal opposite shoulder and a preoperative PSI planning model of the affected side as well as cutting PSI guides, in a consecutive series at a single center.

Methods: The device is patient specific, based on a method comprised of image-based the affected and the normal opposite shoulder 3D preoperative planning (CT, MRI or computed X-ray) to design the templates (PSI) that are used to perform the shoulder surgery by converting them to physical templates using computer-aided manufacturing.

Twelve consecutive TSA were performed using custom-made patient-specific positioning guides for the head component and the glenoid component as well as a planning PSI model.

Each patient had preoperative computed tomography scans and guides produced to allow head width, height, retroversion, valgus angle, head centre to shaft centre offset, shaft width, and glenoid length, width, location and deepness of the three cancellous bags, version angle as well as the Modified Glenohumeral Offset.

Results: Twelve TSA were done for twelve patients four of them had also reconstruction of the fractured glenoid with bone graft. The size of the head, its retroversion, height, valgus angle and head offset were done according to measurements of the normal opposite side as well as the glenoid. All cases had a range of motion between 150° to 180° elevation and 40 to 70 degrees external rotation, both active and passive after an average of 12 weeks from surgery. There is 30% reduction in surgical time According to Neer classification the results were excellent in 10 cases and satisfactory in two.

Conclusions: This technique of PSI guided anatomical total shoulder prosthesis in osteoarthritis using the other normal shoulder measurements and PSI guide devices increase accuracy in the placement of the humeral component, which improves the likelihood of an optimal outcome.

EP.06.277

PREOPERATIVE PLANNING TO PRESERVE GLENOID SUBCHONDRAL BONE IN ANATOMICAL SHOULDER REPLACEMENT

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Background: Planning software and patient specific guides allow implantation optimisation in anatomical total shoulder replacement (a TSR). To date, this aims to reproduce the normal anatomy of the scapula, reduce the risk of vault penetration, and address adaptive changes due to underlying arthropathy. This study was designed to (a) investigate the version and inclination in glenoid component planning, and (b) compare the bone preservation achieved with freehand against placement using anatomical landmarks as described by Friedman.

Glenoid loosening remains a major concern in aTSR. Preoperative planning has traditionally been based on anatomical landmarks as described by Friedman. This study evaluates the relevance of Friedman's lines with respect to bone preservation.

Methods: A retrospective cohort study was designed: Two groups of pre-operative shoulder CT scans were assessed: (a) normal and (b) osteoarthritic patients who had undergone aTSR. Patient specific software was used to conduct preoperative planning of the glenoid implants. The glenoid was placed in a position defined by scapular geometry. Bone implants surface contact was assessed. Subsequently, the component was placed in a position to maintain the subchondral plate with minimal bone loss and respecting the integrity of the glenoid vault. The geometric position in which this was achieved, was recorded: bone preservation was examined with neutral alignment (0, 0°), 10° retroversion, 10° inclination, and free hand positioning.

Results: The total number of CT scans was 68, with 34 normal and 34 osteoarthritic. A broad distribution in patients anatomy was observed with pre-operative anatomical inclination ranging from -4 to 23° and version from -38 to 10°. The angle of freehand glenoid implantation had an inclination, ranging from 2 to 22°, and version from -40 to 10°. The median IQR for percentage cortical bone seating achieved in the normal scans with the freehand technique was 44%, +/-28.75, neutral = 21% +/-16, retro version=22% +/-15 and inclination = 30.5% +/-16. In the osteoarthritic group the median percentage cortical bone seating was 51% +/-23 with the freehand technique, neutral equals 36%+ / -20.75, retroversion = 39%+/-21.50 and inclination = 36% +/-20.75, retroversion =39%+ /-21.50 and inclination equals 36% +/-20.75.

Conclusions: The freehand method resulted in significantly improved cortical bone seating compared to prescribed adjusted angles. These findings questions the use of a one-size-fits-all-orientation and suggests that applying a technique that aims for maximum cortical fixation (freehand) may reduce the risk of aseptic loosening.

EP.06.278

RADIOGRAPHIC VARIATION OF HUMERAL ARTICULAR ANATOMY IN SHOULDERS WITHOUT GLENOHUMERAL OSTEOARTHRITIS. HOW PERFECT IS THE CIRCLE?

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Background: Anatomic reconstruction is an established goal of anatomic shoulder arthroplasty. The circle described by Youderian et al is often referred to as a perfect circle (PC) and used to determine the accuracy of humeral reconstruction. The PC has never been validated in a sample of normal humeri. The purpose of this study was to validate the PC as a determinant of proximal humeral articular anatomy.

Methods: 200 high quality true AP plain radiographs of patients evaluated for non-arthritic shoulder conditions were studied. There were 110 males. The mean age was 56 ± 14 years and mean height was 170 ± 10 cm. PC was determined with the method described by Youderian, et al. Native circle (NC) was determined with a best fit method. Magnification was controlled. Radius of curvature (ROC), center offset (CO), and humeral head thickness (HHT) were measured. Data was analyzed with Student's t-tests, Pearson correlations, and linear regressions.

Results: The mean NC ROC was 0.21 mm greater than the PC ROC ($p < 0.001$). The NC ROC was greater than the PC ROC in 62%. The difference was > 2 mm in only 6 (3%). The mean PC CO was 0.09 mm greater (more medial) than the NC CO ($p = 0.3$). The NC CO was 0.921 ± 0.653 lateral to the PC center offset in 55%. The CO difference was > 2 mm in 11%. The mean NC HHT was 0.8 mm greater than the PC HHT ($p < 0.001$). The NC HHT was greater than the PC HHT in 75%. The difference was > 2 mm in 22%. The PC radius to HHT ratio was 0.75 compared to 0.78 NC HHT ($p < 0.001$). There was a strong correlation between height and ROC ($r = 0.78$ PC; $r = 0.74$ NC), and moderate with HHT ($r = 0.59$ PC; $r = 0.58$ NC).

Conclusions: This study validates the PC as a surrogate of normal proximal humeral anatomy. On average there were statistically significant but only slight actual differences between the PC and NC anatomic parameters. There was greater variation in the dimensions of the articular segment, NC larger than PC. The clinical relevance of the PC to anatomic shoulder arthroplasty is unclear and other factors including the extent of humeral pathology, glenoid deformity, and soft tissue contracture must be considered.

EP.06.279

PROSTHETIC SHOULDER ARTHROPLASTY IN PATIENTS 80 YEARS AND OLDER: A SYSTEMATIC REVIEW OF OUTCOMES AND COMPLICATIONS

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Background: Prosthetic shoulder arthroplasty in older patients engenders concerns over surgical morbidity, patient longevity, and implant durability. The purpose of this study was to provide a review of current literature evaluating the clinical and radiographic outcomes of prosthetic shoulder arthroplasty performed in patients 80 years or older.

Methods: A literature search of Embase, Pubmed, Medline, and Cochrane databases was performed according to PRISMA guidelines. Studies evaluating the outcomes of primary or revision anatomic (aTSA) or reverse (RSA) shoulder arthroplasty in patients 80 years or older were included for analysis.

Results: A total of 15 studies evaluating 1,685 primary aTSAs, 1,170 primary RSAs, 69 RSAs performed for fracture, and 45 revision RSAs were included for review. Postoperative active forward flexion and external rotation ranged from 138°-150° and 45°-48° following aTSA, respectively, and 82.9°-139° and 15.6°-47° following RSA, respectively. Postoperative 10-point VAS pain scores ranged from 0-1.8 following aTSA and 0-1.4 following RSA. Ninety-day mortality ranged from 0-3% and perioperative complications ranged from 0-32% amongst the entire population. Late complications ranged from 5.6-24% amongst aTSA patients and 3.5-28.6% for patients undergoing primary or revision RSA for all indications. The most common complications following aTSA included glenoid loosening (0-18%) and rotator cuff tear (5.6-10%). The most common complications following RSA included scapular notching (0-40%) and acromial or scapular spine fracture (4-9.4%). Reoperation rates ranged from 0-6% following aTSA and 0-13% following RSA.

Conclusions: aTSA and RSA performed in patients 80 years or older are both safe and effective, demonstrating low rates of perioperative mortality and reoperation with satisfactory postoperative range of motion and excellent pain relief. Late complication rates for aTSA and RSA are similar, and comparable to those in younger patients.

EP.06.281

PREVALENCE OF IMAGING ABNORMALITIES IN ADULT SHOULDERS: THE GLENOHUMERAL JOINT

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Background: Shoulder symptoms are among the most common musculoskeletal causes for pain and disability and occur in one quarter of the population. Physicians commonly rely on shoulder imaging to ascertain the cause of symptoms. Imaging of a painful shoulder will often reveal structural changes, such as glenohumeral osteoarthritis or labrum abnormalities. Establishing a link between symptoms and abnormal imaging findings seems rational as does restoring these allegedly pain-causing structural changes through surgery if symptoms persist. However, some studies have shown that these imaging abnormalities can also be found in asymptomatic individuals, especially with increasing age

Methods: We conducted database and citation searches (1/12/2020) for studies reporting prevalence of x-ray, ultrasound (US), computed tomography (CT) and magnetic resonance imaging (MRI) abnormalities in asymptomatic adult shoulders. We also included studies reporting the same outcomes from symptomatic shoulders of the same individuals or from the same population. We assessed risk of bias of included studies using a tool designed for prevalence studies and judged the certainty of evidence using the Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) approach.

Results: Of 79 studies included in the systematic review, 6 X-ray, 7 US and 17 MRI studies reported useable prevalence data for this study. We categorized the studies according to study population; 1) General population, 2) Mixed study-populations (volunteers, healthcare populations), 3) Athletes. All studies were judged to be at high risk of bias. Heterogeneity precluded data pooling. Prevalence rates in asymptomatic shoulders ranged from 0 to 75% for glenohumeral osteoarthritis, 0 to 100% for labral abnormalities, and 0 to 90% for humeral head cysts, and 0 to 79% for the abnormalities of the long head of biceps tendon. The certainty of evidence was low for general population and very low for athletes and mixed populations. Prevalence rates were generally higher in symptomatic shoulders although the differences were small.

Conclusions: The prevalence estimates of GH joint imaging abnormalities in asymptomatic people varied widely across different populations. Generally, the certainty of evidence was very low. Although prevalence rates were higher in symptomatic shoulders, the presence of abnormalities may be of little relevance in an individual patient.

EP.06.282

CLINICAL AND RADIOLOGICAL COMPARISON OF DIFFERENT NECK-SHAFT ANGLES IN REVERSE SHOULDER ARTHROPLASTY FOR PATIENTS WITH PRIMARY OSTEOARTHRITIS

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Background: In reverse shoulder arthroplasty, different concepts ranging from medialized implants to strongly lateralizing onlay designs with different neck-shaft-angles (NSA) and thus different degrees of lateralization are currently used.

The aim of this study is to compare clinical and radiological differences in NSA of 155°, 145° and 135° in a homogeneous patient population with primary osteoarthritis (OA).

Methods: Patients with OA who underwent reverse shoulder arthroplasty between March 2014 and January 2020 were included in this prospectively collected database. It was divided into three groups based on the implantation of the prosthesis type: 135° (Univers Reverse), 145° (Ascend Flex), and 155° (Reverse II). Inclusion criteria were prospective data collection and completed clinical-radiological follow-up (FU) of at least 24 months. Clinical evaluation was performed at follow-up using range of motion, abduction force, Constant-Murley score (CS), Subjective Shoulder Value (SSV), and the Shoulder Pain and Disability Index (SPADI). Radiological evaluation was performed using true-AP, axial and Y-imaging.

Results: Patients with OA who underwent reverse shoulder arthroplasty between March 2014 and January 2020 were included in this prospectively collected database. It was divided into three groups based on the implantation of the prosthesis type: 135° (Univers Reverse), 145° (Ascend Flex), and 155° (Reverse II). Inclusion criteria were prospective data collection and completed clinical-radiological follow-up (FU) of at least 24 months. Clinical evaluation was performed at follow-up using range of motion, abduction force, Constant-Murley score (CS), Subjective Shoulder Value (SSV), and the Shoulder Pain and Disability Index (SPADI). Radiological evaluation was performed using true-AP, axial and Y-imaging.

Conclusions: Reverse arthroplasty systems with a 145° humeral inclination show superior results compared to the classic Grammont design in terms of clinical and radiological parameters. The NSA of 145° provides the best results in our cohort and avoids scapular notching.

EP.06.283

RESULTS OF METALLIC, GLENOID LATERALIZATION IN REVERSE SHOULDER ARTHROPLASTY AS REVISION PROCEDURE FOR FRACTURE SEQUELAE

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Background: Fracture sequelae after failed conservative or operative treatment of proximal humerus fractures (PHF) represent a complex pathology with osseous defects and rotator cuff deficiency.

Reverse shoulder arthroplasty (RSA) plays an important role as treatment for fracture sequelae. Glenoidal lateralization may improve pretensioning of the deltoid muscle and the residual rotator cuff and reduce scapular notching.

Methods: This retrospective study from prospective data included patients who underwent a RSA after failed conservative or operative treatment for PHF. Inclusion criteria was a complete 2 year follow-up for patients with metallic glenoid lateralization using augmented baseplate (group A) compared to Grammont approach without lateralization (group B).

Constant-Murley Score (CS) and Subjective Shoulder Value (SSV) were collected. Possible loosening of the RSA and scapular notching

Results: Group A included 16 patients (female: n=9; Ø=66 years). Group B included 37 patients (female: n=23; Ø=67 years). Both groups showed preoperatively comparable cohort characteristics in terms of age, gender and arm dominance.

Patients in group A (mean CS: 69 points (25-87), forward flexion: 160° (40-170), external rotation: 30° (0-80)) improved significant in CS, SSV, active flexion, abduction (p<0.01), internal (p=0.04) and external rotation (p=0.003).

Patients in group B (mean CS: 59 points (27-91), forward flexion: 120° (75-170), external rotation: 20° (-5-60)) improved significant in CS, SSV, active flexion and abduction and internal rotation (p<0.01) compared to preoperatively. External rotation (p=0.07) did not improve significantly.

There were statistical significant differences resulting in superior forward flexion (p=0.04), abduction (p=0.03) and external rotation (p=0.03) for patients with lateralization (group A).

The complication rate (group A: traction damage axillary nerve n=2, instability n=1) (group B: traction damage axillary nerve n=1, instability n=1; loosening n=1; periprosthetic fracture n=1) was comparable in both groups.

Radiologically, SN grade 1 (A: n=0; B: n=6) was only observed in patients without glenoid lateralization. There were no signs of early loosening present.

Conclusions: RSA provides reliable results as revision procedures for fracture sequelae.

Metallic glenoid lateralization provides benefits in terms of function with better active range of motion and avoids scapular notching compared with the conventional Grammont design.

EP.06.284

DOES AGE AFFECT OBJECTIVE AND SUBJECTIVE FUNCTIONAL SCORES AFTER SHOULDER ARTHROPLASTY?

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Background: Anatomical total shoulder arthroplasty (aTSA) has been shown to result in greater range of motion than reverse shoulder arthroplasty (RSA). However, as patients age, it is expected that both overhead range of motion and patient functional needs will decline. We hypothesized that at some age, the functional results of TSA and RSA would be equivalent, due to natural changes of the aging shoulder. To evaluate this hypothesis, we compared how objective and subjective functional scores of aTSA and RSA were affected by age when evaluated as a continuous variable.

Methods: We retrospectively reviewed prospectively collected data from 1059 primary TSAs and 747 primary RSAs performed for osteoarthritis. Patients between 55 and 85 years old were included (mean age aTSA: 68 years old \pm 6.8; mean age RSA: 72 years old \pm 6.6). All procedures were performed using a single platform implant system. Range of motion (forward elevation (FE), abduction, external rotation (ER), internal rotation (IR)) and functional outcome scores were evaluated at a minimum two-year follow-up. Both objective and functional outcome scores were compared between aTSA and RSA using age as a continuous variable.

Results: Post-operative overhead range of motion declined as patient age increased. This trend occurred after the age of 70 for patients treated with aTSA and after 76 for those treated with RSA. Specifically, for forward elevation, post-operative motion was similar between TSA and RSA beginning at age 65 and continuing until 85. TSA maintained greater abduction regardless of patient age. ER and IR remained relatively stable until age 80, with TSA maintaining slightly higher range of motion. As patients aged, post-operative pain was noted to be significantly higher for patients treated with aTSA compared to RSA at all ages?. Despite the small differences in motion, outcome scores demonstrated similar performance regardless of age and implant type.

Conclusions: aTSA demonstrates maintained benefits of abduction compared to RSA in patients treated for OA at all ages. However, more functional post-operative FE does diminish overtime and is similar to RSA outcomes after age 65. Despite loss of FE with increasing age, the functional benefits of both prostheses are similar at all ages.

EP.06.286

UTILITY OF RECOVERY ROOM VS POST-OPERATIVE DAY 1 RADIOGRAPHS FOLLOWING SHOULDER ARTHROPLASTY

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Background: Postoperative radiographs may be performed at different timelines after shoulder arthroplasty. Radiographs obtained in the post-operative recovery unit (PACU) are often of poor quality and do not alter patient care. The purpose of this study was to determine if PACU radiographs differed in quality from radiographs performed in the radiology suite at post-operative Day 1 (POD1) following anatomic total shoulder arthroplasty.

Methods: Our series included 50 consecutive anatomic total shoulder arthroplasties (TSA) for which post-operative immediate radiographs were obtained in the PACU, and then at 2-weeks post-operatively, and 50 consecutive TSA for which post-operative immediate radiographs were obtained in the radiology suite on POD 1. TSA radiographs were blinded and reviewed by 3 and graded on their quality using criteria described using previously published methods. The weighted kappa was used to describe the intra-rater and inter-rater agreement.

Results: There was no statistical difference in age, sex, BMI, and number of comorbidities between both groups. Intra-observer reliability was moderate to substantial with weighted kappa values of 0.65 ± 0.07 (95% CI 0.51-0.80, $p < 0.001$), 0.58 ± 0.09 (95% CI 0.41-0.75, $p < 0.001$), and 0.67 ± 0.07 (95% CI 0.53-0.82), $p < 0.001$). Inter-observer reliability was moderate to substantial with weighted kappa values of 0.605 ± 0.07 (95% CI 0.46-0.75, $p < 0.001$), 0.66 ± 0.07 (95% CI 0.52-0.81, $p < 0.001$), and 0.65 ± 0.08 (95% CI 0.50-0.80, $p < 0.001$). When assessing quality of radiographs, 30% of radiographs obtained in the PACU were deemed quality while 57% of radiographs obtained in the radiology suite were deemed quality, showing statistical significance ($p < 0.001$). Of the 50 patients that received two week post-operative radiographs, 60% were deemed to be sufficient to serve as baseline radiographs which was significantly improved from PACU radiographs ($p < 0.001$) but not radiology suite radiographs ($p = 0.64$).

Conclusions: Post-operative radiographs in the PACU do not alter patient management and are often inadequate to serve as baseline radiographs. Radiographs obtained in the radiology suite are of higher quality and serve as a superior baseline radiograph to help inform shoulder surgeons in the post-operative setting.

EP.06.287

INVERTED-BEARING MATERIALS IN REVERSE SHOULDER ARTHROPLASTY: CLINICAL AND RADIOLOGICAL RESULTS AT 5 YEARS MINIMUM FOLLOW-UP

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Background: Scapular notching following reverse shoulder arthroplasty (RSA) is caused by both biological and mechanical mechanisms. Some postulated that osteolysis that extends over the inferior screw is caused mainly by biological notching. Inverted-bearing RSA (IB-RSA) is characterized by a polyethylene glenosphere and a metallic humeral liner, decreasing the poly debris formation and potentially reducing high grades of notching. This study aims to report the results of IB-RSA at minimum 5 years, focusing on the incidence of Sirveaux grade 3 and 4 notching.

Methods: A retrospective monocentric study was performed analyzing patients who underwent primary IB-RSA between 2010 and 2017. All patients were evaluated clinically (pain, Constant Score (CS), Subjective Shoulder Value (SSV), ASES Score and range of motion) and radiologically at minimum 5 years after surgery. Survivorship of the implant and all complications were reported. X-Rays were evaluated for glenoid base plate position (high, low), implant loosening and scapular notching.

Results: 77 patients (82 shoulders) were evaluated at a mean follow-up of 6.8 ± 1.8 months. Survivorship using revision as an endpoint was 98.8%. The following complications were reported: 3 acromial fractures (3.7%), 2 traumatic humeral fractures (2.4%), 1 postoperative axillary neuropraxia (1.2%), 1 stiffness (1.2%); 1 infection (1.2%), 1 unexplained painful prosthesis (1.2%), 3 heterotopic ossification (3.7%). The mean pain was 0.9 ± 1.6 , CS 67 ± 17 , SSV 80 ± 16 , ASES 82 ± 17 , forward flexion 139 ± 31 , external rotation 26 ± 17 , median internal rotation L3. All clinical parameters significantly improved ($P < 0.05$). No clinical or radiographical loosening were reported. Scapular notching was present in 20 (25%) patients (eleven grade 1, nine grade 2) and no cases of grade 3 and 4 were observed. Nothing was significantly associated with high glenoid position ($p < 0.001$) and with lower CS ($p = 0.007$), SSV ($p = 0.009$), ASES ($p = 0.039$), and anterior elevation ($p = 0.002$).

Conclusions: IB-RSA is a safe and effective procedure for mid-term follow-up. Inverting biomaterials leads to a distinct kind of notching with mainly mechanical features. Scapular notching is associated with a high baseplate position and has a negative influence on range of motion and clinical outcome.

EP.06.289

TRENDS IN INDICATIONS FOR TOTAL SHOULDER ARTHROPLASTY IN THE UNITED STATES 2010 TO 2018: A RETROSPECTIVE POPULATION-BASED STUDY

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Background: Shoulder arthroplasty has transformed the shoulder surgery landscape in the last 10 years. Both anatomic and reverse total shoulder arthroplasty (TSA) have broad surgical indications, most notably primary osteoarthritis (OA), rheumatoid arthritis (RA), cuff tear arthropathy (CTA), proximal humerus fracture, and avascular necrosis. However, recent modifications in indications, knowledge of the complication profile and revision rates may have changed implant selection trends. This study aimed to report how United States incidence of TSA for each surgical indication had changed during this period.

Methods: Using IBM MarketScan® database, all patients who underwent a TSA, including anatomic and reverse, from 2010 to 2018 were identified using common Current Procedural Terminology (CPT) codes. Using International Classification of Diseases (ICD) codes, patients who underwent TSAs specifically for OA, RA, proximal humerus fracture, avascular necrosis, and CTA were included in the study. Population estimates were used to estimate the annual incidence of patients with TSA for the above diagnoses. Case volume and incidence were estimated for gender, and age subgroups were determined with 95% confidence intervals.

Results: From 2010 to 2018, 311,153 TSAs were performed. Indications for surgery were: OA (56%), CTA (34%), proximal humerus fracture (5%), RA (2%), proximal humerus necrosis (2%), and combined RA + OA (1%). During this period, annual case volumes of TSAs significantly increased for patients diagnosed with OA by 120%. Across the reportable sex and age cohorts, most of the TSA incidences of patients diagnosed with OA, CTA, and proximal humerus fracture from 2010 to 2018 significantly increased, with the most growth being seen in both males and females aged 65-74 years.

Conclusions: TSA for all major indications has become more popular in the past decade. Expanding indications, stronger evidence and superior implants may all be responsible for the increase in TSAs being performed. Osteoarthritis continues to be the major indication for TSA. These results suggest that we need orthopedic training should prepare trainees by mirroring up-to-date trends and incorporate sufficient exposure to total shoulder arthroplasty.

EP.06.290

CLINICAL RESULTS AND COMPLICATIONS IN REVERSE TOTAL SHOULDER ARTHROPLASTY USING THE LARGEST LATERALIZED HUMERAL COMPONENT

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Background: Reverse total shoulder arthroplasty (RTSA) is widely used in shoulder and has shown excellent outcomes. In addition, implant design has been developed to achieve effective functional recovery and reduce complications. The purpose of this study is to analyze the clinical outcomes and related complications of RTSA using lateralized humeral component system.

Methods: From May 2019 to December 2021, a retrospective study was performed on 15 patients who underwent RTSA using the lateralized humeral component system (AGILON® modular shoulder system, implantcast GmbH, Germany). Except for one patient who died during follow-up, we analyzed 14 patients with a minimum follow-up period of 24 months. Eight patients underwent surgery for cuff tear arthropathy, four patients for osteoarthritis, and two patients for humeral head avascular necrosis. The active external rotation (ER) angle of shoulder before surgery and after surgery were compared, and complications were analyzed.

Results: The mean follow-up was 28.7 ± 4.3 months. 13 patients were female and the mean age of patients was 71.9 ± 5.4 years. During the operations, periprosthetic fractures around proximal humerus portion occurred in 3 patients (21.4%) during humeral component insertion, and one of them was treated with conservative treatment and two performed cerclage wirings. One patient (7.1%) underwent implant removal and PROSTALAC insertion for periprosthetic infection at 9 months after surgery. The mean preoperative active ER angle was $23.2 \pm 17.1^\circ$ and $46.1 \pm 15.5^\circ$ at the last follow-up ($p=0.001$).

Conclusions: RTSA using a lateralized humeral component showed significant improvement in active shoulder external rotation postoperatively. However, there were high incidence of periprosthetic fracture during humeral component insertion, so careful humeral stem size selection and caution during insertion of humeral stem seem to be needed.

EP.06.291

CAN ECCENTRIC GLENOSPHERE HELP TO PREVENT SCAPULAR NOTCHING AFTER REVERSE TOTAL SHOULDER ARTHROPLASTY IN A THREE-DIMENSIONAL COMPUTATIONAL MODEL?

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Background: Scapular notching is a frequently observed radiographic phenomenon in reverse shoulder arthroplasty (RSA), signifying impingement of components. Inferior glenosphere overhang may help prevent scapular notching. The purposes of this study were to evaluate the effect of eccentric glenosphere on impingement-free range of movement (ROM) for extension and external rotation in a virtual three-dimensional RSA model, and to determine the effectiveness of eccentric glenosphere to reduce the incidence of friction-type scapular notching.

Methods: Preoperative CT scans obtained in 30 patients (20 male, 10 female) with primary osteoarthritis or cuff tear arthropathy without glenoid bone defect were analyzed using three-dimensional templating software for RSA. Each template used the same implant and configuration, which consisted of 2 types of humeral implant (inlay type and onlay type) using bony increased-offset (BIO) RSA with 5mm glenoid lateralization. Two glenosphere types (standard concentric, 2 mm inferior eccentric offset) were tested for impingement-free ROM for extension and external rotation.

Results: In inlay type humeral implant, the eccentric glenosphere significantly improved extension by a mean 7.8 degrees and external rotation by a mean 11.7 degrees compared with a standard concentric glenosphere. In onlay type humeral implant, the eccentric glenosphere significantly improved extension by a mean 11.0 degrees and external rotation by a mean 11.9 degrees compared with a standard concentric glenosphere.

Conclusions: From this study showed that the eccentric glenosphere could increase impingement free ROM for extension and external rotation. Friction-type scapular notching might be effectively reduced by use of an eccentric glenosphere.

EP.06.292

DO PATIENTS WITH AN ANATOMICAL TOTAL SHOULDER ARTHROPLASTY FOR GLENOHUMERAL OSTEOARTHRITIS ACHIEVE A CLINICALLY RELEVANT IMPROVEMENT?

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Background: The minimal clinically important difference (MCID) is defined as the smallest meaningful change in a health domain that a patient would identify as important. The primary aim of this study was to determine the proportion of patients achieving a clinically important improvement among patients with glenohumeral osteoarthritis treated with an anatomical platform total shoulder arthroplasty. As a secondary endpoint we compared the platform shoulder arthroplasty system with a non-platform system.

Methods: Between March 2017 and February 2019 patients with symptomatic glenohumeral osteoarthritis indicating an anatomical total shoulder arthroplasty at Herlev/Gentofte University Hospital, Denmark were evaluated. The included patients received a Global Unite Anatomical Shoulder Arthroplasty. Patients were clinically evaluated preoperatively and 3, 6, 12 and 24 months postoperatively using the Western Ontario Osteoarthritis of the Shoulder index (WOOS), the Oxford Shoulder Score (OSS) and the Constant-Murley Score (CMS). The MCID for WOOS, OSS and CMS are reported to be 12.3, 4.3 and 9.8 respectively. As a reference group, we included the 44 most recently operated patients with a Global Advantage prosthesis. These patients were followed up minimum 2 years postoperatively with completion of WOOS, OSS and CMS.

Results: For WOOS, OSS and CMS 89%, 96% and 91% had an improvement above the MCID value respectively. The difference between the Global Unite system and the Global Advantage system was 2.4 (P=0.575) for WOOS, 0.8 (P=0.617) for OSS and 3.1 (P=0.411) for CMS.

Conclusions: In patients with glenohumeral osteoarthritis treated with an anatomical total shoulder arthroplasty, we found approximately 90 % of the patients to achieve a clinically relevant improvement. This is a clear and distinct message for the surgeon to explain to the patients preoperatively. We found no difference between the Global Unite platform shoulder system and the Global Advantage non-platform shoulder system.

EP.06.293

THE COST-EFFECTIVENESS OF TRANEXAMIC ACID FOR PREVENTING BLOOD TRANSFUSIONS FOLLOWING REVERSE TOTAL SHOULDER ARTHROPLASTY: A BREAK-EVEN ANALYSIS

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Background: The administration of tranexamic acid (TXA) to patients undergoing shoulder arthroplasty has increased. Its use reduces blood loss, need for blood transfusion, and is safe, even in those with a history of thromboembolic events. Because of the low cost of TXA, and the ability to prevent costly complications, its use is thought to be a cost-saving practice. The purpose of this study was to determine the cost-effectiveness of TXA in patients undergoing reverse shoulder arthroplasty (RSA).

Methods: The cost of TXA (\$5.22) and the cost of blood transfusion (\$280.10) from our institution, as well as baseline published blood transfusion rates following RSA (14.3%), were included in a break-even model to calculate the absolute risk reduction (ARR) that the routine use of TXA would need to achieve to be considered economically justifiable. To account for variance in baseline transfusion rates, the cost of TXA, and the cost of blood transfusion across institutions, sensitivity analyses were conducted in which the break-even infection rate and ARR were calculated across a wide range for each variable.

Results: TXA is deemed economically justifiable if it prevents one blood transfusion out of 54 RSAs (ARR = 1.86%). Its use is cost-effective across a range of drug costs with an ARR range of 0.36% at a cost of \$1 to 8.93% at \$40, at varying costs of blood transfusions (\$50 - \$5,000), and at varying baseline transfusion rates (2.00% - 50.00%).

Conclusions: The current literature suggests the efficacy of TXA in preventing blood transfusion following RSA. Our study found that TXA would be cost-effective in preventing blood transfusion if its routine use achieves an ARR greater than 1.86% following RSA. This ARR has been demonstrated in the literature, therefore, TXA can be considered cost-effective in preventing blood transfusion following RSA.

EP.06.294

GLENOID FAILURE AFTER TOTAL SHOULDER ARTHROPLASTY WITH CEMENTED ALL-POLYETHYLENE VERSUS METAL-BACKED IMPLANTS: SYSTEMATIC REVIEW

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Background: Anatomical total shoulder arthroplasty (TSA) is an effective treatment adopted for patients with glenohumeral osteoarthritis. Loosening of the glenoid component represents one of the main failure mechanisms; however, a gap of reliable evidence remains regarding the selection of the best implant for avoiding complication. This systematic review aims to evaluate the glenoid component in TSA by comparing the effectiveness and complications of different types of implants

Methods: this systematic review followed the recommendations proposed by the Cochrane Handbook of Interventions Reviews, including only randomized or quasi-randomized clinical trials, assessing relevant evidence regarding exclusive polyethylene (PE) (keeled and pegged) versus metal back (MB) implants. A comprehensive search was performed across several databases without restriction for language, date and status of publication

Results: eight RCTs were included, with 323 patients and 338 shoulders, 151 men, 157 women, aged between 60 and 74 years with follow-up from 6 weeks to 7.5 years. Clinical outcome through the Constant-Murley score, range of motion and pain through the Visual Analogue Scale, showed no difference comparing the PE components; meanwhile, there was a reduction in radiolucency lines (RL) up to grade two around 50% and 9.3% for complications and surgery revisions, respectively, in favor of the peg over the keel. Compared to MB, there was 25% more RL around PE, however function and complication rates were equivalent

Conclusions: the PE component in anatomical total shoulder arthroplasty, shows more RL compared to MB, especially around the keel design

EP.06.296

PREVALENCE OF PHYSICAL THERAPY AFTER PRIMARY REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: Opinions vary widely about the need for physical therapy (PT) after reverse total shoulder arthroplasty (RTSA). For such prosthesis configuration, patients were initially not encouraged to have formal physical therapy and were given a home program. Our belief was that PT was not necessary postoperatively for RTSA. The hypothesis of this study was that a minority of patients who underwent RTSA as a primary procedure would not undergo formal PT after this procedure.

Methods: This was a retrospective review of patients who underwent a primary RTSA by one surgeon at one institution from 2003 to 2021. To be included patients had to have primary diagnosis of rotator cuff tear arthropathy (CTA) (N=336) or osteoarthritis with glenoid bone loss (OA) (N=522) and a minimum follow up of 6 months. Any formal PT was considered a positive finding.

Results: Of those who had RTSA for CTA - 144 cases (43%) were followed by PT. Of those who had RTSA for OA - 153 cases (29%) had PT. More females had PT compared to males both after CTA (45% vs 39%) and OA (34% vs 23%). When evaluating percentage of patients per decade who had PT, there was no one decade which predominated. In the CTA group more patients underwent PT for their dominant extremity (46% vs 37%) which was not true for the OA group. Outpatient PT was the most common form of formal PT for both CTA (84%) and OA (92%).

Conclusions: Our impression was incorrect as many patients with RTSA sought out or needed physical therapy postoperatively, mostly in the form of outpatient PT.

EP.06.297

COMPARISON OF HUMERAL HEAD RESURFACING VERSUS STEMLESS HUMERAL COMPONENTS IN ANATOMIC TOTAL SHOULDER ARTHROPLASTY: A MULTICENTER INVESTIGATION WITH MINIMUM TWO YEAR FOLLOW UP

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Background: The purpose of this investigation was to compare minimum two-year outcomes of anatomic total shoulder arthroplasty (aTSA) performed with humeral head resurfacing (HHR) versus stemless implants.

Methods: A retrospective review of a large multicenter database was conducted. All patients who underwent aTSA with either HHR or stemless implants with minimum two-year follow-up were evaluated. Range of motion (ROM) and patient reported outcomes (PROs) including Constant Score, Simple Shoulder test (SST), American Shoulder and Elbow score, University of California Los Angeles shoulder score, Shoulder Pain and Disability Index and Shoulder Arthroplasty Smart score were collected for all patients pre- and post-surgery. Radiographic data was collected to determine the presence of radiolucent lines as well as evaluation of implant sizing and anatomic shoulder restoration.

Results: Overall, 127 patients were included with 49 receiving HHR and 78 stemless aTSA. The HHR group were significantly older (69.3 ± 8.6 versus 64.3 ± 8.7 , $P < 0.01$), had a lower BMI (27.7 ± 4.3 versus 31.5 ± 7.2 , $p < 0.01$) and a higher percentage were females (87.8% versus 35.9%, $p < 0.01$) compared to the stemless group. Both groups demonstrated significant improvements in all PROs and ROM from pre- to post-surgery ($p < 0.05$). At final follow-up the stemless group had significantly greater active abduction (148.5 ± 27.7 versus 115.6 ± 22.4 , $p < 0.01$), forward flexion (154.3 ± 20.6 versus 140.6 ± 15.3 , $p < 0.01$) and external rotation (52.14 ± 14.9 versus 34.4 ± 19.8 , $p = 0.01$). The stemless group exhibited better scores on the SST (10.4 ± 2.0 versus 9.5 ± 1.9 , $p = 0.01$), but no other PROs demonstrated significant difference. Radiographic evaluation of HHR patients demonstrated overstuffing, oversizing, and lucent lines around the glenoid component in 8.7%, 39.1%, and 13.0% of implants, respectively. Radiographic evaluation of stemless patients demonstrated radiolucent lines around humeral component and glenoid component in 4.2% and 18.8% of implants, respectively. One patient in the stemless aTSA group required a revision surgery for aseptic glenoid loosening, otherwise no other major complications were reported.

Conclusions: Anatomic TSA performed both with stemless implants and HHR resulted in significant improvements in ROM and multiple PROs at minimum two year follow up with a low complication rate. The HHR group had significantly worse pre-operative ROM and PROs which lead to greater magnitudes of improvement at final follow up.

EP.06.299

IS SCAPULAR NOTCHING COMMON AMONG THE ASIAN POPULATION THAT UNDERWENT REVERSE SHOULDER REPLACEMENT?

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Background: Scapular notching is a “defect on the inferior part of the glenoid component in Reverse Shoulder Arthroplasty. Minimal information regarding the risk factors, and implications exists. The study determined the incidence of scapular notching and its correlation to the preoperative glenoid height, range of motion and patient reported outcome measures.

Methods: The study was a Retrospective Cohort comprised of 142 patients from January 2011 to December 2019. Preoperative, 1-year post-operative radiographs and range of motion were taken. All surgeries were carried out by an internationally trained senior shoulder consultant. Standard Deltopectoral approach was applied, and patients underwent similar follow up at weeks 2 and 4 and months 3,6,12,18 and 24 after surgery. Rehabilitation protocols were standard among all patients. UCLA, Oxford, and Constant Shoulder Scores were taken 2 years post-surgery and correlated with Scapular Notching.

Results: There were 137 patients in this study; five patients had bilateral Reverse Shoulder Arthroplasty, operated on different times. Overall cumulative incidence of notching within 1-year was 17.61%. There was no significant difference between shoulders with versus those without scapular notching in terms of Implant Neck Shaft Angle and the median 1-year forward flexion and abduction. The median 2-year post-op CONS Score was 68 and was significantly better in patients without scapular notching [69 (IQR 62-76) vs 51 (IQR 40-65), $P < .001$]. The median 2-year post-op UCLA Score was also significantly better in patients without scapular notching [29 (IQR 26-32) vs 25 (IQR 22-31); $P = .046$]. The median 2-year post-op OSS was also significantly better in patients without scapular notching [15 (IQR 12-20) vs 24 (15-35); $P < .001$]. There was insufficient evidence to demonstrate an association between scapular notching with age, glenoid height, sex, or type of implant NSA.

Conclusions: Insufficient evidence exists to suggest a correlation between the preoperative glenoid height, sex, and implant type to scapular notching. The study was able to measure the overall incidence of Scapular notching among the subjects. Lastly, all patient reported outcome measures 2 years post-surgery yielded statistically significant better results favoring patients without scapular notching, highlighting the clinical implication of its occurrence.

EP.06.300

ACCURACY OF DEEP LEARNING-BASED DECISION FOR CUTTING LEVEL ON HUMERAL HEAD FOR REVERSE TOTAL SHOULDER ARTHROPLASTY

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Background: Application of deep learning (DL) in the orthopaedic surgery is spreading to the field of surgery by the development of novel model, over the diagnostic field. The purpose of this study is to show the effectiveness and accuracy of DL-based decision for cutting level on humeral head for the reverse total shoulder arthroplasty (RTSA).

Methods: The 60 patient image set (pre CT, post CT, pre X-ray, and post X-ray) for RTSA with label for cutting level were used for this study. And 31 layers region with convolutional neural network (R-CNN) model was trained using 46,400 images (train: 0.7, validation: 0.3) for decision of cutting level on humeral head. 20 images were used for prediction of cutting level by 100% manual measurement with surgeons' decision (Group A). Linear regression which is one of machine learning (ML) techniques (50 size information trained) was applied to make a decision for cutting level using other 20 images with information of humeral head size by the manual measurement on the pre X-ray image (Group B). Lastly, the remained 20 images were used for decision of cutting level using the trained R-CNN model (Group C). The acceptable error range was within ± 1 mm.

Results: Final validation accuracy for R-CNN model in this study was 98.78% after 40 epochs. Correct answer ratio in Group A, B, and C were 85%, 90%, and 95%. Only two and one case had the wrong decisions from Group B (ML), and Group C, respectively. Total working time to make the decision for all cases from Group A, B, and C were 42 min (with full manual measurement), 18 min (with manual measurement for only humeral head size), and 51 sec (without any manual measurements).

Conclusions: When R-CNN in this study is applied to decide the cutting level for the RTSA, the surgeon can progress the operation using the quickly prepared information with high accuracy from the preoperative step using only pre X-ray image. And it does not require any manual measurements anymore.

EP.06.301

ELECTIVE SHOULDER REPLACEMENT SURGERY AND PERIOPERATIVE MANAGEMENT IN BELGIUM AND CANADA

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Background: Advancements in elective shoulder replacement (SR) surgery have been numerous over the recent decades. Prosthetic design has improved but so has perioperative management. Our aim of this study was to identify the current perioperative management strategies for elective anatomic (aSR) and reverse shoulder replacement (rSR) in Belgium and Canada.

Methods: The study anonymously surveyed 188 shoulder-specialised orthopaedic surgeons (88 from the Belgian Elbow and Shoulder Society (BELSS) and 100 from the Canadian Shoulder and Elbow Society (CSES)) to help identify current perioperative measures used in elective SR.

Results: Twenty-five of 88 (28.4%) BELSS and thirty-three of 100 (33%) CSES orthopaedic surgeons participated in this online survey. In addition to standard x-rays, surgeons request preoperatively most of the time a CT (75.6% vs. 81.8%) scan and less often an MRI (28% vs. 12.1%), BELSS vs. CSES respectively. Surgical planning software is used routinely in 20% vs. 51.5% between societies. When difficult glenoids are anticipated, planning software is utilized in 68% vs. 30.3% respectively. Tranexamic acid (TXA) is routinely used in 36% vs. 56.3% of surgeries. Most surgeons prefer a subscapularis tenotomy (64% vs. 43.8%) or a subscapularis peel-off (12% vs. 40.6%) versus 12% vs. 9.4% doing a lesser tubercle osteotomy, BELSS vs. CSES respectively. All subscapularis tendons are being refixed in aSR cases (100%) in both countries, this differs to rSR surgeries where 88% (Belgium) and 84.4% (Canada) of subscapularis tendons are being refixed. In Canada, the majority (56.3%) discharge the patient on the following day of surgery, but 43.8% of the CSES surgeons discharge the patient on the same day of surgery. Belgian surgeons most often discharge their patients (64%) after 2 nights in the hospital, followed by 28% after one night and by 8% after three to five nights. No patients are discharged on the same day of surgery in Belgium.

Conclusions: The outcomes represent the current perioperative practice for elective SRs in Belgium and Canada. Results demonstrate a continuous advancement in perioperative management such as the use of perioperative CT scans and pre-operative planning software in both countries. However, big differences are seen in patient discharge management among these two countries.

EP.06.302

PERIPROSTHETIC FRACTURE OF THE HUMERUS. WHERE DO I START?

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Background: Humeral periprosthetic fractures in the reverse prosthesis present a rate of 0.6-2%. The treatment is difficult and represent a surgical challenge. To deal with them we must be able to answer the following questions:

- Location of the fracture according to the Wright and Cofield classification?
- Loosening of the prosthesis? And if it exists, mechanical or due to infection?
- What is the proximal remnant bone stock?
- Do we need to replace the prosthesis? How will we fix the fracture?

Methods: A patient who 11 years ago (65 years old) underwent surgery for a proximal humerus fracture treated by intramedular nailing. After the pseudarthrosis of the first osteosynthesis (OS), a new OS attempt was made that also failed and a reverse prosthesis was finally implanted. Currently, at the age of 76, he falls and presents a humeral periprosthetic fracture. The patient presents a Wright and Cofield type A periprosthetic fracture. The prosthesis that was initially implanted lacked metaphyseal fixation due to the sequelae of the original fracture. There were no acute phase reactants in the analytical, for which we consider this to be an aseptic loosening. Regarding the bone stock, it was very poor, with thin cortices and remnants of original prosthesis cementation.

Results: Due to the location of the fracture and the loosening of the prosthesis, a replacement was made for a long cemented stem and metaphyseal supplements to maintain stability. For the fixation of the fracture, taking into account the poor bone stock, two long structural grafts carved as a sarcophagus and cerclages are used. 10 samples are taken for microbiological culture, all of which are negative. The patient evolves favorably without pain and acceptable function.

Conclusions: There are no guidelines or therapeutic consensus and the literature is scarce and with short series for this pathology. There is an important variability of surgical options, which reflects the complexity of this pathology. Probably, the increase in arthroplasty in fractures and in glenohumeral degenerative pathology, increases the incidence of periprosthetic fractures and it is important to develop a therapeutic algorithm to be able to predict the best results in our patients.

EP.07.001

QUANTITATIVE CHANGES IN SCAPULOHUMERAL RHYTHM IN SERRATUS ANTERIOR PALSY AND SCAPULAR DYSKINESIS - A MATCHED, CONTROLLED STUDY USING DYNAMIC RADIOGRAPHY

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Background: Serratus anterior palsy and scapular dyskinesis cause abnormal scapula motion and shoulder complex kinematics. This arises from a reduced shoulder abduction contribution from the scapulothoracic (ST) joint and frequently a compensatory increase from the glenohumeral (GH) joint. These contributions make up the scapulohumeral rhythm (SHR), defined as the ratio of the change in humeral abduction over the change in scapula upward rotation during humeral abduction and is an important parameter in assessing shoulder complex kinematics. Dynamic Digital Radiography (DDR) is a novel technique which takes a series of pulsed low radiation radiographs during active range of motion and may enable quantitative SHR analysis and assist diagnosis of scapular pathology. The purpose of this study was to compare SHR in patients with serratus anterior palsy and scapular dyskinesis to normal controls throughout active ROM, using DDR.

Methods: Shoulders were included if they had a diagnosis of serratus anterior palsy and scapular dyskinesis based on history, examination, electromyography, and DDR. These patients were matched based on age and sex to a group of normal controls. All included patients were prospectively analyzed using DDR under a standardized protocol, obtaining a series of pulsed radiographs during arm abduction. GH and ST motion were quantified based on DDR images taken in 0-30°, 30-60°, 60-90° of arm abduction. SHR was calculated by dividing the change in humeral abduction by the change in scapular upward rotation in each abduction interval. Data was analyzed with descriptive statistics and ANOVA.

Results: Forty patients were included – 11 patients with serratus anterior palsy, 8 with scapular dyskinesis, and these were matched with 21 normal controls with 1:1 matching. Patients with serratus anterior palsy had significantly higher SHR (12.6 ± 16.4), than scapular dyskinesis (3.67 ± 1.45), and normal controls (2.18 ± 0.67), $p < 0.001$. The difference was most apparent in the 0-30 range of humeral abduction.

Conclusions: Scapula pathology is poorly understood, frequently misdiagnosed and often left untreated. Our study uses dynamic radiography and offers a novel, cost-effective and rapid diagnostic method, and demonstrates consistently higher SHR values in patients with serratus anterior palsy.

EP.07.002

EVALUATION OF NEEDLE LENGTH AND INJECTION SITE TO MAXIMIZE SUCCESSFUL INTRAMUSCULAR INOCULATIONS AND MINIMIZE OVERPENETRATION DURING INTRAMUSCULAR DELTOID VACCINATIONS

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Background: Current recommendations for needle length and vaccination site for intramuscular deltoid vaccinations are backed by minimal data. We aimed to determine the ideal needle length and vaccination site for intramuscular deltoid vaccine administration.

Methods: 120 shoulder CT scans were evaluated and grouped by patient weight and sex as recommended by the United States CDC: Group 1, <60 kg, Group 2, 60-70 kg, Group 3, females 70-90 kg and males 70-118 kg, and Group 4, females >90 kg and males >118 kg. For each group, distance from skin to deltoid fascia and deltoid muscle width were measured at 2, 4, and 6 cm distal to the posterolateral corner of the acromion for 5 unique trajectories. Needle lengths of 0.625", 1.0", and 1.5" were simulated at each site to determine inoculation location relative to the deltoid.

Results: For Group 1, a 0.625" needle in the mid-lateral (ML) trajectory 4 cm distal to the posterolateral corner provided a perfect rate of successful inoculations (100%). For Groups 2-3, a 1" needle in the posterolateral (PL) trajectory 4 cm distal provided high rates (>80%) of successful intramuscular inoculations with low rates of overpenetration (<15%) while minimizing risk to the axillary nerve. For Group 4, a 1.5" needle using the same strategy provided the highest rate of successful inoculations (96%) and minimal overpenetration (4%). Overpenetration was associated with more anterior and superior injection sites ($P < 0.001$ for both) for all needle lengths.

Conclusions: The overall ideal injection site to maximize successful intramuscular vaccine administration, minimize overpenetration, and avoid axillary nerve injury is 4 cm distal to and in line with the posterolateral corner of the acromion, a site more posterior and inferior than current CDC recommendations. We caution against use of a 1.5" needle for patients <118 kg due to high predicted rates of overpenetration.

EP.07.003

THE EFFECT OF CELLULAR NUCLEAR FUNCTION ALTERATION ON THE PATHOGENESIS OF SHOULDER ADHESIVE CAPSULITIS. AN IMMUNOHISTOCHEMICAL STUDY ON LAMIN A/C EXPRESSION

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Background: The network of intermediate filament proteins underlying the inner nuclear membrane forms the nuclear lamina. Lamins have been associated with important cellular functions: DNA replication, chromatin organization, differentiation of the cell, apoptosis and in maintenance of nuclear structure.

Little is known regarding the etiopathogenesis of adhesive capsulitis (AC); recently, a dysregulating fibrotic response starting from a subpopulation has been described within the fibroblast compartment that suddenly turns on an activated phenotype.

Considering the key role of A-type lamin in the regulation of cellular stability and function our aim was to compare the lamin A/C expression between patients with AC and healthy controls.

Methods: a case-control study was performed between January 2020 and December 2021. Tissue samples excised from the rotator interval were analysed for lamin A/C expression by immunohistochemistry. Patients with AC were arbitrarily distinguished according to the severity of shoulder flexion limitation: $<90^\circ$ and $>90^\circ$. Controls were represented by samples obtained by normal rotator interval excised from patients submitted to shoulder surgery. The intensity of staining was graded, and an H-score was assigned. Statistical analysis was performed (Chi-square analysis; significance was set at $\alpha=0.05$).

Results: Twenty-six patients [12M-14F, mean age (SD): 52.3 (6.08)] and 15 controls [6M-9F, mean age (SD): 57.1 (5.3)] were enrolled. The expression of lamin A/C was found to be significantly lower in the fibroblasts of patients with adhesive capsulitis when compared to controls (intensity of staining: $p: 0.005$; H-score: 0.034); no differences were found regarding the synoviocytes ($p>0.05$). Considering only patients with AC, lamin A/C intensity staining was found to be significantly higher in samples where acute inflammatory infiltrate was detected ($p: 0.004$).

No significant changes in levels of lamin A/C expression were documented between the mild and severe adhesive capsulitis severity groups.

Conclusions: Our study demonstrated that the activity of lamin A/C in maintaining nuclear structural integrity and cell viability is decreased in patients with adhesive capsulitis. The phase of the pathogenetic process (freezing and early frozen) is the key factor for cell functionality which is maintained in the early stages of the disease; on the contrary, the clinical severity of adhesive capsulitis plays a marginal role on nuclear stability.

EP.07.004

USE OF THE PECTORALIS MINOR AND CORACOACROMIAL LIGAMENT FOR CHRONIC ACROMIOCLAVICULAR JOINT INJURIES: PRELIMINARY RESULTS OF A CASE SERIES

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Background: Chronic ACJ dislocation requires surgical treatment, but more than 150 techniques are described, with no gold standard of treatment. New techniques have focused on vertical and horizontal stabilization with different grafts. We present a prospective case series of patients with chronic ACJ dislocation treated with biplanar reconstruction using a local tendon autograft as a vertical stabilizer (PM) and a local ligament autograft as a horizontal stabilizer (CAL).

Methods: prospective case series. Chronic ACJ injuries treated with PM and CAL transfer for CCL and ACL reconstruction were included. Grafts were prepared with highly resistant sutures in a Krakow manner, and intraoperative reduction was maintained with a double peri and transclavicular FiberTape lock. The CC distance de

Results: sixteen patients were included, mostly men (15:1) with a mean age of 45.69+-15.70. This series showed 12.50% Rockwood IIIb and 87.50% Rockwood V ACJ injuries. The median time to surgery was 5 (3-32) weeks. Immediate postoperative CC distance was statistically different from preoperative, with an overcorrection of 6.88 vs. 9.00 mm ($p=0.010$, compared to the healthy side), normalized at three months follow-up (10.69 vs. 9.00 mm; $p=0.130$). At six months follow-up, there was a loss of reduction (13.09 vs. 9.18 mm, $p=0.001$). Nevertheless, functional outcomes were excellent: VAS = 2 (0-5)SSV = 82.50%+-19.24%; Constant = 83.13%+-16.83%; and ASES = 78.98% +-18.48%. At this point, there were two complications (12.5%): one patient had a traumatic relaxation that was reduced with a Hook plate, and the PM graft was reattached, and another had an abscess of the surgical wound treated with wound lavage.

Conclusions: the PM and CAL transfer technique showed excellent functional results, comparables to other techniques, and a lower complication rate. This technique allows a biplanar reconstruction with local grafts, reducing morbidity and surgical costs. Although, longer follow-up is needed to better understand the CC distance behavior and randomized clinical trial to address superiority over other techniques commonly used.

EP.07.005

AN ARTIFICIAL INTELLIGENCE DEEP LEARNING MODEL AUTOMATICALLY CLASSIFIED SHOULDER RADIOGRAPHS WITH EXCELLENT PERFORMANCE

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Background: Most institutional and national arthroplasty registries lack an adequate organized set of radiographs. Artificial intelligence (AI)-powered automatic processing of images to link radiographs to databases would tremendously strengthen the value of registries. The purpose of this study was to develop a deep learning algorithm that can process large numbers of radiographs in very little time to classify them automatically according to side, projection, presence or absence of implants, and implant type.

Methods: All patients who had undergone a primary shoulder arthroplasty between 2004 and 2022 at a single academic institution were identified using our Total Joint Registry Database. Preoperative and postoperative Digital Imaging Communication in Medicine (DICOM) files for all these shoulders were pooled, and a sub-cohort of 920 radiographs from 860 patients (407 (47%) males; mean age 77) was randomly selected. There were 667 anteroposterior (AP) and 254 axillary (Ax) radiographs. The side imaged was the left shoulder in 51%. Each film was labeled manually according to the side (right/left), view (AP/Ax), and implant information (preoperative/anatomic shoulder arthroplasty [ATSA]/reverse shoulder arthroplasty [RSA]). The radiographs were divided into training, validation, and testing sets using a 64:16:20 proportional split. A deep learning model of EfficientNet-b4 with pre-trained weights was trained for 60 epochs using the training and validation sets to predict the manually labeled information. The performance of the trained model was evaluated on the testing set.

Results: The trained model processed and classified the 241 testing images in 5.2 seconds. The overall accuracy was 0.979, and the overall F1 score was 0.975. The model's accuracy to predict AP and Ax views was 0.969 and 0.989, respectively. The accuracy to predict the film side was 0.977 for the left and 0.981 for the right side. The model's accuracies to predict if each radiograph was preoperative, postoperative ATSA or postoperative RSA were 0.974, 0.963, and 1.0, respectively.

Conclusions: The deep learning algorithm developed to automatically classify radiographs according to side, view, presence of implant, and implant type demonstrated outstanding accuracy with extremely fast processing times. This represents an exciting first step to automatically add radiographic images to large-scale shoulder arthroplasty registries.

EP.07.006

ORTHOPEDIC INTERNATIONAL ROUND TABLE IN MIXED REALITY, A NOVEL TECHNOLOGY FOR CASE DISCUSSIONS

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Background: Mixed Reality(MR) is a display technology that combines the real world with the virtual world; it permits digital images & 3D Holograms to be manipulated in a surgeon's view of the real world in real time. The potential usage of this technology goes beyond the OR, for example in sharing 3D, holograms, exams, video files and pictures for case discussions. This article will show the first round table discussion occurred using Mixed Reality and describe the steps and devices needed to replicate it.

Methods: Using a HoloLens 2 MR headset system (Microsoft Corporation, Redmond, Washington, USA), four orthopedic surgeons from Brazil, Switzerland, USA and Scotland connected to a free software called Mesh Meeting (Microsoft Corporation, Redmond, Washington, USA) that allows digital meetings. Each surgeon uploaded pictures of preoperative imaging and 3D models for four different shoulder cases. Each surgeon could manipulate any media uploaded into the environment with their own hands in the collaborative virtual room. The reliability of the connection, usability of the platform and virtual interaction were subjectively evaluated.

Results: The internet connection and latency were not an issue during the discussion despite the international connection. All 3D holograms uploaded to the platform were successfully manipulated by all the different surgeons. The use of the virtual hands increased the perception of a real life discussion when pointing anatomical structures in 3D models and images.

Conclusions: International surgeons, using the HoloLens 2, successfully connected in a virtual room and with their digital avatars, and interacted with each other using voice and hand gestures for shoulder case discussion. Advantages of this new format of round table discussion includes allowing any kind of media to be shared, and the ability to freely manipulate any 3D model with their hands in real time without any additional handheld devices or controls. A potential disadvantage is device cost (US\$3500) but with new players in this metaverse market, we believe that a new format for digital discussion has emerged and has opened a different approach to case discussion and international collaboration.

EP.07.007

OUTCOMES OF SCAPULOTHORACIC FUSION IN PATIENTS WITH FACIOSCAPULOHUMERAL DYSTROPHY: A COMPARISON OF ALLOGRAFT VERSUS AUTOGRAFT BONE GRAFTING

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Background: Scapulothoracic fusion (ST) for Facioscapulohumeral Muscular Dystrophy (FSHD) corrects scapular instability secondary to periscapular muscle deficiency, though has high reported complication rates. The purpose of our study was to characterize the outcomes of ST fusion for FSHD in a large patient cohort and to compare the outcomes of patients receiving ST fusion by bone grafting types and fixation techniques.

Methods: A retrospective chart review was undertaken for patients receiving ST fusion at multiple institutions performed by a single surgeon from a period of 2013 to 2020 with minimum 2-year follow-up. Patient demographics, surgical technique, time to union, complications, and clinical outcomes including active range of motion, subjective shoulder value (SSV), visual analog scale (VAS) pain, and American Shoulder and Elbow Surgeons (ASES) scores were recorded.

Results: Fifty patients with 54 ST fusions (n=4 bilateral) and average follow-up of 5.8 years (SD 1.6) were included. Active forward elevation (77 degrees vs 124 degrees; $p < 0.00001$) and abduction (60 degrees vs 90 degrees; $p < 0.00001$) improved significantly after fusion. Average internal rotation after fusion was L3-L4. VAS pain (2.6 vs 1.2; $p < 0.00001$), SSV (33 vs 76; $p < 0.00001$), and ASES (41.8 vs 76.1; $p < 0.00001$) improved significantly postoperatively. Fifty percent (n=27/54) of patients received treatment with cerclage versus Luque (n=27/54) wires, while 53.7% (n=29/54) received allograft versus 46.3% (n=25/54) iliac crest autograft. Average radiographic time to healing was 11.1 (SD 3.2) weeks with no incidence of non-union and did not significantly differ by graft type ($p=0.26$) or technique ($p=0.20$). There was a complication rate of 24.1% including seroma (n=3), superficial infection (n=2), transient neurologic injury (n=2), hemothorax (n=1), rib fracture (n=1), pneumothorax (n=1), and shortness of breath (n=1), though no reoperations. There was no significant difference in the rate of post-operative complications when comparing surgical technique ($p=0.81$) and bone graft type ($p=0.93$). There were no independently predictive factors influencing the rate of post-operative complications by multivariate regression.

Conclusions: Patients receiving ST fusion for FSHD demonstrate globally improved motion and PROMS. Technique and type of graft does not affect time to union or complication rates. Surgeons should be aware of a relatively high complication rate in the early post-operative period.

EP.07.008

ULTRASONOGRAPHY OUTPERFORMS MAGNETIC RESONANCE IMAGING IN DIAGNOSING PARTIAL-THICKNESS SUBSCAPULARIS TEAR

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Background: To evaluate the diagnostic reliability of ultrasonography (US) and magnetic resonance imaging (MRI) for subscapularis (SSC) tears with shoulder arthroscopy as the gold standard and to investigate the diagnostic value of 2 MRI signs (lesser tuberosity cysts and subcoracoid cysts) for SSC tears.

Methods: We consecutively enrolled 437 patients who were scheduled to undergo arthroscopic rotator cuff repair from January 2019 to December 2020. Patients with previous shoulder surgery or shoulder fracture, recurrent shoulder instability, and systemic inflammatory disease were excluded. Preoperative US and MRI of the shoulder were performed and interpreted with a standardized approach. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy of US and MRI were calculated using arthroscopic findings as the gold standard.

Results: Of the 437 patients, 157 had SSC tears confirmed at the time of arthroscopy, 126 of whom had partial-thickness tears. US correctly diagnosed 122 of 157 patients with SSC tears, with an overall sensitivity of 77.7% (confidence interval [CI] 70.6%-83.5%), which was significantly greater than that of MRI (49.7%, CI 42.0%-57.4%, $P < .001$). For partial-thickness SSC tears, US correctly diagnosed 93 of 126 positive patients and 276 of 311 negative patients. This resulted in a sensitivity of 73.8% (CI 65.5%-80.7%), specificity of 88.7% (CI 84.8%-91.8%), and accuracy of 84.4% (CI 80.7%-87.5%). As with MRI, the sensitivity, specificity, and accuracy were 38.1% (CI 29.7%-47.2%), 86.5% (CI 82.3%-89.9%), and 72.5% (CI 68.2%-76.5%), respectively. Lesser tuberosity cysts and subcoracoid cysts were 2 MRI signs with high specificity (98.2% and 94.6%); however, their sensitivities were relatively low (19.8% and 33.8%).

Conclusions: US is a reliable and accurate diagnostic method for SSC tears, especially in easily missed partial-thickness tears. Lesser tuberosity cyst and subcoracoid cyst are highly specific but insensitive MRI signs for SSC tear.

EP.07.009

A MORPHOMETRIC STUDY OF THE SCAPULA FOLLOWING SCAPULOTHORACIC ARTHRODESIS

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Background: Facioscapulohumeral Dystrophy (FSHD) affects periscapular muscles which causes scapular winging. Scapulothoracic arthrodesis (STA) aims to increase the upper extremity range of motion. The ideal fixation position of the scapula is yet to be determined. We reviewed the computed tomography(CT) imaging of 14 patients who underwent bilateral STA to identify the fixation position and the qualitative fusion characteristics of these cases.

Methods: CT imaging of 14 patients, 28 shoulders were examined. 3D Slicer, was used for the evaluation. The qualitative fusion characteristics of each level were classified as A: clear union; B: Probable union; C: Probable non-union; D: Clear non-union and E: Scapula fracture (clear union). 3D Slicer markup tools were used for determining the scapular position. Reference points for the scapula were the center of glenoid, spine of scapula and inferior angle. The angle between the scapula, and the coronal, sagittal and transverse planes were noted. Scapular position in each patient was compared using the paired samples t-test.

Results: There were 10 male and 4 female patients. The mean age was 34.4 years (+/- 11.4). Mean postoperative time from the evaluated CT imaging was 4.3 years (range, 3 months - 11.5 years) Clear union was seen in 17, 14, 14, 14, 11 and 5 shoulders in 2nd, 3rd, 4th, 5th, 6th and 7th ribs, respectively. Probable union was seen in 10, 12, 12, 10, 11 and 7 shoulders in 2nd, 3rd, 4th, 5th, 6th and 7th ribs, respectively. Probable non-union was seen in 1, 2, 2, 4, 4 and 3 shoulders in 2nd, 3rd, 4th, 5th, 6th and 7th ribs, respectively. No significant differences were found for the angles between the scapula and the coronal and sagittal planes ($p=.271$ and $p=.297$, respectively). The angle between the scapula and the transverse plane (tilt angle) was significantly different in the cases ($p=.026$). Additionally, the mean difference in scapular vertical position (height) was 12.15mm (range, 26mm- 1.5mm).

Conclusions: Scapulothoracic fusion can be achieved without much variation in the coronal and sagittal plane in bilateral cases. 7th rib is at higher risk for nonunion. Shoulder asymmetry may cause in a difference in range of motion of the shoulder joints.

EP.07.010

MENTAL HEALTH DISORDERS AND PAIN MODULATION IN ORTHOPEDIC SHOULDER PATIENTS

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Background: Various studies have examined the relationship between preoperative mental health diagnoses (MHD) and postoperative outcomes in orthopedic shoulder patients. However, few investigations delve into the relationship between a preoperative MHD and postoperative opioid pain control regimens in patients who have undergone rotator cuff repair (RCR), total shoulder arthroplasty (TSA), and reverse total shoulder arthroplasty (RTSA). We hypothesize that orthopedic shoulder patients with a preoperative MHD will be prescribed more opioids postoperatively than those without a MHD.

Methods: An IRB-approved retrospective chart review was performed on 438 patients, 18 years or older, who underwent RCR, TSA or RTSA. Patients were divided into two groups: those diagnosed with depression, anxiety, bipolar disorder, and/or schizophrenia (n=193); and those with no previous MHD (n=245). Statistical outcomes were analyzed with the independent T-test, Mann-Whitney U test, One-way ANOVA, and Kruskal-Wallis test.

Results: Univariate analysis demonstrated significant differences between the MHD group and non MHD group in average 90-day postoperative opioid scripts (2.10 versus 1.55 respectively, $p < 0.001$) and median 90-day postoperative Morphine Milligram Equivalents (MMEs) prescribed (225 MME versus 185.25 MME respectively, $p < 0.001$). Among patients who were opioid naive 90 days preoperatively, significant differences were found in MMEs prescribed between the MHD and non MHD group (225 MME versus 150 MME respectively, $p < 0.001$). Further analysis of opioid naive patients with specifically depression compared to patients with an alternate or no MHD diagnosis yielded significant differences in scripts (1.78 versus 1.33 respectively, $p = 0.031$) and MMEs prescribed (225 MME versus 150 MME respectively, $p < 0.001$).

Conclusions: This study found that RCR, TSA, or RTSA patients with a preoperative MHD were prescribed significantly more postoperative MMEs and more opioid scripts than those without MHD. Our findings support our hypothesis and emphasize the clinical importance of recognizing mental health disease while navigating postoperative pain control expectations. Given the rising prevalence of mental health disorders nationwide, considering the effect of these comorbidities on postoperative pain in RCR, TSA and RTSA patients will be essential to enhance postoperative counseling and management by orthopedic surgeons.

EP.07.011

SURGICAL TREATMENT OF SPRENGEL'S DEFORMITY IN BOTH CHILDREN AND ADULTS: A CASE SERIES

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Background: Most patients with congenital structural abnormalities of the shoulder girdle receive treatment in childhood. Treatment in adult populations is limited to individual case reports. The purpose of this study was to describe surgical treatment and outcomes for both children and adult populations with Sprengel deformity

Methods: A retrospective review was performed for patients receiving treatment for congenital structural abnormalities of the shoulder girdle between 2011 and 2018 by a single surgeon. Patient demographics, surgical technique, complications, and clinical outcomes including active range of motion, visual analog scale (VAS) pain, and Likert-scale satisfaction were recorded. Univariate statistics were performed to compare pre- and post-operative outcomes.

Results: Seven patients with an average age of 21.5 +/- 14.6 years (two children and 5 adults) and follow-up of 1.5 years (SD 1.4) were included for analysis. All patients had unilateral pathology. Mean VAS pain improved from 4.3 +/- 4.0 preoperatively to 0.5 +/- 1.2 (p=0.09) postoperatively. Average postoperative satisfaction on a 5-point Likert-scale was 4.7 +/- 0.5. Forward elevation (101.7 +/- 27.1 versus 143.3 +/- 25.0; p=0.01), abduction (80 +/- 0 versus 120 +/- 32.9; p=0.22), external rotation (41.7 +/- 16.0 versus 46.7 +/- 20.8; p=0.81), and internal rotation (T12 (9.3 +/- 6.1) versus T10 (11.0 +/- 0)) all improved postoperatively. There were no apparent early or late complications or revisions. Surgical techniques were guided by 1) presence of an anlage and omovertebral bar 2) scapular deformity 3) peri-scapular muscular deficiency and 4) scapulothoracic abnormal motion. Surgical treatments included omovertebral bar resection, functional periscapular tendon releases or transfers (including levator scapulae, latissimus dorsi, serratus anterior, trapezius, and pectoralis major), partial scapular resection/ostectomy, and scapulothoracic (ST) fusion.

Conclusions: Targeted surgical treatments to correct bony abnormalities, periscapular muscle deficiencies and abnormal motion provide symptomatic relief and improve function in children and adults with congenital structural abnormalities of the shoulder girdle. Adults with untreated Sprengel's deformity achieve reduced pain, improved function, and are satisfied postoperatively in this case series.

EP.07.013

TRANSOSSEOUS SUPRAPECTORAL BICEPS TENODESIS: CLINICAL RESULTS OF AN IMPLANT FREE TECHNIQUE

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Background: Biceps tenodesis, above or below the pectoralis, is recognized increasingly as a valuable technique for treating anterior shoulder pain. The purpose of this study was to evaluate clinical results of a novel, cost effective and implant-free suprapectoral biceps tenodesis technique utilizing a reusable transosseous arthroscopic tunneling device. This technique secures the biceps with anatomic length tension relationship in the supra-pectoral location utilizing all arthroscopic technique with no axillary skin incision.

Methods: 27 patients (Average age 52 years) treated with arthroscopic transosseous biceps tenodesis technique over one year (2015) were evaluated with preoperative and post operative outcomes using the ASES and VAS Scale. They were assessed for recurrent pain, deformities, revision surgery, cost, and complications.

Results: Mean ASES scores significantly improved from 46 to 81 (p-value < 0.0001) at a median follow-up 14 (range 6-22 months) months. Average VAS improved from 5.89 to 1.89 (p-value < 0.0001). There were no popeye deformities noted. Cost savings of \$300 per case were realized by omitting implant use. There were no device related complications. One patient acquired a propionobacter infection.

Conclusions: The suprapectoral transosseous biceps tenodesis was safe and effective. Providing equivalent outcomes with decreased cost is by definition increased value. This technique offers an option to reduce or eliminate anchor cost with similar outcomes to arthroscopic or open anchor or screw based methods, while eliminating the axillary incision and difficulty with ascertaining length tension relationship of the muscle.

EP.07.014

POSTOPERATIVE PAIN MANAGEMENT ON THE DAY OF ARTHROSCOPIC SHOULDER SURGERY -COMPARISON BETWEEN NSAIDS AND SIGLE OR MULTIPLE ADMINISTRATION OF ACETAMINOPHEN-

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Background: Postoperative effective pain management on the day of arthroscopic shoulder surgery is important for patients' prompt recovery to normal shoulder function and reduce the incidence of adverse physiologic and psychological effects associated with acute uncontrolled pain. Our arthroscopic shoulder surgeries were performed under general anesthesia combined with ultrasound guided brachial plexus block (0.75% Ropivacaine Hydrochloride Hydrate). Another analgesic drug is necessary after decreasing of analgesic effect of Ropivacaine which lasts for 10-12 hours in average. Non-steroidal anti-inflammatory drugs (NSAIDs) such as diclofenac suppositories (50mg) and acetaminophen such as Flubiprofen axetil (50mg) are commonly used in our country, however appropriate drug use is not well known. The aim of this study was to compare the drug effect between NSAIDs and acetaminophen and to analyze single or multiple intravenous administration for effective pain management after arthroscopic shoulder surgery.

Methods: Ninety-nine patients (60.8 ± 14.6 years) after arthroscopic shoulder surgery were involved in this study. Diclofenac suppositories (Group D) and Flubiprofen axetil (Group F) were randomly used as an analgesic drug. Single intravenous administration of Flubiprofen axetil (Group FS) and multiple (three times for every 4 hours) intravenous administration of Flubiprofen axetil (Group FM) were also enrolled. Analgesic drug effect of single administration was evaluated with VAS value at 2-4, 5-7, 8-10, 11-13 hours after administration of each drug. Analgesic drug effect of multiple administration was evaluated with VAS value at 15 minutes after administration of each drug. Comparison among each group was statistically analyzed.

Results: In average 12.4 hours after surgery analgesics are required to use in all the cases. VAS values were decreased both in group D and group F; VAS values in group D were significantly lower compared to group F. VAS values after first administration significantly decreased compared to those before administration both in group FS and FM. VAS values in group FM decreased significantly than those in group FS.

Conclusions: NSAIDs might be more useful for pain management than acetaminophen. Multiple intravenous administration of acetaminophen might be more useful compared to single intravenous administration.

EP.07.015

RESULTS OF SURGICAL TREATMENT OF SPRENGER'S DEFORMITY -CASES FOLLOWED UP FOR MORE THAN 10 YEARS AFTER SURGERY

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Background: Sprengel's deformity is not only a malposition of the scapula, but it is also often associated with dysplasia of muscles around it. We studied influence of this dysplasia on the treatment of modified Woodward's method.

Methods: We observed fifteen shoulders (left 11, right 2, both 1) of fourteen patients (5 males, 9 females) (age: 1.8~7.5 years, average 3.5) whom we could evaluate the muscles around the scapula by 3DCT and MRI before surgery. Cavendish classification before operation were 2 cases of Grade3, 12 of Grade4.

Operation method was modified Woodward's method by which we lowered the scapula after osteotomy of the clavicle in two places. The outcome was assessed using Cavendish classification and active ROM of the shoulder joint at a mean follow-up of twelve years and six months (10 to 16 years).

Results: In the case of dysplasia of muscles, the scapula moved to a higher position at the time of the final observation compared to the position immediately after surgery. At the last observation there were 2 cases of Grade1, 7 of Grade2, 4 of Grade3, and 1 of Grade4. The abduction improved 96degrees (75~140) before surgery to 146 degrees (110~175). We classified dysplasia of the muscle into 3 grades by image evaluation before surgery. (grade1: almost normal, grade2: slight dysplasia, grade3: severe dysplasia) Among 14 cases, there were 2cases of grade1, 5 of grade2, and 7 of grade3. We compared the changes in Cavendish classification of all the cases before and after of surgery. 2 cases of grade1: Cavendish3 to 1, 4 cases in grade2: Cavendish4 to 2, 1 case in grade2: Cavendish4 to 3, 3 cases in grade3: Cavendish4 to 2, 3 cases in grade3: Cavendish4 to 3, 1 case in grade3: Cavendish4 to 4.

Conclusions: The surgical results of Sprengel's deformity are influenced by not only Cavendish classification before surgery but also dysplasia of muscles around the affected scapula.

EP.07.017

TYPE II SLAP LESION REPAIR: POSTERIOR REPAIR OF SLAP MAKES EXTERNAL ROTATION DEFICIT: LONG-TERM OUTCOME STUDY

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Background: This study aimed to evaluate the outcomes of arthroscopic type 2 superior labrum anterior-posterior (SLAP) lesion repair in the general population and compare clinical outcomes according to patient age and repair site.

Methods: Between 2005 and 2018, patients who underwent arthroscopic repair for isolated type 2 SLAP lesions were retrospectively reviewed. Baseline characteristics, pre- and postoperative [1-year and >2-year (final)] shoulder range-of-motion, and functional scores, comprising the pain visual analog scale (PVAS), functional VAS, and American Shoulder and Elbow Surgeons (ASES) score, were evaluated. Return to overhead activities and subjective satisfaction were assessed at the final follow-up, and patients were divided by age [group YB (<40 years) and group OB (>40 years)] and repair site [group P (only posterior labrum repair) and group AP (anterior and posterior labrum repair)]. Overall patient outcomes were analyzed and compared between groups.

Results: This study included 54 patients (45 men) with a mean age of 37.1 ± 8.3 years. The mean follow-up was 90.8 ± 51.3 months. Two patients experienced early failure, and one had a ruptured biceps tendon during the follow-up period. Final functional scores improved compared to their preoperative scores in all patients except three (all $p < 0.001$). Fifty patients (98.0%) were satisfied, and 39 patients (76.5%) were able to perform overhead sports without restriction. In 25 patients who attended more than 7 years of follow-up (mean, 11.3 ± 2.7 years), 21 patients (84%) had an ASES score > 80 , and all patients had PVAS < 2 . There was no significant difference in clinical outcomes between groups YB and OB. The final median external rotation was significantly more restricted in group AP than in group P (40 [25-65] vs. 60 [50-70], $P = 0.002$).

Conclusions: Arthroscopic type 2 SLAP repair induced good short- and long-term clinical outcomes, return to overhead activities, and subjective satisfaction in the general population, regardless of age, due to the careful evaluation of patient history, physical examination, and imaging studies. However, performing only posterior repair seems sufficient since anterior labral SLAP lesion repair can limit ER. Isolated type 2 SLAP lesion posterior repair only is, thus, recommended to reduce external rotation deficit risk and increase satisfaction, regardless of patient age.

EP.07.018

TRIAMCINOLONE ACETONIDE WITH ARTHROSCOPIC CAPSULAR RELEASE FOR FROZEN SHOULDER PROMOTES EARLY RECOVERY OF SHOULDER ABDUCTION

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Background: Current treatment options for frozen shoulder are not established as a standard-of-care. The condition may resolve without intervention, but symptoms may persist despite treatment. Frozen shoulder is associated with inflammatory reactions that can reduce the quality of life. Our aim was to determine whether triamcinolone acetonide, an immunosuppressive steroid, improved functional recovery when administered after arthroscopic capsular release (ACR) for frozen shoulder.

Methods: Participants were selected using inclusion and exclusion criteria designed to reduce the impact of potential confounding factors. ACR was performed under general anesthesia, followed by manipulation to ensure adequate range of motion and wound closure. In the steroid treatment group, triamcinolone acetonide was injected into the glenohumeral joint immediately prior to wound closure. The follow-up period was six months. Data from various qualitative and quantitative variables were statistically analyzed to determine the efficacy of steroids in improving overall post-procedural functional recovery.

Results: Our study consisted of 22 patients with frozen shoulder, 11 in each of the surgery-only (ACR group) and surgery with steroid injection groups (TA group). No significant differences were found in the demographic data of the study participants. Significantly greater improvements in abduction range of motion were observed in the TA group, compared to the ACR group, at three and six months post-treatment (TA group; 3 months - Pre = 63.6°, 6 months - Pre = 68.5° / ACR group; 43.0°, 45.4°). Improvements in other movement parameters were similar in both groups. The TA group had significantly higher numerical rating scale for night pain at three months post-treatment than the ACR group.

Conclusions: Postoperative steroid treatment led to early recovery of the abduction range of motion in patients with frozen shoulder. Hence, it should be included in the current standard-of-care protocol for frozen shoulder and other similar conditions requiring surgical intervention. Therapeutic reduction in the inflammatory response following arthroscopic capsular release can significantly improve prognosis and quality of life.

EP.07.019

CLINICAL AND RADIOLOGICAL COMPARISON OF TWO TECHNIQUES FOR BICEPS TENODESIS : OPEN SUBPECTORAL TENODESIS VERSUS ARTHROSCOPIC PROXIMAL BICEPS TENODESIS

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Background: The study was aimed to compare open subpectoral biceps tenodesis and arthroscopic proximal biceps tenodesis in repair of small or medium rotator cuff tears.

Methods: 84 consecutive patients (47 open subpectoral tenodesis, group A; 37 arthroscopic proximal biceps tenodesis technique, group B) who underwent biceps tenodesis were evaluated retrospectively. The surgery time and residual pain, popeye deformity were compared between the two groups. The mean age at the time of operation was 49.3 years in group A (range, 44-58 years) and 55.9 years in group B (range, 45-61 years). Postoperative magnetic resonance images were evaluated in 84 patients to determine the integrity of the tenodesis and the location of the tenodesis tunnel.

Results: At the most recent follow-up, the UCLA score in group A improved from a preoperative mean of 16.2 ± 4.1 to 30.2 ± 3.9 ($P < .001$). In group B, these scores improved from 16.3 ± 4.2 to 30.4 ± 3.2 ($P < .001$). There were no statistically significant differences between the 2 groups ($P = .43$ for UCLA). Popeye deformity was detected in 2 cases of group A (4.3%) and in 5 cases of group B (8.1%) ($P = .16$). In postoperative MRI analysis, There were no statistically significant differences between the 2 groups distal migration of biceps tendon.

Conclusions: For the treatment of LHBT lesions, both open subpectoral tenodesis and arthroscopic proximal biceps tenodesis technique showed good clinical outcomes. But, open distal subpectoral tenodesis had the additional advantage of shorter surgery time, less residual pain and encouraging early results compared to arthroscopic proximal tenodesis. There was no significant difference in the overall incidence of Popeye deformity between the 2 groups.

EP.07.020

VASS VACCINE / VIRUS ASSOCIATED SHOULDER SYNOVITIS - CLINICAL PRESENTATIONS, CLASSIFICATION, EPIDEMIOLOGY

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Background: COVID vaccines are associated with sub-acromion bursitis and shoulder synovitis leading to adhesive capsulitis. This phenomenon, also known as SIRVA (Shoulder Injury Related to Vaccine Administration) in American legal literature, has previously been reported with Influenza and other vaccines. There is a paucity of literature informing doctors, vaccinators, patients and policy makers, which leads to increased incidence, delayed diagnosis and treatment.

Methods: In a multi-centre study cases of Covid vaccine related VASS were collated. Presentations were documented along with medical imaging including MRI scans and pathology tests including tissue biopsy. Treatment and efficacy was also documented. The Victorian Vaccine Surveillance Registry VICSAFE was also queried for shoulder pathology. We devised a broad classification that could be tested and validated in this and subsequent pandemics.

Results: A total of 34 cases (41 shoulders) from 12 centres were reported. 19 were acute presentations (within 7 days of vaccination) 22 were sub-acute presentations. 7 cases demonstrated sequential bilateral shoulder involvement. MRI findings showed subacromion pathology in 16 shoulders, shoulder capsulitis and synovitis in 14 cases and combined pathology in 11 cases. 7 cases had sequential bilateral pathology. All 7 cases with contralateral shoulder involvement occurred after the primary shoulder was affected, and all showed synovitis. 3 cases had Covid shoulder synovitis. Superior and or deep injection as a cause of the bursitis could only be established in 17 cases. Contralateral shoulder synovitis suggested an immune or systemic inflammatory phenomenon. Treatment: The average VAS scale pain reported in acute presentations was 8.2, and 6.6 in sub-acute presentations. Acute cases responded to a 5-day course of 5 mg oral prednisolone. Sub-acute presentations responded partially to oral NSAIDs. 29 cases required sub-acromion and or gleno-humeral steroid injection. 2 cases needed arthroscopic shoulder capsular release. Acute presentations had better outcomes and a quicker recovery. 14 cases had residual restriction of movement, though none had residual pain.

Conclusions: There needs to be better data global collection and analysis of VASS/SIRVA. This would spur further research into the effect of vaccines on the shoulder and recommendations for injection sites such as the thigh or buttock especially for lean individuals.

EP.07.021

WHAT FACTORS IMPACT A PATIENT'S DECISION TO UNDERGO SHOULDER SURGERY?

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Background: Patient decision to undergo shoulder surgery is multifactorial and has been shown to be influenced by level of pain and functional limitation. To assess such factors, many shoulder specific patient reported outcome measures (PROMs) have been developed, with the ASES score being the most common. Yet, we are still not able to assess which of these factors have the greatest impact on a patient's decision to undergo shoulder surgery. Thus, our study aimed to assess the relative impact of the individual activities that compromise the ASES score on patient decision to undergo shoulder surgery.

Methods: An anonymous survey was administered to participants above the age of 18 in Palm Beach County, Florida. Patients were asked to rank pain, shoulder function, sleep, driving, and self-care activities to assess the importance and impact of these factors on their decision to undergo shoulder surgery. Patients were also asked to predict the time to recovery of these activities. Descriptive statistics and Kruskal-Wallis analyses were conducted.

Results: The cohort consisted of 101 participants, with 51.4% identifying as male. The mean age of the cohort was 38.72 with the majority (68.2%) identifying as White. Only 53.3% percent of participants said they would consider undergoing shoulder surgery, with 45% ranking pain as the most influential factor. This was followed by activities of daily living (ADLs) (20.6%), shoulder function (14%), driving (10.3%), and sleeping (9.3%). Regarding ADLs, the top 3 were sleeping (34.7%), toileting (33.7%), and doing usual work (31.6%). When asked how influential information about time to return to these activities would be on their decision to undergo surgery, over 71% felt this would be very or somewhat important.

Conclusions: Although pain is frequently cited as most influential on a person's decision to undergo surgery, it is not always the only factor to consider. The ability to perform ADLs, sleep without difficulty, and drive are also critical. Orthopaedic surgeons should account for this patient perception in their discussions to personalize care and manage patient expectations.

EP.07.022

UTILIZATION OF TELEMEDICINE IN ORTHOPAEDIC SURGERY DURING COVID-19

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Background: Due to the COVID-19 pandemic, telemedicine experienced a dramatic increase in utilization affecting patient care and physician reimbursement. Previous studies have reported on the safety and efficacy of telemedicine in orthopaedic surgery, however the future role of telemedicine in shoulder surgery is unknown. The purpose of this study was to observe and compare telehealth trends over the course of the pandemic amongst elective fields like orthopedic surgery and rheumatology, and non-elective specialties such as oncology and family medicine.

Methods: This was a retrospective analysis of all telemedicine and in-person visits at a single institution from January to December 2020. Data was collected using electronic health record platform, EPIC, and QLIK. Inclusive parameters for data collection were solely based on telemedicine and in-person provider visits.

Results: Orthopedic virtual visits increased from 0% of total visits in January 2020 to 3.6% in March 2020 to 33.5% in April 2020. It decreased shortly after to 18.5% by May 2020 and 6.5% by December 2020. Shoulder surgeons specifically, utilized virtual visits even more; 6.0% in March 2020 to 56.1% in April 2020. Thereafter, telemedicine utilization dropped to 32% in May 2020 and 19.8% by December 2020. As for Oncology virtual visits, there were 0% telehealth visits in January, 2.6% in March and a sharp increase to 25.5% in April. Telehealth Oncology trends dropped shortly after to 19.3% in May and down to 7% by December. Virtual visits in Family Medicine and Rheumatology spiked in April 2020 (94.0% and 92.9%) with downward trends thereafter. Family medicine and Rheumatology maintained telehealth visits at 17.4% and 26.2% into December 2020.

Conclusions: As a result of the COVID-19 pandemic, changes to the provision of telemedicine led to a rapid increase in the number of virtual visits among many specialties by April 2020. However, regardless of increase in COVID lock downs, infections, hospitalizations and deaths, telehealth saw a downward trend by December 2020, especially in procedure-based fields like Orthopedics and Oncology. Interestingly, shoulder surgeons had higher rates of telemedicine usage throughout 2020 when compared to other orthopedic providers.

EP.07.023

SHOULDER PAIN AND DISABILITY AFTER COVID-19 VACCINATION: A NATIONAL SURVEY OF 1097 PATIENTS

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Background: To assess the impact of COVID-19 vaccination on post-vaccination shoulder pain and disability and whether the type of vaccine impacts post-vaccination shoulder function.

Methods: The present survey was conducted using an online-based, self-administered questionnaire that assessed the post-vaccination shoulder status using the Constant-Murley Shoulder Pain and Disability Score (CMS). The questionnaire was distributed throughout the Alchemer platform from mid-March 2021 to mid-January 2022. Participants who had COVID-19 vaccine doses within an average of 121 days after the vaccine were asked to participate. The study retrieved 1097 valid response

Results: The mean age of the participants was 55.6 ± 16.8 years old, and the majority of them were females (64%). Almost 57% of the participants had the COVID-19 vaccine dose at the left side. Besides, 628 participants (57.2%) received Pfizer vaccine and 462 (42.1%) received AstraZeneca vaccine. Nearly 11% of the participants reported previous shoulder issues. Overall, 342 participants (31.2%) had no shoulder pain after vaccine. Amongst the patients who had pain, the average days from vaccination to pain was 2.6 ± 4.1 days. The average CMS was 76.1 ± 11.6 , with 21.9% had very good function and 49.3% had good function. Patients who received Pfizer vaccine had higher pain score than patients received AstraZeneca vaccine ($p = 0.014$). However, the total CMS was similar between both types of vaccines.

Conclusions: COVID-19 vaccines were generally well-tolerable and had no substantial impact on shoulder function after vaccination. The type of vaccine had no significant impact on the post-vaccination disability; however, respondents who received Pfizer vaccine had higher level of post-vaccination pain than those who received AstraZeneca vaccine.

EP.07.025

EARLY EFFECTIVENESS OF ENDOSCOPIC PECTORALIS MINOR TENOTOMY AND SUCCLAVIDIAN MUSCLE RELEASE IN PATIENTS WITH NEUROGENIC PECTORALIS MINOR SYNDROME. A CASE SERIES STUDY

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Background: Pectoralis minor syndrome (PMS) PMS is a subset of neurogenic Thoracic Outlet Syndrome (TOS) that can cause upper extremity symptoms of pain, paresthesia, and/or weakness due to compression of the Brachial plexus compression below the clavicle under the pectoralis minor muscle

This study evaluated the early effectiveness of endoscopic pectoralis minor tenotomy and succlavian muscle release in patients with neurogenic PMS.

Methods: Data were obtained for patients undergoing operative treatment for disabling PMS between 2018 and 2022. Preoperative Neurological Clinical exam, X-ray, MRI (shoulder and neck) and EMG were performed. Functional outcomes were assessed before and 3 months after surgery using (DASH) survey

Results: The study involved 45 patients (M:F;15:30), The median age was 27 years (IQR 25-36). All patients had a significant improvement of the post-operative median DASH score from 50.8 ± 1.6 , to $(29.6 \pm 4.2; P < .01)$ and we observed a clear regression of neurological symptoms in the immediate postoperative. We registered no infections, no vascular-nerve injuries and no post-op complications

Conclusions: Endoscopic pectoralis minor tenotomy and succlavian muscle release is a low-risk procedure that is effective to treat PMS. These findings emphasize the importance of recognizing subcoracoid brachial plexus compression as part of the spectrum of TOS and support its role in surgical management.

EP.07.026

EARLY EFFECTIVENESS OF ENDOSCOPIC PECTORALIS MINOR TENOTOMY AND SUCCLAVIAN MUSCLE RELEASE IN PATIENTS WITH NEUROGENIC PECTORALIS MINOR SYNDROME. A CASE SERIES STUDY

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Background: Patients with upper obstetric brachial plexus lesion (OBPL) have internal rotation deformity of the shoulder with loss of overhead elevation. In this study the Hoffer technique in which the latissimus dorsi or Teres major or both muscle was used for reconstruction. The use of a posterior and transaxillary approach allows the release of the subscapularis muscle from its origin , relocation of the posteriorly subluxated head and suturing the transferred muscles directly at the insertion of the rotator cuff.

Methods: 62 patients with upper OBPL suffering from limited shoulder function were treated with transfer of the teres major +/- latissimus to the head of humerus at the insertion of the rotator cuff with subscapularis release if tight. Patients with deformed head or loss of Deltoid function were not included in this study. Age ranged from 4 to 12 years with a mean 5. A posterior and axillary extension was used to approach the insertion of the latissimus and teres major and to release the subscapularis muscle from its origin from the anterior surface of the scapula. The muscles were released and transferred directly to the head of humerus in an abduction and maximum external rotation. The patient was then placed in a shoulder spica for 6 weeks followed by a physiotherapy program.

Results: Active shoulder function was measured by the Mallet score. All patients improved with correction of the deformity and increase of overhead function. The mean follow up period was 7 years . The range of abduction and overhead elevation depends on the original strength of the Deltoid muscle. Patients with strong Deltoid gave excellent results

Conclusions: Muscle transfer for shoulder reconstruction in upper OBPL gives excellent results as long as the head humerus is not deformed and the patient has Deltoid muscle function. The posterior approach allows proper dissection and reinsertion of the transferred muscles directly on the relocated head .Subscapularis release from its origin on the bone maintains the muscle tendon unit therefore prevents subluxation of the head anteriorly after restoration of full external rotation. This technique preserves a functional degree of internal rotation.

EP.07.027

COMPARISON BETWEEN OSTEONECROSIS OF THE HUMERAL HEAD AND FEMORAL HEAD: AN ANALYSIS USING THE NATIONWIDE CLAIMS DATABASE

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Background: The humeral head is the second most common site of osteonecrosis, after the femoral head. However, compared to osteonecrosis of the femoral head (ONFH), epidemiological information on osteonecrosis of the humeral head (ONHH) is scarce. Therefore, in this study, we aimed to evaluate the epidemiological factors of ONHH by comparing the trends in the surgical treatment of ONHH and ONFH using the nationwide medical claims database of the Republic of Korea (ROK).

Methods: We analysed epidemiological data from the Health Insurance Review and Assessment (HIRA) database of the ROK between January 2008 and December 2018. Demographic factors and the proportion of surgical procedures were compared according to the anatomical site of osteonecrosis and the affected year.

Results: The total number of patients treated for ONHH and ONFH during the study period was 1,028 and 66,260, respectively. Although the incidence of ONHH increased during the study period, it is a relatively rare disease compared to ONFH. ONHH occurred more frequently in female patients, while ONFH occurred predominantly in male patients ($p < 0.001$). Surgical treatment for ONHH was most frequently performed in older patients (63.7%), whereas middle-aged patients had the largest proportion of ONFH (48.9%, $p < 0.001$, Table 1). The proportion of post-traumatic osteonecrosis was significantly higher in the ONHH group (5.1%) than in the ONFH group (1.9%, $p < 0.001$). Arthroplasty was performed more frequently in the ONHH group (96.0%) than in the ONFH group (92.9%, $p < 0.001$).

Conclusions: Despite the anatomical similarities between the hip and shoulder joints, the different biomechanical properties, such as weight-bearing functions, might cause epidemiological differences between ONHH and ONFH.

EP.07.028

RECONSTRUCTION OF ERB'S SHOULDER IN PATIENTS ABOVE 14 YEARS OF AGE; ARTHROSCOPIC RECONSTRUCTION TECHNIQUE

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Background: external rotation weakness secondary to obstetrical brachial plexus palsy leads to Internal rotation contracture of the shoulder causing functional and cosmetic problems. The persistent muscle imbalance and soft tissue contracture can lead to progressive glenohumeral joint deformity which if not treated early can lead to complete disfunction of the shoulder in mature young patents. This study will present a new arthroscopic technique and results to reconstruct the shoulder in patients above 14 years of age.

Methods: The bony deformity is decrease in the head curvature and rotation (usually with 20-50% loss of elevation and 50% external rotation). The about 5 to 10 mm superior protrusion of the greater tuberosity causes impingement on elevation above 70degrees. Also, soft tissues change as contraction of the anterior capsule and subscapularis, the disuse weakness of the infraspinatus, the elongation of the supraspinatus and the contracted inferior capsule, leads to limitation.

The arthroscopic surgery addresses the bony deformity by resecting the overriding part of the greater tuberosity and an anterior acromioplasty to treat the bony impingement. A cruciate repair of the superior capsule and tendon allow more stability to the head and decreases superior migration on elevation. Release of contractions of the anterior capsule and elongation of the subscapularis through an oblique cut will allow more range of motion in external rotation. Also releasing the inferior capsule leads to increase in elevation. After this all-arthroscopic procedure, the shoulder is immobilized in 50 degrees external rotation and 2 degrees abduction for 6 weeks followed by 3 to 12 months rehabilitation.

Results: The surgery was done to 5 patients with average 27 months follow up minimum 12 months. Average age was 17 years. All had the above procedure and two had open additional latissimus dorsi transfer. All patients were able to achieve the limited goals of the surgery to completely use the arm in daily living after long years of no use and no difference in the results was noticed between cases with latissimus dorsi transfer and those without.

Conclusions: Successful limited goals intervention in adults after this procedure is an option for older patients with Erb's Palsy deformity.

EP.07.029

THE RISK OF SHOULDER ADHESIVE CAPSULITIS IN INDIVIDUALS WITH PREDIABETES AND TYPE 2 DIABETES MELLITUS - A LONGITUDINAL NATIONWIDE POPULATION-BASED STUDY

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Background: This study aimed to investigate the association between type 2 diabetes mellitus (T2DM) and shoulder adhesive capsulitis (AC) using a large-scale, nationwide, population-based cohort in the Republic of Korea.

Methods: A total of 3,471,745 subjects aged over 20 years who underwent a National Health Insurance Service medical checkup between 2009 and 2010 were included in this study, and followed from the date of their medical checkup to the end of 2018. Subjects were classified into the following four groups based on the presence of dysglycemia and history of diabetes medication: Normal, Prediabetes, Newly diagnosed T2DM (New-T2DM), and T2DM (claim history for anti-diabetic medication). The endpoint was new-onset AC during follow-up. The incidence rates (IRs) in 1,000-person years and hazard ratios (HRs) of AC for each group were analyzed using Cox proportional hazard regression models.

Results: The IRs of AC were 9.453 (Normal), 11.912 (Prediabetes), 14.933 (New-T2DM), and 24.3761 (T2DM). The adjusted HRs of AC in the Prediabetes, New-T2DM, and T2DM groups were 1.084 (95% CI [1.075, 1.094]), 1.312 (95% CI [1.287, 1.337]), and 1.473 (95% CI [1.452, 1.494]) compared to the Normal group, respectively. This secular trend of the HRs of AC according to T2DM status was statistically significant ($P < .0001$).

Conclusions: This large-scale, longitudinal, nationwide, population-based cohort study of 3,471,745 subjects confirmed that the risk of AC increases in prediabetic subjects and is associated with T2DM status.

EP.07.030

TELEMEDICINE EVALUATION OF THE SHOULDER BASED ON THE CONSTANT AND ASES SCORES COMPARED TO PRESENTIAL EXAMINATION

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Background: Telemedicine consists of the use of information technology over the Internet with the purpose of connecting healthcare professionals with patients or other professionals of health in a virtual way to carry out medical procedures such as consultation, consultation, rehabilitation and postoperative follow-up. Performing this physical examination virtually is a great challenge, which can lead to the abandonment of the tool by some healthcare providers who consider telemedicine incapable of providing adequate care. Our objective with this study was to evaluate the applicability and efficacy of the use of the Constant and the ASES scores in consultations carried out virtually (teleconsultations) compared to the physical exam carried out in person.

Methods: 50 patients from the outpatient clinic of the Shoulder and Elbow Group at an tertiary hospital were selected. Each patient was attended by 02 trained orthopedists, 01 of whom was responsible for the telemedicine consultation and the other for the face-to-face appointment of the same patient. The two moments followed the same script: personal data questionnaire and other regarding telemedicine, orthopedic physical exam of the shoulder, strength test and functional scores of Constant and ASES. Teleconsultations were performed using the iClinic® digital platform and range of motion was assessed using the Protractor™ digital goniometer. Data collected virtually were compared with data collected in face-to-face visits.

Results: Thirty-four patients (68%) had results within the same parameter as the Constant score. Of the 16 patients with different results, in half of them strength was the factor responsible for this divergence, followed by medial and lateral rotation. Separately, strength was the parameter with the greatest difference in values between face-to-face and remote consultations, with 43 patients (86%) having different values comparing the two assessments.

Conclusions: The use of telemedicine proved to be a good resource and tool for assessing the physical exam of the shoulder, making it possible to assess objective criteria for ROM and shoulder strength and, even with some divergences between the data in both situations, especially due to strength, we saw that this did not change the final value of the Constant score between the telepedegetic measurement and the face-to-face measurement.

EP.07.031

MEASUREMENT OF SHOULDER ABDUCTION ANGLE WITH POSTURE ESTIMATION ARTIFICIAL INTELLIGENCE

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Background: Goniometer is traditional tool to measure abduction angle, however real-time evaluation by goniometer is difficult. Recently artificial intelligence (AI) based marker less pose estimation from movies has been developed. AI model-based pose estimation can detect the joint position with high accuracy and speed. Therefore these models can be used for motion capture during rehabilitation. In this study, marker less motion capture was performed during shoulder abduction motion. Abduction angle was calculated from 2D images. To detect joint position, two AI libraries were used Mediapipe and LightGBM. Mediapipe is pose estimation library to detect joint position from 2D images or movies. LightGBM, which is machine learning library, was used to calculate shoulder abduction angle from detected joint position.

Methods: Ten healthy volunteers participated to the study. Movies were captured using smart phone cameras with right shoulder joint abduction angles from 10° to 160°. Cameras were set at 45°, 30°, 15°, 0°, -15°, or -30° diagonal position to the subject at a distance of 3 meters. Positions of bilateral shoulder, hip, elbow joint and nose position were detected from movies using Mediapipe. Thereafter, distance or angles of each joint were calculated. These parameters were used as training data of lightGBM and data from goniometer was set as grand truth. Machine learning model at each camera position and the model which estimates the abduction angle from various camera angle were developed. The coefficient of determination R² and mean absolute error (MAPE) were evaluated to compare each model.

Results: The R² and MAPE at each camera angle were as follows. R² was 0.999 at -30°, 0.999 at -15°, 0.999 at 0°, 1.000 at 15°, 0.998 at 30°, 0.998 at 45°. The MAPE was 0.612 at -30°, 0.978 at -15°, 0.686 at 0°, 0.322 at 15°, 1.706 at 30° and 1.516 at 45°. The R² and MAPE of various camera angle model were 0.988 and 4.057%, respectively.

Conclusions: Combination of pose estimation AI and machine learning model can detect shoulder joint abduction angles with high accuracy in various camera positions, which may be useful for real-time estimation of shoulder motion during rehabilitation or sports motion.

EP.07.032

INTEROBSERVER RELIABILITY OF BOILEAU CLASSIFICATION FOR PROXIMAL HUMERUS FRACTURE SEQUELAE: DOES THREE-DIMENSIONAL COMPUTED TOMOGRAPHY IMPROVE SENSITIVITY, SPECIFICITY AND INTER-RATER AGREEMENT?

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Background: The aim of this study is to investigate the impact of computed tomography (CT) on the reliability of the Boileau classification for proximal humerus fracture sequelae (PHFS).

Methods: A prospective study was designed using STARD guidelines. All patients affected by PHFS surgically treated between 2017 and 2021, who underwent preoperative radiographs (X-rays) and CT scan were included. Three independent raters classified the PHFS. We quantified both intra- and inter-rater reliabilities and the diagnostic effectiveness of X-rays and CT scan in detecting chronic dislocation (CD), nonunion (NU) and severe greater tuberosity dislocation (GTD).

Results: Fifty-two patients were included in the study (twenty-nine type 1, eight type 2, nine type 3, six type 4).

The overall inter-rater percentage agreement was low with both X-rays and CT scan. X-rays showed a sensitivity of 97%, 88.9% and 84.1%, and a specificity of 58.3%, 40% and 53.3% detecting CD, NU, and GTD; respectively. CT scan showed a sensitivity of 100%, 96.8% and 93.7%, and a specificity of 91.7%, 86.7% and 93.3% detecting CD, NU and GTD respectively.

Conclusions: CT scan is more specific than X-rays evaluating PHFS. However, even using three-dimensional evaluation of the deformity, the interobserver agreement using Boileau classification remains low.

EP.07.033

TWO YEAR CLINICAL OUTCOMES OF CHRONIC ACROMIOCLAVICULAR JOINT RECONSTRUCTION USING A SYNTHETIC LIGAMENT AND MODIFIED WEAVER DUNN TECHNIQUE

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Background: This prospective study presents 2-year results of reconstruction for chronic acromioclavicular joint (ACJ) dislocations. It is the only series known to compare pre and post operative clinical outcomes.

Methods: The Lockdown (LockDown Medical Limited, Worcestershire, UK) is a synthetic ligament which was positioned to replicate the axis of the Conoid ligament. We combined this with a transfer of the bony attachment of the Coracoacromial ligament from acromion to Trapezoid tubercle on the inferior clavicle. All patients had failed non-operative management. Patient reported outcome scores (Subjective Shoulder Score (SSS), American Shoulder and Elbow Score (ASES) and Oxford Shoulder Score (OSS)) and strength testing was performed pre-operatively, 1 and 2 years after surgery.

Results: 43 patients (22-73 years, mean 31, 4 females) were reconstructed for chronic ACJ dislocation at mean 12 months (1 - 59) after injury. All patients were assessed at minimum 12 months and 27 patients completed 24-month review for an overall mean of 27 months follow up; 4 were lost (8.5%).

Average pre-op scores were: ASES 56 (19 - 90), OSS 31 (17 - 53), SSS 37% (9 - 79%)

Average 1-year scores were: ASES 86 (41 - 100), OSS 19 (12 - 44), SSS 79% (40 - 98%)

Average 2-year scores were: ASES 93 (52 - 100), OSS 16 (12 - 30), SSS 87% (50 - 100%)

Mean VAS pain was 7.3 (3 - 10) preop to 3.6 (0 - 9) at 1 year and 2.1 (0 - 7) at 2 years. Average final improvement in ASES was 37, OSS 15, SSS 50%, VAS 5.3. 79% of the final recovery was achieved in the first year. Strength improved from 77% of the contralateral side to 94% at final follow up. Complications included 2 frozen shoulders, 2 removals of construct for bone erosion (at 18 and 41 months post op) and 1 superficial infection successfully treated with oral antibiotics.

Conclusions: Results of this reconstruction for chronic ACJ dislocations appear favourable with good clinical outcomes up to 2 years. Complications were within acceptable limits. Subjective shoulder scores improved by a mean of 50%, with the majority (80%) of the total improvement seen within the first year.

EP.07.034

ASSOCIATION BETWEEN SOCIAL MEDIA ACTIVITY AND PATIENT RATINGS IN SHOULDER AND ELBOW SURGEONS: HOW MANY 'LIKES' FOR FIVE STARS?

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Background: Social media plays an important and growing role in healthcare and physician selection by facilitating direct communication, which may improve physician ratings. An important concern is whether social media presence exposes surgeons to increased online scrutiny and social risks or whether it provides an avenue for greater patient satisfaction by improving physician perception. The purpose of this paper is to investigate how social media impacts physician ratings.

Methods: The ASES Find a Physician tool was used to identify currently practicing shoulder and elbow surgeons in the United States. An original program was written in Python to search the first page of Google and identify physician pages, Healthgrades, Google reviews, and Vitals, as well as to search for the physician's name, medical degree (MD or DO), and identify the physicians' public Facebook, Twitter, and Instagram accounts in the top ten search results. Surgeons were divided into two groups: social media group (SMG) and non-social media group (NSMG). Association of social media use with physician ratings was evaluated using simple and multiple linear regression.

Results: A cohort of 385 surgeons was identified, of which 21.30% were social media users. On average, social media users were younger at 48 years old compared to nonusers at 51 years old ($p = 0.01$). There was no significant difference in other characteristics including sex ($p = 0.797$), medical degree (MD or DO) ($p = .114$), or geographic location within the US (West, Midwest, Northeast, or South) ($p = 0.49$). Being a social media user did not increase the number of website reviews ($p > 0.05$). Controlling for demographic characteristics, being a social media user increased Healthgrades ratings by 0.2 ($p < 0.01$), Vitals ratings by 0.3 ($p < 0.01$). Overall, the ratings improved by an average 0.167 across all review platforms with social media use.

Conclusions: Our results highlight the low rate of social media use among currently practicing shoulder and elbow surgeons. Being a social media user significantly increased surgeon's online ratings. Social media may improve surgeon ratings by increasing patient perception and experience. Alternatively, social media use may be indicative of certain surgeon characteristics, such as sociability, that correlate with patient satisfaction.

EP.07.035

IS CORACOCCLAVICULAR OSSIFICATION A COMPLICATION OR A GOOD PROGNOSTIC FACTOR AFTER SURGICAL TREATMENT OF ACROMIOCLAVICULAR JOINT INJURY?

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Background: The purpose of this study was to investigate whether heterotopic ossification in the coracoclavicular space after surgical treatment of acromioclavicular joint injury is a complication or a sign of good prognosis.

Methods: Fifty-nine consecutive patients who underwent coracoclavicular reconstruction with or without augmentation of the acromioclavicular joint for acute acromioclavicular joint injuries were analyzed. Postoperative American Shoulder and Elbow Surgeons (ASES) score, Constant score (CS), subjective shoulder value (SSV), and visual analog scale (VAS) results were evaluated. For radiological evaluation, heterotopic ossification was evaluated, and coracoclavicular distances were measured.

Results: Fifty-one patients (11 women and 40 men; mean age, 36 years [range, 17-68 years]) were evaluated after a mean follow-up of 3 years (range, 2-8 years). The mean ASES score at the follow-up was 82.73 (range, 51.6-100), mean CS was 85 (range, 50-100), mean SSV was 80 (range, 40-100), and mean VAS was 1.9 (range, 0-5). It was observed that the clinical outcomes (ASES, CS, SSV, VAS) of patients who developed ossification in the coracoclavicular space were better than those who did not although it was not statistically significant. No statistically significant differences were found in the clinical outcomes (ASES, CS, SSV, VAS) between patients who underwent coracoclavicular reconstruction without augmentation of the acromioclavicular joint and those who were combined ($P > .05$).

Conclusions: Heterotopic ossification in the coracoclavicular space is a common finding following acromioclavicular joint fixation injury. We suggest that heterotopic ossification is not a complication and might possibly have positive effects on clinical outcomes.

EP.07.036

OUTCOMES AFTER SHOULDER ARTHROPLASTY IN UNCOMMON AND LOW FREQUENCY DIAGNOSES – AN ANALYSIS OF THE SWEDISH SHOULDER ARTHROPLASTY REGISTRY

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Background: The incidence of and indications for shoulder arthroplasty has increased and the increase is expected to continue. The Swedish Shoulder Arthroplasty Registry (SSAR) has collected data on arthroplasties since 1999, including data on uncommon diagnoses such as malignancies, chronic dislocations and diverse degenerative causes. Results after arthroplasty in low frequency indications have not yet been assessed from the registry, why an analysis of these diagnoses would be of value. Our aim was to analyze patient reported outcomes after primary shoulder replacement for uncommon diagnoses as indication for arthroplasty. Secondly, to analyze implant survival for uncommon diagnoses.

Methods: A registry study was based on data from the SSAR containing above 25,000 cases, where 600 patients with diagnoses qualified as uncommon were included for analysis of patient related outcome, represented by WOOS score (evaluation of quality of life) and satisfaction level (satisfied vs. dissatisfied). As reference diagnoses for comparison, proximal humerus fracture was used for the more acute cases and osteoarthritis for the elective.

Results: No significant difference in patient reported outcome was seen between uncommon acute diagnoses and the reference fracture. WOOS score was higher, i.e., the outcome was better, for the reference osteoarthritis than for uncommon diagnoses (95% CI [3.97 - 10.63]). Satisfaction was higher for the reference osteoarthritis than for uncommon diagnoses as indication ($p=0.003$). Revisions were overall uncommon and there was no difference in revision rate between uncommon and common diagnoses, neither acute ($p=0.09$) nor elective ($p=0.94$).

Conclusions: Outcomes for elective cases were worse if the indication for surgery is an uncommon diagnosis compared to the reference of osteoarthritis. For uncommon acute diagnoses there was no difference in outcome, compared to the reference acute fracture. Revision rates were not different between uncommon and common diagnoses.

EP.07.037

SCAPULAR DYSKINESIS AFTER TREATMENT OF PROXIMAL HUMERUS FRACTURE, A THREE-DIMENSIONAL MOTION ANALYSIS (3-DMA) AND CLINICAL OUTCOMES

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Background: The alteration of scapular kinematics can predispose patients to shoulder pathologies and dysfunction. Previous literature has associated various types of shoulder injuries with scapular dyskinesia, but studies are limited regarding the effect that proximal humeral fractures (PHF) have on scapular dyskinesia. This study aims to determine the change in scapulohumeral rhythm following treatment of a proximal humerus fracture and differences in shoulder motion and functional outcomes among patients who presented with or without scapular dyskinesia. We hypothesized that differences in scapular kinematics would be present following treatment of a proximal humerus fracture, and patients who presented with scapular dyskinesia would have inferior functional outcome scores.

Methods: Patients who were treated for a proximal humerus fracture from May 2018 to March 2021 were recruited for this study. The scapulohumeral rhythm and global shoulder motion were determined using a three-dimensional motion analysis (3DMA) and the scapular dyskinesia test. Functional outcomes that were compared among patients with or without scapular dyskinesia included the SICK (scapular malposition, inferomedial border prominence, coracoid pain and malposition, and dyskinesia of scapular movement) Scapula Rating Scale; the ASES (American Shoulder and Elbow Surgeons Shoulder Score); the VAS (visual analog scales) for pain and the 5-level EQ-5D version (EQ-5D-5L).

Results: Twenty patients were included in this study with the mean age of 62.9 ± 11.8 years and follow-up time of 1.8 ± 0.2 years. Surgical fixation was performed in 9 patients (45%). Scapular dyskinesia was present in 50% of patients ($n = 10$). There was a significant increase in scapular protraction on the affected side of patients with scapular dyskinesia during abduction of the shoulder ($p=0.037$). Additionally, patients with scapular dyskinesia demonstrated inferior SICK scapula scores (2.4 ± 0.5 vs. 1.0 ± 0.4 , $p=0.024$) compared to those without scapular dyskinesia. The other functional outcome scores (ASES, VAS pain scores, and EQ-5D-5L) showed no significant differences among the two groups ($p=0.848$, 0.713 and 0.268 respectively).

Conclusions: Scapular dyskinesia affects a significant number of patients following treatment of their PHFs. Patients presenting with scapular dyskinesia exhibit inferior SICK scapula scores and have more scapular protraction during shoulder abduction compared to patients without scapular dyskinesia.

EP.07.038

IMPACT OF SURGICAL DELAYS DURING A WORLDWIDE PANDEMIC FOR PATIENTS AWAITING SHOULDER SURGERY INCLUDED IN A PREVIOUS CLINICAL TRIAL DATABASE

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Background: The aim of this study is to compare quality of life questionnaire in patients on surgical waitlists for either shoulder arthroplasty or an instability procedure, at the time of their inclusion on surgical list and two years after the beginning of the COVID pandemic. The hypothesis is that functional scores will be significantly worse at follow up.

Methods: Patients were recruited from pre-existing on-going clinical trial databases in a single-center setting and had completed baseline quality of life questionnaire upon enrollment (WOSI, WOOS). They underwent telephone interviews at a minimum of 1 year after enrollment.

Our power study showed that 18 patients would be needed to produce conclusive evidence.

Results: 20 patients were enrolled. 12 patients (mean age 68.7 years old) were on the waitlist for an elective shoulder arthroplasty (reversed of anatomical) for an average of 490.29 days (range 191-924). 8 patients (mean age 38.5 years old) awaited a procedure for shoulder instability, and the average surgical delay was 697.75 (range 343-441).

In patients waiting for a shoulder arthroplasty, comparing mean WOOS scores showed that patients had significantly higher scores at follow up ($p=0.04$). The most significant difference was in the sports, leisure and work component of the questionnaire ($p=0.001$).

In patients waiting for a shoulder instability procedure, comparing mean WOSI scores showed that patients had significantly lesser scores at follow-up ($p=0.042$), regardless of surgical delays. Patients scored significantly better in the questionnaire section regarding their physical symptoms ($p=0.027$) and emotional concerns ($p=0.09$).

Conclusions: Results show that patients waiting for a shoulder arthroplasty score significantly worse in terms of pain and functional abilities on follow-up questionnaire. This is mainly reflected by a deterioration of their activities of daily living, work and leisure.

Patients waiting for an elective shoulder instability procedure tend to score better at follow up. The given hypotheses are that with the pandemic lock down and patients mostly working from home, patients were involved in fewer activities and leisure putting them at risk of shoulder dislocation.

The future goal of this study will be to identify variables that may contribute to a more rapid deterioration of functional impairment and pain.

EP.07.039

THE WALCH B0 SHOULDER SURVEY-BOSS: WHAT IS THE CURRENT UNDERSTANDING?

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Background: The Walch B0 shoulder is controversial with limited research or literature currently available. We present the results of an international survey of shoulder surgeons to assess the understanding of pathoanatomy, diagnostic assessment and treatment strategies.

Methods: A web-based survey was sent to expert members of SECEC and ASES, reflecting broad experience from both Europe and North America. Respondents were asked about their understanding of, diagnostic methods, examination findings and management for this condition.

Results: 151 responses were analysed. The large variation in responses reflects the uncertainties of this condition and its management. There was heterogeneity about all factors, such as aetiology, diagnostic measurements and even more so about treatment strategies. Whilst most agreed on the pathogenesis of posterior subluxation (80%), which is initially dynamic then evolves into static (62%) and about glenoid retroversion measured by Friedman's line method (72%) but the measurement of humeral head subluxation had only 41% agreement (Scapulohumeral index). The responses to aetiology were far-ranging with the most common: increased glenoid retroversion (59%), capsular imbalance (56%) and abnormal scapula positioning (47%). Most expected negative posterior apprehension test with pain (68%) and some limitation in movement (53%) as common clinical findings.

Surgical options were offered in four different case examples after failure of non-operative management. Subluxation only was treated with capsular rebalancing or posterior bone block procedures unless associated labral tears occurred then posterior labral repair was the commonest option (62%). Increased glenoid retroversion was treated with corrective posterior glenoid osteotomy (21%) or posterior glenoid augmentation +/- correction (30%) unless associated posterior labral tears as posterior labral repair became again the commonest procedure (29%).

Conclusions: The results of this survey demonstrate the paucity of data and variety in diagnosis and management of Walch B0 shoulders and encourage further research about diagnostic and treatment strategies.

EP.07.041

CONCORDANCE OF SHOULDER SYMPTOMS AND IMAGING FINDINGS - A PROTOCOL FOR THE FINNISH IMAGING OF SHOULDER (FIMAGE) STUDY

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Background: Shoulder pain is a substantial medical and socioeconomic problem in most societies, affecting the ability to work or carry out leisure time activities as well as subsequently influencing physical and psychological well-being. According to a recent nation-wide survey in Finland, approximately 25% of the population reported shoulder pain within the last 30 days. In clinical practice, imaging findings of structural abnormalities are typically thought to explain symptoms, even though such findings are also prevalent in asymptomatic individuals, particularly with increasing age. Overall, there is a paucity of high-quality evidence on the prevalence, clinical relevance and prognosis of "abnormal" imaging findings of the shoulder.

The aim of the Finnish imaging of shoulder study (FIMAGE) is four-fold: To determine (1) the prevalence of the most common anatomical variants and "abnormal" structural findings in shoulder imaging (PREVALENCE); (2) the association between self-reported shoulder symptoms, findings in clinical examination, and "abnormal" imaging findings (CONCORDANCE); (3) the most important determinants of self-reported shoulder symptoms, and findings deemed "abnormal" in clinical examination and imaging (DETERMINANTS); and (4) the natural course of shoulder symptoms and imaging abnormalities by carrying out a 5-year follow-up of our participants (LONGITUDINAL).

Methods: The FIMAGE target population of 600 participants, aged 40 to 75, will be randomly selected from a nationally representative general population sample of 9,922 individuals originally recruited for the Finnish Health 2000 Survey. Upon giving informed consent, the participants will be invited to a clinical visit that includes assessment of general health and shoulder-specific functions, a bilateral physical shoulder examination, and imaging with plain radiography and magnetic resonance imaging.

Results: The FIMAGE study will offer novel data on the epidemiology of shoulder disorders in the population, symptom severity, and their impact on quality of life and work productivity. Implementing bilateral shoulder imaging will be essential to resolve longstanding questions regarding the association between findings on MRI scans and symptoms in people with shoulder problems, in order to clarify the role of imaging in patients with shoulder pain, aiming to prevent over-diagnosis and overtreatment.

Conclusions: This is a study protocol for an upcoming study.

EP.07.042

PREVALENCE OF SHOULDER INJURY RELATED TO VACCINE ADMINISTRATION AFTER COVID-19 VACCINATION IN HOSPITAL WORKERS

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Background: Shoulder Injury Related to Vaccine Administration (SIRVA) is an uncommon disorder consisting of lasting shoulder pain with a limited range of motion (ROM) occurring within 48 hours after vaccine administration. SIRVA likely occurs when the vaccine is administered too high or too deep, causing an inflammatory reaction. The prevalence of SIRVA is still unknown. The COVID-19 vaccine has been extensively administered worldwide. The objective of this study was to describe the prevalence of SIRVA after administration of the COVID-19 booster vaccine in hospital workers in the Netherlands.

Methods: A questionnaire was sent to all hospital workers from a single non-academic hospital in the Netherlands. Respondents who had active SIRVA complaints were invited for an outpatient orthopedic clinic appointment. Data was collected on participant characteristics, physical examination including inspection, active and passive ROM. An ultrasound was performed to screen for abnormalities.

Results: 32 out of 981 respondents had shoulder pain with limited ROM occurring within 48 hours after vaccine administration with complaints lasting at least 7 days. This results in a prevalence of 3.3% of people suffering from SIRVA. Of these 32 people with SIRVA seventeen still had active symptoms. Clinical examination of 13 patients with active SIRVA complaints resulted in nine patients being diagnosed with subacromial bursitis, one partial thickness supraspinatus tear, one patient with tendinitis of the long head of the biceps tendon, one patient with capsulitis and one without a specific diagnosis. Physiotherapy was the most common treatment modality for persistent SIRVA complaints.

Conclusions: The prevalence of SIRVA is estimated at 3% in the adult population. Sign and symptoms of SIRVA are variable in severity, localization and timing. SIRVA does not require medical treatment in most cases. However, early recognition and treatment are imperative for prevention of long lasting and severe shoulder pathology. With this study we want to create awareness on the existence and presentation of SIRVA, to aid in early diagnosis and treatment.

EP.07.043

CORACOCLAVICULAR AUGMENTATION IN HOOK PLATE FIXATION OF ACROMIOCLAVICULAR DISLOCATIONS – A SYSTEMATIC REVIEW AND META-ANALYSIS

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Background: Acromioclavicular joint (ACJ) injuries of the shoulder are very common. Hook plate fixation is one of many options to address high-grade (Rockwood III-VI) ACJ dislocations. While it remains one of the most utilised surgical techniques, concerns about subacromial osteolysis and loss of reduction are some limitations to its widespread use. The role of additional coracoclavicular (CC) ligament augmentation in these injuries has been increasingly studied. A systematic review and meta-analysis were performed to determine whether additional CC ligament augmentation (CA) showed any difference to post-operative radiological or functional outcomes in hook plate fixation of high-grade ACJ dislocations compared to no augmentation (NA).

Methods: A systematic search of literature in the databases was performed for randomised and non-randomised controlled trials. All studies published in English were included. Quality of studies were assessed. Relative risk (RR) was used for dichotomous outcomes, while mean difference (MD) was used for continuous variables, with 95% confidence intervals. Alpha was set to 0.05.

Results: A total of five studies with 473 patients were included. There was no statistically significant difference for mean post-operative coracoclavicular distance between the CA and NA groups when compared to the uninjured side or as a gross distance (MD -9.35, 95% CI: -19.09 - 0.38, $p = 0.06$ and MD -1.42, 95% CI: -5.15 - 2.31, $p = 0.46$ respectively) while a statistically significant difference was found for subacromial osteolysis in favour of the CA group (RR 0.46, 95% CI: 0.23 - 0.90, $p = 0.02$). No statistically significant difference was identified for various functional scores ($p > 0.05$).

Conclusions: In conclusion, during hook plate fixation of high-grade (Rockwood III-VI) acromioclavicular joint (ACJ) dislocations, the addition of coracoclavicular ligament augmentation (CA) appears to significantly reduce the risk of subacromial osteolysis without any difference to rates of subluxation. While there was a trend towards a reduced loss of reduction in the CA group, ultimately higher quality randomised trials are required. Despite the radiological benefits, the routine application of CA does not appear to affect functional scores and should not be applied routinely.

EP.07.044

ROLE OF SHOULDER ARTHROSCOPY IN OBPP

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Background: Latissimus dorsi (LD) and teres major (TM) tendon transfers are effective surgical procedures to improve shoulder abduction and external rotation for children with obstetrical brachial plexus palsy (OBPP). Open Z-plasty and arthroscopic subscapularis (SS) release are 2 options for the release of internal rotation contractures to enhance muscle transfers. This study aimed at showing technical hints and functional outcome of arthroscopic anterior shoulder release.

Methods: The study included 10 patients who underwent arthroscopic anterior shoulder release, with a mean follow-up of 18 months. Functional evaluation was made according to range of motion and Mallet scoring system.

Results: The study included 10 patients who underwent arthroscopic anterior shoulder release, with a mean follow-up of 18 months. Functional evaluation was made according to range of motion and Mallet scoring system.

Conclusions: Arthroscopic anterior shoulder release of the internal rotation contracture yielded good clinical and functional results in patients younger than age 7. Arthroscopic anterior shoulder release, although requiring an experienced surgeon, revealed better clinical and functional outcomes and is considered to be a less invasive and superior method.

EP.07.045

INTRAOSEOUS MIGRATION OF ROTATOR CUFF CALCIFICATIONS

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Background: Rotator cuff calcium hydroxyapatite crystal deposition is a common disorder. Rarely, however the calcification can extend into the epiphyseal region causing subcortical calcium migration and even extensive intramedullary calcium propagation. In some cases, the patients suffer intense pain and the images can be confused with infectious or tumor lesions. The aim of this study is to evaluate the incidence of intraosseous migration in cases of rotator cuff tendinopathy and to describe the types of injuries.

Methods: In a retrospective study of a consecutive series of 100 cases of rotator cuff calcifications, an analysis of the images (X-rays, and MRI or CT-scan when was considered necessary) was carried out by two specialists in shoulder surgery. Lesions were classified into three types:

a-cortical erosion,

b-intraosseous migration, and

c-progression to the medullary canal of the humerus.

Results: In 81 cases there was not bone compromise and in 19 cases bone progression was found. In this last group, 12 patients presented bone erosion, 6 intraosseous migration, and in one case there was progression to the intramedullary canal. In the complete series of rotator cuff calcifications, 54.4% were women, but in cases associated to bone lesion the percentage rose to 83%.

MRI showed a pronounced edema in the neighboring soft tissue and in bone marrow in the acute phase. We have found a frequent image (71.4%) in both magnetic resonance and computed tomography that we have called the "hourglass sign". It is a demonstration of the presence of calcium on both sides of the bone cortex.

These erosive lesions showing soft tissue and bone marrow edema, frequently associated with severe pain, can be easily mistaken for osteitis or aggressive neoplastic lesions. In fact in 3 of the 7 cases with bone progression, biopsy was initially indicated.

The higher frequency of this lesion in women could be related to lower bone density.

CT was an optimum modality to depict the continuity between the subcortical and tendinous calcifications (hourglass sign).

Conclusions: Intraosseous loculation is a rare phenomenon. Recognition of these atypical presentations may prevent an unnecessary biopsy and overtreatment as it can mimic infection or tumor lesions.

EP.07.049

THE POSTERIOR APPROACH CAUSES MUCH PAIN IN SHOULDER ARTHROGRAPHY THAN THE ANTERIOR TRANS-ROTATOR INTERVAL APPROACH: PROSPECTIVE RANDOMIZED CLINICAL TRIAL

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Background: Both anterior and posterior approaches are commonly used for the glenohumeral joint injection and arthrography. But there are no study about comparing of the post-injection pain between two injection methods.

Methods: 68 patients scheduled to take magnetic resonance arthrography (MRA) were randomly allocated into two groups depending on injection method; Group 1: blind anterior trans-rotator interval approach, n=34, Group 2: ultrasound-guided posterior approach, n=34. The patients in both groups received a mixed solution of 1mL of dotarem and 15mL of normal saline just before taking MRA. Visual analog scale (VAS) pain scores were evaluated for the first post-injection 24 hours. And the accuracy of arthrography was evaluated through the finding of MRA.

Results: At the time of injection and 30 minutes after injection, VAS scores in the group 1 were significantly lower than in the group 2 ($P < .05$). From 1 hour to 24 hours after the injection, there was no significant difference in VAS scores between the 2 groups ($P > .05$). The failure rate of arthrography showed no significant difference between two groups. (Group 1: 5.5%, Group 2: 8.8%, $P = 0.642$)

Conclusions: The anterior trans-rotator interval approach causes less pain in shoulder arthrography than the posterior approach from the time of injection to 30 minutes after injection. The blind anterior trans-rotator interval approach provides as high accuracy as the ultrasound-guided posterior approach in shoulder arthrography.

EP.07.050

POOR CLINICAL OUTCOMES AFTER TREATING SEIZURE-RELATED SHOULDER INJURIES

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Background: Treating seizure-related shoulder injuries is challenging and an evidence-based consensus to guide clinicians is lacking. The primary aim of this monocentric prospective observational clinical trial on a historical cohort was to evaluate the clinical results of patients who suffered seizure-related shoulder injuries at a minimum follow-up of one year; in particular, we hypothesized that patients suffering a shoulder fracture-dislocation, would report worse clinical results in terms of the quick Disabilities of the Arm, Shoulder and Hand questionnaire (qDASH) as compared to the other patients.

Methods: Patients referred to a tertiary epilepsy centre suffering from seizure-related shoulder injuries and with a minimum follow-up of one year were included. A quality-of-life assessment instrument (EQ-5D-5L), a district-specific patient reported outcome measure (qDASH) and a pain assessment tool (Visual Analogue Scale, VAS) were used for the clinical outcome evaluation. The differences between groups were evaluated with unpaired Student's t-test, Mann-Whitney, one-way analysis of variance or Kruskal-Wallis test.

Results: Sixty-four patients were included. After a median follow-up of 4.9 years, the mean EQ-5D-5L index value was 0.76 ± 0.22 . Mean qDASH was 32.81 ± 24.64 points, with 27.4% of the patients scoring < 15 points (no problems), and 35.5% of the patients > 40 points (severe disability); mean VAS was 23.38 ± 37.20 mm, with 30.0% of the patients scoring > 35 mm (moderate to severe pain). In the subgroup of patients suffering combined shoulder-dislocations, the percentage of patients with VAS > 35 mm and qDASH > 40 points rose to 38.5% and 46.2%, respectively, with only 23.1% of patients scoring < 15 points in the qDASH. 40.6 % of the patients considered themselves unsatisfied with the treatment. It was not possible to identify a specific lesion or treatment type associated with significantly superior or inferior clinical results.

Conclusions: Patients suffering from seizure-related shoulder injuries reported only moderate clinical results at their mid-term follow-up; these results are substantially inferior to those reported in high-quality trials not restricted to patients with seizures. This warrants special care and appropriate counselling when treating patients with seizure-related shoulder injuries.

EP.07.051

DETECTION OF CUTIBACTERIUM ACNES IN TISSUE SAMPLES FROM CLEAN PRIMARY SHOULDER SURGERIES

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Background: Infection is one of the most feared complications related to orthopedic surgeries, due to morbidity and high treatment costs. The infection rate of a shoulder arthroplasty can reach up to 15%; in arthroscopies, 3.4% and, in open surgeries, 1.9%. *Cutibacterium acnes*, a gram-positive, slow-growing anaerobic bacterial germ, plays a special role in this scenario, being isolated in up to 41.8% of primary shoulder surgeries in patients with no previous symptoms of infection. The objective is to identify infectious agents, including *C. acnes*, using two culture methods, in deep tissue samples collected in clean shoulder surgeries in patients with no clinical history of infection.

Methods: In a first group of patients, tendon, bursa and bone samples were collected intraoperatively, stored in dry sterile flasks and sent for culture growth analysis in media for aerobic and anaerobic agents in the laboratory accredited to the hospital. 141 samples from 47 shoulders were analyzed. In a second group (84 patients), the results of cultures of intraoperative deep tissue samples were analyzed. This time, tubes containing culture medium were used for storage and transport of anaerobic agents, prolonged incubation time and mass spectrometer for diagnosis of bacterial agents.

Results: Of the 47 shoulders, we obtained negative culture results in 46 cases (97.8%) and in 140 samples (99.2%). Only one patient had a positive result, with growth of *Staphylococcus hominis*. Of the 84 patients in the second group, bacterial growth was seen in 34 patients (40.4%) of which 23 had *C. acnes* (27.3%) and 6 cases had *Staphylococcus epidermidis* (7.2%). We evidenced a greater relation between the positivity of samples and the male gender, a lower mean age, the absence of diabetes mellitus, the ASA I score and antibiotic prophylaxis during anesthetic induction with cefuroxime.

Conclusions: Regarding the first method, we did not show bacterial growth rates consistent with the international literature, warning of the low effectiveness of the laboratory methods used in our country. Regarding the second method, there was a high percentage of bacterial growth with the identification of *C. acnes* in 27.3% and *Staphylococcus epidermidis* in 7.2%.

EP.07.052

BIDIRECTIONAL ARTHROSCOPIC-ASSISTED STABILIZATION OF ACUTE HIGH-GRADE ACROMIOCLAVICULAR JOINT DISLOCATION - SINGLE LOW-PROFILE SUTURE BUTTON VS. DOUBLE SUTURE BUTTON

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Background: The optimal stabilization procedure for acute high-grade AC joint dislocations should be constantly improved. The study objective was to compare the two-year clinical and radiological outcomes of an arthroscopic-assisted bidirectional stabilization procedure for patients with acute high-grade AC joint dislocation with a single low-profile (LPSB) or double suture button (DSB) procedure and additional percutaneous AC cerclage fixation. The hypothesis was that the LPSB technique would show equivalent clinical and radiological outcome to the DSB procedure with less discomfort attributed to the implant and a shorter duration of surgery.

Methods: This retrospective cohort study is to compare male patients aged between 18 and 55 years with acute (< 3 weeks after reported trauma) high-grade AC joint dislocation, according to Rockwood type V, fixed with either LPSB or DSB technique. All patients were examined 24 months post-surgery. Subjective Shoulder Value (SSV), Taft (TF) and Acromioclavicular Joint Instability scores (ACJI) were evaluated. Coracoclavicular difference, ossification status, osteoarthritic AC joint conditions and dynamic posterior translation (DPT) were assessed on bilateral anteroposterior stress radiographs and modified Alexander views. The revision rate due to implant irritation and the duration of surgery were reported.

Results: There were 28 eligible patients per cohort. The average age was 39.2 (LPSB) and 36.4 years (DSB). The mean follow-up was 30.5 (LPSB) and 37.4 months (DSB). While TF and ACJI were similar between groups, LPSB patients did rate a significantly higher mean SSV (93.2%) compared to DSB patients (81.9%) ($p=0.004$). Mean coracoclavicular difference decreased from 12 mm to 3 mm for both cohorts ($p<0.001$). Ossification was detected in over 85% LPSB and DSB patients ($p=0.669$), osteoarthritis in 14.3% (LPSB) and 39.3% (DSB, $p=0.329$). Persistent DPT was found in around 30% for both groups ($p=0.773$). The revision rates were 0% (LPSB) and 7% (DSB) ($p=0.491$). LPSB surgery was shorter (59.7 vs. 71.5 mins [DSB]) ($p<0.009$).

Conclusions: Bidirectional arthroscopic-assisted LPSB or DSB stabilization of acute high-grade AC joint dislocation is associated with excellent clinical and satisfactory radiological outcomes. The LPSB technique offers higher patient-reported shoulder satisfaction without postoperative revision events and a shorter procedure over DSB.

EP.07.054

A CASE OF BILATERAL ELASTOFIBROMA DORSI TREATED SURGICALLY

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Background: Elastofibroma dorsi is an uncommon benign soft tissue tumor which most commonly occurs in the infrascapular region of elderly patients.

This patient was a 70-year-old female with discomfort and painful dyskinesia in both scapulae due to bilateral dorsi elastofibroma.

Methods: Due to the pain presented by the patient, the option was for surgical treatment for tumor resection. Initially, the tumor on the right side was resected, and after 3 months, the left side was operated on.

Results: The patient evolved with recovery of harmonious scapulothoracic movement without bumps or discomfort.

Conclusions: Surgical treatment of elastofibroma dorsi is indicated when there is painful discomfort or motor limitation, and the postoperative result is usually good.

EP.07.056

THE EVOLUTION OF THE CORACOID IN PRIMATES, AND WHY THE CHIMPANZEE DOESN'T FIT IN

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Background: The evolution of man from a last common ancestor (LCA) has been a matter of significant controversy amongst evolutionary biologists. Phylogenetic changes include scapula-glenoid angle to a more horizontal pattern as a result of changing from brachiating as part of arboreal locomotion (tree swinging) to walking and knuckle-walking (terrestrial locomotion), the position of the scapula on the chest wall to open the shoulder out, and changes in humeral version. Current literature suggests that the Pan genus (chimpanzees) were closest in anatomy and function to Homo, and that the LCA is closer to chimpanzees than to other primates.

Methods: I examined 239 skeletal remains of primate scapulae at the Smithsonian Institute and the Harvard Museum of Comparative Zoology. Coracoids were measured for thickness and width (and proportion), and length of the coracoid. The coverage of the bony arch including the acromion and the coracoid was measured in degrees and the position of the coracoid in relation to the mid-point of the glenoid cavity.

Results: The coracoids of all Hylobates measured together demonstrated a 37% thickness to width ratio (thin), compared to 56% for Pongo, 48% for Gorillas, and 43% for Pan. The Homo average is 68%. The arch diameter was similar for all primates, but rotated to the posterior for Homo and Pongo and anterior for Pan and Hylobates.

Conclusions: This study demonstrates that the Pan-cestor LCA origin is NOT the most suitable pathway that follows in the evolution to Homo, and that the "complex mosaic" theory is a more suitable explanation of the evolutionary process. The only possible way the Pan theory exist on this data is that there is homoplasy following coracoid evolution that in itself is divergent to start and then convergent before or at the LCA position.

EP.07.057

SIMPLE METHOD TO MEASURE GLENOID INCLINATION ON PLAIN X-RAY OF THE SHOULDER

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Background: Glenoid inclination has been measured by many different methods. Accurate evaluation of glenoid inclination is important to avoid superior tilt of the glenoid implant in reverse total shoulder arthroplasty. The aim of this study was to evaluate a new radiographic parameter for glenoid inclination which can be easily recognized in plain radiographs.

Methods: Glenoid anterior-posterior(AP) radiographs of 200 shoulders(100 men and 100 women) from hand & upper extremity center at our hospital. Three angles (A, B, C) were calculated for each shoulder. Angle A is composed line 1 (connecting the superior-most point and the inferior-most point on the glenoid rim) and the floor of supraspinatus fossa. Angle B is composed line 1 and line 2 (cortical border of the medial margin of the scapular). Angle C composed line 1 and line 3(connecting the inferior-most point on glenoid rim and the point which the floor of the supraspinatus fossa meets the lateral base of coracoid process). Each angle was measured 2 times by 2 independent observers.

Results: There was no significant difference in intra- and inter-observer reliability between the angle A, B and C. Angle A and angle B values were relatively in consistent tendency. Each angle was form a regular distribution. There was no significant difference related age, gender, the direction of the shoulders.

Conclusions: Angle A by Maurer et al. has been known as reliable parameter in glenoid inclination. Angle B & C also showed good reliability comparable to Angle A and could be used as new parameters of glenoid inclination.

EP.07.058

THE INCIDENCE OF ADHESIVE CAPSULITIS AND COVID-19 PANDEMIC EFFECT

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Background: COVID-19 pandemic had physiological and psychological effects, there is no research aimed at understanding if the pandemic has had an impact on the incidence Adhesive capsulitis .

Methods: all referrals for new shoulder problem from March 2020 to March 2021 , the pandemic period and from March 2019 to March 2020 , the control period, before COVID-19 discovered in the KSA, were manually reviewed through electronic medical records. All patients aged 18 years or older with a first time referral for a new shoulder problem within these 2 specified periods and who are diagnosed with and MRI proved idiopathic adhesive capsulitis were included. Diagnosis of adhesive capsulitis was based on history of pain and loss of range of motion , clinical examination of loss of both active and passive range of motion , plain radiographs that excluded glenohumeral arthritis and MRI findings of adhesive capsulitis.

Results: A total of 142 patients were included, 73 out of 1148 patients (6.3%) before covid-19 pandemic and 69 out of 704 patients (9.8%) after the pandemic (P=.086). Exact of 42 (57.5%) of the patients before the pandemic were females compared to 34 (49.3%) after the pandemic with no statistically significant difference (P=.214). The mean age of cases before the pandemic was 54.5 ± 9.3 years versus 52.9 ± 9.8 after the pandemic (P=.492). A total of adhesive capsulitis cases was on the right side among 32 (43.8%) of cases before the covid-19 pandemic compared to 28 (40.6%) after the pandemic (P=.541). Exact of 43 (58.9%) cases before the pandemic were diabetic versus 37 (53.6%) after the pandemic (P=.449). Additionally, 8 cases (11%) before the pandemic complained of thyroid disorders in comparison to 9 (13%) after the pandemic (P=.619). As for other risk factors, 20 (27.4%) of cases before the pandemic had HTN compared to 10 (14.5%) after the pandemic, while 47 (64.4%) had no other co-morbidities before the pandemic versus 51 (73.9%) after the pandemic (P=.109).

Conclusions: During the COVID-19 pandemic, there was an increase of 3.5% in the incidence of FS presenting to our practice. No significant difference in response to treatment was observed.

EP.07.059

EFFECT OF SUBSTANCE P & CALCITONIN GENE-RELATED PEPTIDE ON SHOULDER JOINT OF RAT

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Background: Adhesive capsulitis of the shoulder is a common pathology. However, biologic etiology of adhesive capsulitis is undetermined. In the present study, we explored the effect of substance P (SP) and calcitonin gene-related peptide (CGRP) on shoulder joint of rat.

Methods: This is an experiment animal study using 80 shoulders of 40 mature rats. Twenty rats constituted SP group, and 20 rats did CGRP group. For 80 shoulders, the range of motion (ROM) was measured with a customized tool using fluoroscopy. After that, SP and CGRP were injected into the right shoulder of the SP group and the CGRP group, respectively, using fluoroscopy. Two weeks after injection, the ROM was re-measured for 80 shoulders. Then, all rats were sacrificed and histologic analysis was performed. Immunohistochemistry and optical density score (ODS) was used to quantify the expression of SP and CGRP in the shoulder capsule.

Results: For the right shoulder of SP group, the ROM after injection was significantly lower than the ROM before injection ($87.3 \pm 8.7^\circ$ vs. $100.0 \pm 8.4^\circ$, $p < 0.001$). Also, for the left shoulder of SP group, the ROM after injection was significantly lower than the ROM before injection ($94.6 \pm 13.7^\circ$ vs. $102.6 \pm 9.8^\circ$, $p = 0.034$). For the right shoulder of CGRP group, the ROM after injection was significantly lower than the ROM before injection ($85.1 \pm 12.6^\circ$ vs. $99.9 \pm 9.9^\circ$, $p < 0.001$). However, for the left shoulder of CGRP group, the ROM after injection and before injection showed no significant difference ($96.7 \pm 8.1^\circ$ vs. $102.7 \pm 13.6^\circ$, $p = 0.084$). In the case of immunohistochemistry ODS, SP expression in the right shoulder of SP group was significantly higher than the left shoulder (1.139 vs. 1.095, $p=0.005$). However, there was no significant difference in CGRP expression in both shoulders of CGRP group (1.125 vs. 1.107, $p=0.321$).

Conclusions: The injection of SP and CGRP into the shoulder joint of the rat causes adhesive capsulitis. Local injection of the SP may have caused a systemic effect in the rat. Further study is needed to verify the role of SP and CGRP in developing adhesive capsulitis.

EP.07.060

AN UNUSUAL CASE OF ANTEROINFERIOR PARALABRAL CYST WITH AXILLARY NERVE COMPRESSION: A CASE REPORT

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Background: Paralabral cysts of the shoulder are a rare cause of shoulder pain. Their association with neurological symptoms is uncommon. This case report presents an antero-inferior paralabral cyst in a painful atraumatic shoulder causing axillary nerve palsy.

Methods: A 59-year-old man was examined in early February 2022 complaining of numbness and progressively worsening impairment of movement of his right shoulder that began two months earlier without trauma. The patient was in good health and was not taking any regular medication. He was working as an employee of a multinational company.

The patient had restriction of overhead abduction, external rotation, and mild restriction of flexion at elbow. Wasting of deltoid muscle was noted and atrophy in the territory of the teres minor. Cervical spine examination was normal and neurological examination revealed wasting of posterior deltoid muscles and loss of sensation over lateral arm.

Magnetic resonance imaging revealed anteroinferior labral tear with large multiloculated paralabral cyst caudal to inferior glenoid rim (38x10x26 mm). The patient was diagnosed to have a compression neuropathy of axillary nerve by the large cyst, which was confirmed by nerve conduction study.

The patient was placed in lateral position under general anesthesia. With posterior portal, diagnostic arthroscopy was done. Anterosuperior and anteroinferior portals were made. Anteroinferior labral tear was confirmed. Cystic fluid was drained to achieve decompression followed by resection of cyst walls with arthroscopic shaver and the labral tear was repaired with three suture anchors .

Results: Post-operative period was uneventful. The patient reported decrease in shoulder pain shortly after the procedure. At 2 weeks postoperatively, the patient no longer had symptoms compatible with axillary nerve paresthesias, nor any type of pain. Gradually, shoulder mobilization was started. A clinical evaluation at 6 months after surgery showed complete recovery of active movements at shoulder.

Conclusions: Inferior paralabral cysts are very rare presentations with an estimated incidence of 0.6% and are usually associated with labral tears most commonly occurring in young active males.

This case report reinforces the importance of an accurate early clinical examination and MRI evaluation in patients with shoulder pain in concurrence with neurological symptoms.

EP.07.061

COMPARISON OF THE EFFECT OF ARTHROSCOPY ASSISTED CORACOCCLAVICULAR LIGAMENT RECONSTRUCTION AND MODIFIED PHEMISTER OPERATION AND HOOK PLATE IN THE TREATMENT OF ACROMIOCLAVICULAR DISLOCATION

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Background: Acromioclavicular (AC) joint dislocation is a common injury. A wide variety of surgical techniques exist. However, to our knowledge, few comprehensive comparative study has addressed the clinical & radiological outcomes and complications associated with acute AC joint injury. The aim of this study was to retrospectively evaluate the mid-term follow-up results of type V ACJ dislocations treated using these three different techniques: arthroscopy assisted coracoclavicular ligament reconstruction, Modified phemister operation and hook plate.

Methods: 68 patients with Rockwood type III to V acromioclavicular joint dislocation who underwent operation from April 2017 to March 2020 were included in the study. Among them, 21 patients were treated using arthroscopy assisted coracoclavicular ligament reconstruction method, 21 patients with modified Phemister method reinforcing the 4 strands of an Ethibond sling and 26 patients with AO hook plate. Clinical and radiologic evaluation was carried out at 2weeks, 6weeks, 3months, 6months and 12months postoperatively.

Results: These three technique proved to be reliable in creating good clinical outcome. Postoperative CCD(coracoclavicular distance) was restored more accurate after modified Phemister method and hook plate fixation. For long-term follow-up, a loss of reduction occurred in ligament reconstruction group with a trend to better anatomical reduction after hook plate fixation. Hook plate fixation technique was found to induce acromial osteolysis in nearly 15% of cases

Conclusions: The results of the study indicated that these techniques were highly effective procedures for surgical treatment of AC joint dislocations Rockwood grade V. These technique we proposed led to good mid to long-term clinical and functional results and proved to be safe, showing a low complication rate. For long-term follow-up, a loss of reduction occurred in ligament reconstruction groups with a trend to better anatomical reduction after modified phemister & hook plate fixation. Hook plate fixation is considered the higher incidence of subclinical acromial erosion with this technique.. These differences should be taken into consideration when the doctor regarding surgical treatment.

EP.07.063

RECONSTRUCTION OF CHRONIC, RETRACTED PECTORALIS MAJOR TENDON TEAR WITH ACHILLES TENDON ALLOGRAFT

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Background: Rupture of pectoralis major tendon (PMT) is an uncommon injury but its incidence has been increasing in the past 2 decades. Direct open repair is often not possible for chronic retracted tendon injuries.

Methods: In this case report, we described the use of the Achilles tendon allograft with unicortical suture buttons for the reconstruction of a chronic and retracted PMT. A 5 x 6 cm Achilles tendon allograft is whipstitched to the pectoralis major tendon with 3 No. 2 Fiberwire sutures in a horizontal Krackow fashion. Each pair of suture limbs are loaded onto a 2.9 x 10.9 mm Pec Button (Arthrex, Naples, Florida). 3 unicortical holes are drilled with a 3.2 mm bit. The buttons are inserted and the sutures are sequentially tensioned to reduce the graft to the bone. Post-operatively, the patient is placed in a sling for 4 weeks, passive range of motion is allowed with no external rotation or extension for the first 3 weeks. Gradual strengthening exercises with elastic bands are initiated after 6 weeks. [Video available]

Results: An advantage of this technique is the Achilles tendon offers larger graft sizes than hamstring grafts allowing a stronger fixation to the native musculotendinous unit. Cortical buttons are also biomechanically stronger than suture anchors and can be evaluated on post-operative Xray radiographs. The disadvantages are the added expense, limited availability, and concern for integration and infection. Preliminary outcome at 3 months post-operative showed restoration of the antero-inferior border of the axillary fold, VAS score of 2/10, SANE score of 80 and 5/5 motor strength at adduction and internal rotation.

Conclusions: The use of the Achilles tendon allograft and unicortical buttons offers a stable construct in the reconstruction of the pectoralis major tendon. Long term outcome of this technique is yet to be investigated.

EP.07.064

NON-SIMULTANEOUS ADHESIVE CAPSULITIS OF THE SHOULDERS, HIP JOINTS, AND ELBOW JOINT IN THE SAME PATIENT

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Background: Adhesive capsulitis of the shoulder is a common disease of middle-aged people. Adhesive capsulitis of the hip or elbow, on the other hand, is quite rare. We present a patient in whom all the mentioned joints were affected at different times.

Methods: Now a 59-year-old lady suffered from adhesive capsulitis of five joints during a 10-year period without any preceding provocative factor. The pain and progressive restriction of active and passive range of motion started with both her hips in 2006. Imaging and laboratory studies were normal. In MRI only a bilateral very small labral lesion was detected. Her hips recovered fully in 2 years without any treatment. In 2008 she developed severe pain and restriction of motion in her elbow joint without any injury. Again, radiology and lab were normal. Her elbow recovered fully within 3 months. In August 2011, she developed very painful adhesive capsulitis on her right shoulder. She received two intra-articular corticoid injections without any effect. The patient is HLA B-27-negative with neither diabetes nor Dupuytren`s disease. In August 2012, her left shoulder was affected similarly. The patient had found that avoiding red meat and wheat might have eased his troubles. The patient has not been diagnosed with celiac disease.

Results: Now, 10 years after the last frozen shoulder all her joints are symptomless.

Conclusions: The patient's symptoms may have been correlated to nutrition and specifically to red meat and wheat. In the peer-reviewed literature, we did not find any clear mention of the association between diet and adhesive capsulitis. This patient case reminds us, that spontaneous adhesive capsulitis is not only a disease of the shoulder joint, but can also occur in other joints.

EP.07.065

ARM POSITION DURING AXILLARY RADIOGRAPH AFFECTS HUMERAL HEAD SUBLUXATION

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Background: Humeral head subluxation on an axillary radiograph is considered to be a pathologic condition, often suggestive of subscapularis failure, instability, and capsular laxity in the setting of glenohumeral osteoarthritis. Translation of the humeral head in the transverse plane is a component of normal glenohumeral motion. The purpose of this study was to determine the effect of arm position on humeral head subluxation during an axillary shoulder radiograph.

Methods: This is a prospective study of patients presenting to a shoulder clinic. Patients with a negative subscapularis exam consisting of a normal belly press, bear hug, and lift off test, as well as a normal instability exam consisting of a negative load and shift and negative apprehension were recruited. Forty patients with a mean age of 50 ± 15 years were enrolled. Patients underwent two axillary radiographs with the arm abducted in the plane of the scapula, and with the arm abducted in the plane of the humerus. The percent of posterior humeral head subluxation was calculated and compared between the two views. This was performed by measuring the percent of the humeral head posterior to Friedman's line. Radiographs were measured by two fellowship trained shoulder and elbow surgeons.

Results: Patient diagnoses included acromioclavicular joint pathology in 8, biceps tendinitis in 7, subacromial impingement in 17, scapular dyskinesia in 2, cervical radiculopathy in 3, mild glenohumeral osteoarthritis in 2, humeral head avascular necrosis in 1. The mean posterior humeral head subluxation with the arm abduction in the plane of the scapula was 53.2% compared to 59.8% with the arm abducted in the plane of the humerus ($p < 0.001$). The maximum difference in the percent of humeral head subluxation between the two radiographs was 13.5%.

Conclusions: There is a wide range of humeral head translation that occurs in the absence of any subscapularis pathology or overt glenohumeral instability. There is significant variability in the percent of humeral head subluxation based on arm position during an axillary radiograph. Standardization of arm position during an axillary radiograph or utilization of two axillary radiographs at a single time point may provide useful dynamic clinical data to guide treatment.

EP.07.066

ABSENCE OF HARDWARE-ASSOCIATED REVISION EVENTS AND HIGH PATIENTS SATISFACTION AFTER ARTHROSCOPIC-ASSISTED LOW-PROFILE SUTURE BUTTON FIXATION FOR ACUTE HIGH-GRADE ACROMIOCLAVICULAR JOINT DISLOCATION

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Background: Discomfort, persistent pain and local hardware irritation are associated with suture button stabilization procedures for acromioclavicular joint (ACJ) dislocations. It is hypothesized that the arthroscopic-assisted bidirectional low-profile suture button (LPSB) procedure would lead to excellent clinical results with high subjective satisfaction and a low rate of discomfort, pain and local hardware irritation with no need for hardware-associated revision surgery.

Methods: This retrospective bicentric study includes patients with acute high-grade ACJ dislocation, according to Rockwood V. Exclusion criteria was previous surgery to the same shoulder. All patients underwent the same LPSB procedure with additional AC cerclage fixation. Primary outcome was the Constant Score (CS) and the Subjective Shoulder Value (SSV). Taft (TF), Acromioclavicular Joint Instability Score (ACJI) and the Visual Analogous Scale (VAS) were evaluated. Coracoclavicular (CC) difference, ossification, ACJ osteoarthritis, dynamic posterior translation (DPT) and superior button migration were assessed on bilateral a.p. stress- and modified Alexander views. The revision rate and duration of surgery were reported.

Results: 47 patients (97.9% male) with a mean age of 41.5 ± 9.8 years were eligible for the analysis. The dominant hand was affected in 68.1% and 17.0% suffered a concomitant glenohumeral injury. Mean time to surgery was 8.8 ± 4.0 days. After 33.0 ± 8.8 months the CS was 89.8 ± 8.4 , SSV: 90.5 ± 13.2 , TF: 9.9 ± 2.0 , ACJI: 78.1 ± 16.7 and VAS: 1.1 ± 2.0 . The CC difference significantly decreased from pre- to postoperative (11.6 ± 3.2 mm to 2.2 ± 3.1 mm; $p < 0.001$). One case was again classified as Rockwood V. Ossification was visible in 87.2% (42.6% milde), ACJ osteoarthritis in 29.8% and persistent DPT in 38.3 (10.6% complete). Intraosseous implant dislocation and hardware-associated revision were not reported; a superficial wound infection led to implant removal in one case. Surgery lasted 64.3 ± 18.7 minutes.

Conclusions: The bidirectional arthroscopic-assisted LPSB procedure for acute high-grade ACJ dislocations is associated with excellent clinical and satisfactory radiological results. Patients reported a high subjective satisfaction and showed a very low rate of discomfort and persistent pain due to the hardware without events of intraosseous implant dislocation and postoperative revision surgery associated with hardware irritation.

EP.07.067

MIXED REALITY MULTI-CAMERA SHOULDER ARTHROSCOPY

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Background: Traditional 2D arthroscopic cameras are displayed on a screen away from the surgical field, making hand-eye coordination difficult for the surgeon. In addition, different arthroscopic shoulder approaches can lead to suboptimal camera views in relation to anatomic structures. To properly evaluate different parts of the glenoid and rotator cuff tears, changing the camera viewpoint is common, but can be time-consuming and logistically challenging to achieve. This study examined using a mixed reality system to simultaneously view multiple arthroscopic camera views and patient imaging while operating.

Methods: A novel mixed-reality display system was designed, including 3D holographic models and two simultaneous arthroscopic camera views oriented in anatomical positions. A 3D shoulder bone model was obtained from the patient's 3D imaging (both CT and MRI) and uploaded to the RSQ HOLO system (RSQ Technologies, Poznan, Poland). Two arthroscopic camera outputs were connected that streamed the video feeds to a mixed-reality headset worn by the surgeon (HoloLens 2, Microsoft, Redmont, Washington). The surgeon then performed an arthroscopic rotator cuff repair while utilizing the information displayed by the mixed-reality headset.

Results: The total time to set up the mixed reality system and camera streams was 5 minutes. The latency of the live feed of the arthroscopic cameras was undetectable. During the procedure, the surgeon was able to manipulate the mixed reality objects while sterile and place the patient's 3D holographic models, the location of the arthroscopic portals, and two virtual screens of the arthroscopic camera views in the same field of view and depth of field of the patient's shoulder. The multi-camera view proved helpful in evaluating the cuff tear location and shape.

Conclusions: Multi-camera arthroscopic systems are traditionally avoided due to logistic difficulties in setup and implementation. The advantage of a mixed reality system is that the surgeon can have the patient, multiple camera views, and 3D holographic imaging in the same field of view and depth of field as his/her hands, and the use of 3D holographic models can aid in the positioning of portals and instrument during the procedure.

EP.07.068

THE EFFECT OF THE CALCIFIC DEPOSIT LOCATION IN THE COMBINED CALCIFIC TENDINITIS AND PARTIAL THICKNESS ROTATOR CUFF TEARS

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Background: A little information has been known about chronic calcific tendinitis combined with rotator cuff tears. The location between rotator cuff tear and calcific tendinitis was coincided or not. Also, chronic calcific tendinitis combined with rotator cuff tears might show different recovery and symptom resolutions depending on the coincidence of the cuff tears and calcific tendinitis. The purpose of our study was to evaluate the effect of the rotator cuff tears in the calcific tendinitis, and also to compare the clinical and radiological outcomes between the same or different locations of the chronic calcific tendinitis combined with these rotator cuff tears.

Methods: From 2010 to 2020, 54 Patients underwent arthroscopic rotator cuff repair with simultaneous calcific deposit removal. All patients were suffered from long standing chronic shoulder pain more than 6 months and we performed arthroscopic confirmation of the rotator cuff tears in these calcific tendinitis. All rotator cuff tears were partial thickness rotator cuff tears and we excluded full thickness rotator cuff tears. We divided these patients into 2 groups, in which these patients showed the same location (group 1, 27 patients) or different location (group 2, 28 patients) between the chronic calcific tendinitis and these rotator cuff tears. We compared the clinical and radiological outcomes between 2 groups at the last follow-up.

Results: Same location on the calcific tendinitis with rotator cuff tears showed similar ROM compared to the different locations at 3, 6, 9 months and 1 year follow-up. At the last follow-up, mean ASES, UCLA, SST scores and ROM showed no significant differences between 2 groups (p -value < 0.05). At 6 months and 1 year follow-up MRI showed good tendon integrity and no retear in all patients.

Conclusions: Among symptomatic chronic calcific tendinitis with rotator cuff tears, both groups all showed satisfactory clinical and radiological outcomes with significant pain relief at the last follow-up. It can be inferred that calcific material has an adverse effect on cuff healing. If pain does not improve early in patients with calcific tendinitis, additional MRI to check for cuff tears and early surgical treatment will help faster patient's recovery.

EP.07.070

VARIATIONS IN SCAPULOHUMERAL RHYTHM OF PATHOLOGIC SHOULDERS ON DYNAMIC RADIOGRAPHY: A NOVEL DIAGNOSTIC TOOL

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Background: Alterations in scapulohumeral joint kinematics occur in various shoulder pathologies. Conventional imaging provides a static assessment of soft tissue and morphologic changes. Quantifying the scapulohumeral rhythm (SHR), using Dynamic Digital Radiography (DDR) can offer clinicians a greater understanding of the pattern and extent of motion impairment as well as reliably monitor changes throughout the treatment course. The purpose of this study was to analyze the SHR of patients diagnosed with small (SRCT) and massive rotator cuff tears (MRCT), adhesive capsulitis (AC), and glenohumeral osteoarthritis (GH-OA) and compare their measurements to those of patient controls with healthy shoulders using DDR.

Methods: Shoulders were prospectively analyzed using DDR under a standardized protocol, obtaining a series of pulsed radiographs during arm abduction in normal controls and in 4 distinct shoulder pathology groups: SRCT, MRCT, AC, and GH-OA. Glenohumeral and scapulothoracic joint angles were measured at 0-30°, 30-60°, 60-90°, and maximal coronal plane humeral abduction. SHR was defined as the ratio of the change in humeral abduction over the change in scapula upward rotation during humeral abduction and was calculated within the above angle intervals.

Results: 121 shoulders were analyzed. 40 normal controls were compared to 13 SRCT, 29 MRCT, 16 AC, and 23 GH-OA. SHR during humeral abduction differed significantly in patients with MRCT (1.91 ± 0.72), AC (1.55 ± 0.37) and GH-OA (2.31 ± 1.01) compared to controls (3.39 ± 0.79). Control patients had an arc of abduction of $103.40^\circ \pm 31.97^\circ$ which was significantly larger than all other pathologies (MRCT: $75.75^\circ \pm 22.61^\circ$, SRCT: $80.93^\circ \pm 20.71^\circ$, AC: $64.49^\circ \pm 27.02^\circ$, GH-OA: $71.05^\circ \pm 34.88^\circ$) and an average scapular abduction of $32.57^\circ \pm 13.60^\circ$, which was significantly less than patients with a MRCT ($45.57^\circ \pm 10.41^\circ$) and AC ($64.49^\circ \pm 27.02^\circ$).

Conclusions: SHR remained significantly lower throughout shoulder abduction in MRCT (43.65%), AC (54.29%), and GH-OA (32.01%) compared to controls. Quantifying kinematic patterns like SHR using DDR can be implemented as a novel, safe, and cost-effective method to diagnose shoulder pathology and to monitor response to treatment.

EP.07.071

QUANTITATIVE CHANGES IN SCAPULOHUMERAL RHYTHM IN ADHESIVE CAPSULITIS A MATCHED, CONTROLLED STUDY USING DYNAMIC DIGITAL RADIOGRAPHY

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Background: Adhesive capsulitis (AC) is largely a clinical diagnosis of exclusion, often with an unnecessarily expensive work-up, delay in diagnosis and subsequent intervention. AC is characterized by a reduction in shoulder abduction range of motion, specifically a reduced contribution from the glenohumeral joint and frequently a compensatory increase from the scapulothoracic joint. The contribution of glenohumeral (GH) motion and scapulothoracic (ST) motion makes up the scapulohumeral rhythm (SHR), defined as the ratio of the change in humeral abduction over the change in scapula upward rotation during humeral abduction and is an important parameter in assessing shoulder complex kinematics. Dynamic Digital Radiography (DDR) is a novel technique which takes a series of pulsed low radiation radiographs during active range of motion, and may enable quantitative SHR analysis and assist diagnosis of AC. The purpose of this study was to compare SHR in patients with AC to normal controls throughout active ROM, using DDR.

Methods: Shoulders were prospectively analyzed using DDR under a standardized protocol, obtaining a series of pulsed radiographs during arm abduction. GH and ST motion were quantified based on DDR images taken in 0-30°, 30-60°, 60-90° of arm abduction. SHR was calculated by dividing the change in humeral abduction by the change in scapular upward rotation in each abduction interval.

Results: Forty-eight patients were included - 16 patients with AC and 32 normal controls, 2:1 matched for age and BMI. Patients with AC had significantly lower SHR (1.55 ± 0.37) compared to controls (3.47 ± 0.80 , $p < 0.001$). When analyzed across 30° intervals of humeral abduction, a statistically significant lower SHR was found at 0-30° (1.67 vs 3.97, $p < 0.001$), 30-60° (1.64 vs 3.17, $p < 0.001$) and 60-90° (1.45 vs 3.43, $p < 0.001$) in AC patients compared to controls. Inter- and intra-rater reliability for SHR measurement had an intraclass correlation of 0.866.

Conclusions: There remains a paucity of data on SHR in patients with AC, and our study uses novel dynamic radiography to demonstrate consistently lower SHR in patients with AC compared to normal controls. While AC continues to be diagnosed clinically, dynamic SHR quantification can also provide a well-defined, objective diagnosis.

EP.07.072

THE PREDICTIVE VALUE AND RELIABILITY OF ULTRASOUND-GUIDED BIOPSIES FOR DIAGNOSING PERIPROSTHETIC SHOULDER INFECTIONS

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Background: Preoperative diagnosis of periprosthetic shoulder infections (PSI) is challenging. Mini-open biopsies could be used for preoperative diagnosis, but this is costly. Ultrasound-guided biopsies (USGB) may be a more patient-friendly and less expensive alternative. The aim of this study was to determine the diagnostic value and reliability of USGB alone and in combination with polymerase chain reaction (PCR), blood and synovial markers for preoperative diagnosis of PSI in patients undergoing revision shoulder surgery.

Methods: A prospective diagnostic cohort study was performed including patients undergoing revision shoulder surgery. A blood sample was obtained to determine C-reactive protein (CRP), white blood cell count (WBC), and erythrocyte sedimentation rate (ESR). A shoulder puncture was taken preoperatively to collect synovial fluid for interleukin-6 (IL-6), calprotectin, WBC, polymorphonuclear cells determination, followed by collection of six USGB for culture and two USGB for PCR analysis. Six standard care tissue biopsies were taken during revision surgery and served as golden standard.

Sensitivity, specificity, positive predictive value (PPV; primary outcome measure), negative predictive value (NPV), and accuracy were calculated for USGB, blood and synovial markers, and combinations thereof, and were compared with the golden standard.

Results: Fifty-five patients were included from March through December 2021. Standard tissue cultures showed the presence of an infection in 24. USGB showed an infection in 7 of these patients, yielding a sensitivity, specificity, PPV, NPV, and accuracy of 29.2%, 93.5%, 77.8%, 63.0%, and 65.6%, respectively.

PCR analyses were performed on USGB of 29 patients. Only 1 was diagnosed with an infection. The sensitivity was 8.3%, specificity and PPV 100.0%, NPV 60.7%, and accuracy 62.1%.

Synovial fluid was obtained in 42 patients. Sensitivities were between 25.0% and 25.7%, specificities between 89.5% and 95.0%, PPVs between 60.0% and 83.3%, NPVs between 65.4% and 69.4%, and accuracies between 64.5% and 70.6%.

Blood samples were collected in 51 patients. NPVs for CRP, WBC, and ESR were respectively 59.0%, 60.0%, and 63.9%. Sensitivities ranged from 4.8% to 27.3% and specificities from 79.3% to 95.8%.

Conclusions: USGB alone and in combination with PCR and blood and synovial markers are not reliable to use in clinical practice for the preoperative diagnosis of PSI.

EP.07.074

ROBOTIC-ASSISTED SHOULDER ARTHROSCOPY

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Background: Shoulder arthroscopy is a well-established procedure with a widespread application, but there is no technique description for robotic-assisted shoulder surgery. The high cost of robotic arms is one of the reasons. Advances in robot controllers allow domestic usage of this tech. The aim of the present study is to test whether robotic-arthroscopy can be performed using a cheap (U\$200,00) voice-assisted-robotic-arm to control the arthroscope.

Methods: Robotic shoulder arthroscopy was tried on two shoulder joints of a male fresh-frozen cadaver. The robot was Hiwonder robotic-arm, a small 6DOF (degree-of-freedom). The robot was assembled by the author and the robotic movements were recorded using a custom-made app. The arthroscope camera was attached with elastic bands. The cadaver shoulder was prepared in a beach-chair and lateral position. Four basic locations were recorded for the robotic arm: 1) Posterior cuff; 2) Lateral (GT); 3) Medial (medial cuff) and 4) Anterior. During the surgery, the surgeon uses a voice-assistant (GoogleVoice) to ask the robot for one of the four pre-recorded locations in subacromial space and the robot-arm position the arthroscope as asked. 10 cycles of the 4 locations were tested in different orders.

Results: Docking the robotic-arm and attaching the arthroscope camera was successful. The robotic-arm has a 250g limit weight carry and could move the camera. The base servo-motor has a 2-degree laxity that transforms into a small standard deviation in the final movement with the exact location deviating about 5mm from the pretended position. The anterior and posterior part of the region was successfully reached. Lateral and medial part was the most difficult to reach due to the robot axis for rotations does not align with the anatomy.

Conclusions: A cheap robotic arm can be a useful tool for shoulder arthroscopy with further development or rigidity. In procedures the surgeon needs to use both hands, a robotic-voice-operated scope can be a useful tool allowing development of different techniques. With minor improvements in the axis to reach medial and lateral, and added safety precautions, this device can be part of any arthroscopy surgery as the main camera or as a second additional view for shoulder procedures.

EP.07.075

ULTRASONOGRAPHICAL DETECTION OF INSTABILITY OF LONG HEAD OF BICEPS TENDON

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Background: The instability of long head of biceps tendon is well known as a cause of anterior shoulder pain. Arthroscopically we sometimes recognize the presence of chondral depression or erosion of humeral head underneath the LHB. This indirect sign caused was described as a chondral print. The purpose of this study is to investigate the efficacy of preoperative ultrasonography (US) for detecting instability of long head of biceps tendon (LHB).

Methods: Fifty patients who received arthroscopic rotator cuff repair were enrolled in this study. The mean age was 57.6 years. There were 32 males and 18 females. At short axis scan view of LHB, positive findings were ultrasonographically diagnosed by the change of high echoic line of humeral head. Arthroscopically, positive findings were confirmed by the presence of instability of LHB and chondral erosion of humeral head. The results of US were compared to the findings of the arthroscopic examination.

Results: US identified 34 of 38 cases of LHB instability diagnosed by arthroscopy. There was a sensitivity of 89.5%, a specificity of 100%, a positive predictive value of 100%, a negative predictive value of 75%, and an accuracy of 92% for US. Concerning false negative cases three out of four patients were traumatic onset. And the other three cases accompanied supraspinatus tendon tear.

Conclusions: Preoperative ultrasonographic examination is useful for detecting the instability of the LHB. It is reported that there was relationship between the instability and subscapularis tendon tear. Thus, it is considered that the accuracy got higher when combined with the ultrasonographic detection of subscapularis tendon tear.

EP.07.076

ARTHROSCOPIC TREATMENT FOR SPINOGLENOID GANGLION CYSTS WITH SLAP LESION: A SYSTEMATIC REVIEW

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Background: Operative treatment should be considered in patients who show clear signs of nerve compression or if discomfort and pain become aggravated despite nonoperative management. But few comprehensive studies on surgical techniques have been reported. The purpose of this study was to evaluate the clinical outcomes following arthroscopic treatment in patients with a concomitant spinoglenoid ganglion cyst and SLAP lesions. The secondary purpose of the study was to determine whether cyst decompression is a dangerous procedure in the treatment of SLAP lesions with concomitant ganglion cysts.

Methods: This study followed the guidelines for preferred reporting items for systematic meta-analyses utilizing PubMed, EMBASE, Cochrane Library, and Scopus databases. Keywords included shoulder, SLAP, labral tear, spinoglenoid notch, paralabral cyst, arthroscopy, and treatment. Criteria from the methodological index for nonrandomized studies (MINORS) were used in performance of quality assessments.

Results: A total of 14 articles (206 patients) were included, and the mean MINORS score was 9.57. The mean follow-up period was 27.6 months. Repair alone was administered in 114 patients (Group R) and 92 patients underwent additional cyst decompression (Group RD). Both groups showed excellent and similar clinical scores. The rate of complete resorption of the cyst was 95.5% in Group RD and 92.2% in Group R. The complication rate was 3.5% in Group RD and 11.4% in Group R. The reoperation rate was 0% in Group RD and 5.3% in Group R. However, none of the included studies reported serious complications.

Conclusions: Reliable clinical outcomes without serious complications were obtained from the use of both procedures, and no significant difference in clinical outcomes was reported. Decompression of the cyst is a safe method that will alleviate pressure on the suprascapular nerve.

EP.07.077

TWO-STAGE GLENOHUMERAL JOINT FUSION USING TEMPORARY PERCUTANEOUS PINNING: A CASE SERIES

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Background: Shoulder fusion after nerve injury can improve overall function, however high revision and low patient satisfaction rates have been described. The purpose of this study is to describe a two-stage shoulder fusion, first pinning in a position of function and then converting to a shoulder fusion. Our hypothesis is that temporary pinning influences patient decision making to proceed to shoulder fusion.

Methods: A retrospective review was performed for patients receiving two-stage shoulder fusion between 2020 and 2022 at a single institution. Patient demographics and clinical outcomes were recorded. Univariate statistics were performed to compare pre- and post-operative values.

Results: Seven patients with an average age of 47 +/- 17.3 years and average follow-up of 24.2 +/- 17.1 weeks were included. Preoperative diagnoses included brachial plexus injury (n=4; 57%), traumatic brain injury (n=1; 14.2%), cervical spinal cord injury (n=1; 14.2%) and iatrogenic axillary nerve injury (n=1; 14.2%). Five (71.4%) patients received unilateral shoulder fusion 5.4 +/- 0.9 days after their initial pinning. Two patients (28.6%) did not receive a second stage fusion. Reasons for not continuing with fusion were perceived hand function and new arm position. One patient (14.2%) received two shoulder pinnings prior to fusion to trial more internal rotation. After fusion, SSV improved (5.3 +/- 5.5% versus 71.7 +/- 10.4%; p=0.003). Forward elevation (5 +/- 12 versus 110 +/- 40; p=0.01), abduction (10 +/- 15 versus 78 +/- 10; p<0.001), and external rotation (5 +/- 12 versus 23 +/- 20; p=0.26) all improved post-operatively while internal rotation remained limited (1.3 +/- 0.9 versus 1.3 +/- 0.5; p=0.84). Time to union was 15 +/- 15.4 weeks confirmed with CT scan. There was one (14.2%) reoperation for hardware irritation, and every fusion patient was satisfied.

Conclusions: Shoulder fusion after neurologic injury provides improved function and patient outcomes, however some patients may be unsatisfied with their new arm position. Percutaneous pinning prior to fusion is tolerated and allows patients to trial potential fusion positions. This method may improve patient satisfaction and avoid morbidity in those that would be unsatisfied with shoulder fusion.

EP.07.079

SURGICAL TREATMENT OF ACROMIOCLAVICULAR JOINT INJURIES IN POPULATION UNDER WORK COMPENSATION: HOOK PLATE VS SUSPENSION SYSTEM. PRELIMINARY RESULTS OF A RANDOMIZED CLINICAL TRIAL

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Background: A great number of techniques have been described for acute Acromioclavicular joint injuries (AJI) surgical management, yet none of them could be considered as gold standard. There have been reports of good clinical and radiological outcomes regarding the use of Hook plate and TightRope suspension system, but there's no clarity about advantages when comparing return-to-work time, quality of reduction and functional scores between both techniques.

Methods: Patients with acute AJI classified as Rockwood IIIb through V operated within 2 weeks after been diagnosed. Randomization for the patients was conducted for "Hook" and "TightRope" groups at the moment of the diagnosis. Hook group was submitted to a more demanding rehabilitation protocol, starting 2 weeks earlier before TightRope group. On the radiological assessment, coracoclavicular distance (CCd) was measured, as well as VAS, SSV, Constant and ASES scores for functionality variables. Complication rates and loss of reduction related re-interventions were recorded. Statistical analysis was conducted with the software STATA v17.0 using descriptive statistics and t-test for independent samples.

Results: The outcomes of the first 18 patients with complete follow up are presented. Mean age 36.56 ± 13.06 years old. Male to female proportion was 17:1 and high energy vs low energy mechanism proportion was 11:7. Both groups were comparable regarding age, laterality, Rockwood classification, time to definitive surgery, length of stay, return-to-work time and immediate postoperative CCd, without significant statistical differences. Rehabilitation protocols were tolerated in both groups without suspension nor loss of follow up. Neither acute complications or re-interventions were recorded in both groups.

Conclusions: In this preliminary study patients with Hook plate presented a tendency for an earlier work reintegration than the TightRope group, while maintaining a comparable radiological reduction and functionality scores. Patients treated with Hook plate technique could be rehabilitated earlier without compromising clinical or radiological results, meaning lower costs for the patient and the health institution.

EP.07.080

UNDERSTANDING THE CLINICAL PROFILE OF PATIENTS WITH FROZEN SHOULDER: A LONGITUDINAL MULTICENTRE OBSERVATIONAL STUDY

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Background: There is a large diversity in the clinical presentation of frozen shoulder (FS) and the clinical outcome is not always satisfactory. The aim of the current study was to examine to what extent range of motion (ROM) limitation, metabolic factors (diabetes mellitus and thyroid disorders), autonomic symptoms and pain sensitivity may contribute to the prognosis in terms of shoulder pain and disability and quality of life in patients with FS.

Methods: Patients with stage 1 or 2 FS were longitudinally followed- up during 9 months after baseline assessment. They completed six questionnaires and underwent quantitative sensory testing (pressure pain thresholds, temporal summation and conditioned pain modulation) and ROM assessment.

Results: One hundred and forty- nine patients with FS were initially recruited and 121 completed at least one follow- up measurement. Shoulder pain and disability improved over time and diabetes mellitus was found to be a prognostic factor for final outcome. Several domains of quality of life also improved over time and external rotation ROM, diabetes mellitus, thyroid disorder and autonomic symptoms were found to be prognostic factors for final outcome. These prognostic factors explained 2.5%–6.3% of the final outcome of shoulder pain and disability and quality of life.

Conclusions: In patients with FS, prognostic variables were able to predict different outcomes, indicating that outcomes in this population can be variable- dependent. Other variables not explored in this study might contribute to the prognosis of patients with FS, which should be investigated in future research. In clinical practice, baseline assessment of prognostic factors and focusing on a more holistic approach might be useful to inform healthcare practitioners about progression of patients with FS during a 9- month period.

EP.07.081

THE NATURAL HISTORY OF FROZEN SHOULDER: A LONGITUDINAL MULTICENTER PROSPECTIVE STUDY OF FUNCTIONAL IMPAIRMENTS

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Background: The natural history of frozen shoulder (FS) is obscure and some contradictory evidence about the natural history arises. Interrelations over time between functional impairments can help to unravel the contribution of different variables to the natural history of FS. However, there is a lack of information about interrelations between functional impairments in a longitudinal way. Therefore, the aim was to determine the natural history of FS regarding disabilities, pain intensity, range of motion (ROM), muscle strength, scapular kinematics, and proprioception and to establish the interrelations over time between these variables.

Methods: Patients with FS (stage 1 or 2) were assessed at baseline and 3, 6, and 9 months after baseline. They filled out the Disabilities of the Arm, Shoulder, and Hand (DASH) and the Visual Analogue Scale (VAS). Shoulder ROM (external and internal rotation, flexion, and abduction), muscle strength (abduction and external and internal rotation), scapular upward rotation (SUR), and proprioception were examined.

Results: Initially, 149 patients were included and 88 completed all follow-up assessments. All variables except proprioception improved during the course of FS, but most variables had an early (from baseline and 3 months to other follow-up measurements) improvement. Additionally, external and internal rotation at 90° abduction continued to improve from 6 to 9 months follow-up. A moderate correlation over time was found between self-reported disabilities and active external rotation, while fair correlations over time were found between self-reported disabilities, ROM (flexion, abduction), muscle strength (abduction and external and internal rotation) and SUR. Poor correlations over time were found between self-reported disabilities, muscle strength (lift-off) and SUR.

Conclusions: Almost all factors improved in the early phase (3-6 months) after baseline assessment, while external and internal ROM at shoulder level continued to improve. Several interrelations between disabilities, ROM, muscle strength and SUR were established.

EP.07.082

SHOULDER INJURY RELATED TO VACCINE ADMINISTRATION FOLLOWING SARS-COV-2 INOCULATION

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Background: Shoulder Injuries Related to Vaccine Administration (SIRVA), describes those cases of shoulder severe post-inoculation complications, including pain and prolonged disability. Most of the reported cases have been secondary to influenza vaccination. This study retrospectively describes a series of 18 patients following SARS-CoV-2 inoculation and compares the findings with those previously reported for other vaccines.

Methods: Inclusion criteria was onset of symptoms within 48 h after injection, symptoms duration of at least seven days, and restricted range of motion in absence of symptoms prior to vaccination. Average age was 59.4 years old (38–76), and 72.2% were women.

Results: In many cases (58%) the initial diagnosis was not clear, which lead to incorrect treatment. The most common pathological finding was subacromial-subdeltoid bursitis (66.6%). All patients who received depot corticosteroids followed by a gentle rehabilitation program showed strong clinical improvement but did not completely resolve the symptoms at 7.2 months average final follow-up. Surgical intervention was necessary in one of the patients due to the persistence of symptoms despite conservative treatment.

Conclusions: Shoulder injury related to vaccine administration is rare, but when present, its torpid evolution makes it difficult to treat. We have found in our case series a similar pattern to that already described for other vaccines. A high index of suspicion helps to pick up the condition promptly and early treatment can bring satisfactory outcome.

EP.07.083

THE INCIDENCE AND ASSOCIATED PATHOLOGIES OF OS ACROMIALE IN A SUBSPECIALTY SHOULDER CLINIC

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Background: Os acromiale, a failure of ossification in one of four ossification centers along the anterior acromion, occurs in approximately 8% of the population. While prior studies have suggested associations between os acromiale and race, impingement syndrome, acromioclavicular joint arthropathy, and rotator cuff pathology, it remains controversial whether os acromiale is associated with any underlying pathology or if it is just an incidental radiographic finding. The purpose of this study is to identify the prevalence of os acromiale in a subspecialty shoulder clinic and to determine if associations can be drawn between diagnosis and/or patient demographics. We hypothesize os acromiale will be more commonly seen in diagnoses related to rotator cuff disease.

Methods: All patients presenting to a subspecialty shoulder clinic from July 2, 2018, to May 5, 2021, had their charts retrospectively reviewed for demographic information, diagnosis classification, and any imaging studies including radiographs, computed tomography scans, or magnetic resonance imaging to evaluate for presence of an os acromiale.

Results: 1,238 patients (1,846 shoulders) were included in the study. The analysis revealed os acromiale had a radiographic prevalence of 5.5% (102/1,846). There were 35 patients with os acromiale who had bilateral imaging available for review. Of these, 10/35 (29%) had bilateral os acromiale. The meso-acromion type was most commonly identified (81%), followed by pre-acromion type (16%) and meta-acromion type (3%). African Americans were identified to have os acromiale at a significantly higher frequency than other races ($p < 0.001$). Rotator cuff arthropathy was significantly associated with os acromiale compared to the control cohort (27% vs. 9%, $p < 0.001$). Rotator cuff disease was the most frequent diagnosis but had no significant association (35% vs. 28%, $p = 0.999$).

Conclusions: The current study demonstrates that os acromiale is significantly associated with rotator cuff arthropathy, with rotator cuff disease being the most frequent associated diagnosis. Though associated with rotator cuff arthropathy, further studies are needed to determine the contribution of an os acromiale to rotator cuff pathology and associated arthropathy.

EP.07.084

CURRENT TREATMENT OF FROZEN SHOULDER: A SURVEY AMONG 744 BRAZILIAN ORTHOPEDISTS.

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Background: Frozen shoulder is a prevalent disease that affects up to 5% of the world population. Its main clinical manifestations are joint stiffness and often disabling pain. Although there are several treatment options, there is no consensus on which should be indicated and in which clinical situations. The aim of this study is to determine the therapeutic methods most used by Brazilian orthopedists in the treatment of adhesive shoulder capsulitis and its indications.

Methods: This observational, analytical cross-sectional study was elaborated from an original questionnaire, with 26 questions about possible therapeutic approaches for frozen shoulder, allowing only one response per user. The titular members of the Brazilian Society of Orthopedics and Traumatology (SBOT) were invited to participate in the study through e-mail contact, sent by the society itself, so that the researchers did not have access to the e-mails of the study participants, whose identity was preserved.

Results: After submission of the answers, the final sample was composed of 744 orthopedists. Of these, 64.65% have been working for more than 10 years as orthopedists; 47.58% are shoulder specialists; 64.38% work in both the public and private systems. Most of orthopedists who answered the questionnaire (59.41%) work in the southeast region. The results show that the most indicated methods were physiotherapy (selected by 91.80% of the participants) and opioid analgesics (70.30%); followed by common analgesics, such as paracetamol and ibuprofen (62.10%); serial blocks of the suprascapular nerve (60.35%); pregabalin (57.93%); non-steroidal anti-inflammatory drugs (56.59%); intramuscular corticosteroids (46.37%); corticosteroid infiltration (37.10%) and amitriptyline (29.17%). The least indicated treatments were oral corticosteroids (9.01%); shockwave therapy (8.20%) and immobilization (6.59%). The main methods chosen for treatment were physiotherapy (52.48%) and serial blocks of the suprascapular nerve (23.96%). If conservative treatment failed, 56.59% of the participants indicated arthroscopic release of the shoulder, while 37.37% would opt for manipulation under anesthesia.

Conclusions: Physiotherapy is the main treatment of choice in adhesive shoulder capsulitis for most of the orthopedists interviewed, with suprascapular nerve block, the use of analgesics and pregabalin also among the most indicated by them.

EP.07.086

ADHESIVE CAPSULITIS OF THE SHOULDER: COMPARISON BETWEEN CONSERVATIVE TREATMENT METHODS

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Background: To evaluate the functional outcomes of three different conservative treatment protocols in patients with adhesive capsulitis of the shoulder

Methods: Reviews of medical records were carried out on patients treated at the institution for adhesive capsulitis in the period between January 2016 and January 2019. 3 different treatment protocols were compared. Group 1; Suprascapular nerve block (SSNB) with local anesthetic and corticosteroid, analgesics, and physiotherapy after pain reduction. Group 2: SSNB with local anesthetic without corticosteroids, analgesics, and physiotherapy, and group 3: analgesics and physiotherapy, without SSNB. The functional outcomes were determined with the ASES scale and the subjective results were assessed with the SSV.

Results: A total of 46 patients treated for adhesive capsulitis were divided into 3 groups. Group 3 presented a higher mean number of physiotherapy sessions (30.31 ± 21.07). Group 2 had the highest mean number of SSN blocks (3.27 ± 1.22). The results of the functional scores were: group 1 (15 patients): mean ASES 84 and mean SSV 84; group 2 (15 patients): mean ASES 93.40 and mean SSV 91.67; group 3 (16 patients): mean ASES 79.4 and mean SSV 80.63.

Conclusions: The various forms of conservative treatment for adhesive capsulitis achieve excellent outcomes. Analgesia through serial blocks of the suprascapular nerve with an anesthetic and corticosteroid achieved better functional and subjective outcomes and decreased the need to administer analgesics and physiotherapy sessions (group 1).

EP.07.087

TELEMEDICINE IN ORTHOPEDICS: ASPECTS THAT INTERFERE IN PATIENT SATISFACTION

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Background: Virtual consultations in health care using telecommunication technologies represent an alternative for service provision and an important tool in patient care, particularly due to the numerous socioeconomic benefits and ease of access. Still today, very few studies in Orthopedics and Trauma have focused on patient perception and factors affecting patient satisfaction. We aimed to identify the factors that interfere with patient satisfaction during teleconsultations compared with in-person consultations.

Methods: This study enrolled fifty patients complaining of shoulder pain. Each patient was attended by two different orthopedists, one of whom was responsible for the video consultation and the other for the in-person consultation.

Results: In a first quantitative analysis, telemedicine had a higher score compared with in-person in all evaluated items. Even when the evaluation included qualitative criteria and was conducted globally, the teleconsultation score was higher compared with in-person, particularly due to cost and travel time.

Conclusions: The telemedicine service proved to be reliable and was positively evaluated by patients who used it, providing an alternative to in-person orthopedic care based on satisfaction, cost and travel time-related advantages.

EP.07.088

A TECHNIQUE OF SUBACROMIAL DECOMPRESSION FOR OUTLET IMPINGEMENT BASED ON THE ARTHROSCOPIC CLASSIFICATION OF THE SUBACROMIAL SPACE

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Background: the determination of the appropriate amount of bone to resect is a common technical difficulty in performing arthroscopic subacromial decompression. We describe a technique that simplifies the procedure while providing more precise bone resection and contouring in cases of outlet Impingement. This technique is based on the arthroscopic Fleega classification of the subacromial space by using a special measuring needle device for measuring the subacromial space and monitoring the decompression.

Methods: The subacromial space is divided into four types based on arthroscopic measuring of the space between the anterior acromion and the rotator cuff (Type 0 space: no space, Type I: 1-6 mm, Type II: 6-12mm, Type III: more than 12mm). 289 cases of outlet impingement had a subacromial decompression to achieve type III space. First, the coracoacromial ligament is released by sectioning the anterior margin of the acromion. An acromioplasty is then performed with the arthroscope in the posterior lateral portal and the burr in the lateral anterior portal. The cutter is rested against the acromion. Bone resection is done by sweeping the cutter from posterior to anterior progressively till the marking of 12 mm or more on the measuring needle is visualized.

Results: Results All the 289 cases with outlet impingement who had a standardized subacromial decompression were followed for more than ten years.

All cases were satisfied with the surgery and had a normal shoulder function. This study showed no relation between the shape of the acromion or the radiological subacromionl space size and outlet impingement. A direct relation between impingement syndrome pathology and the arthroscopic subacromial space classification was found. No impingement was found in type 3.

Conclusions: According to this study in treating outlet impingement syndrome the subacromial bone removed with an acromionizer with the patient in a sitting position has to be enough to create a space between the anterior acromion and the tendon of more than 1.2 cm (Type III space).

EP.07.090

BIBLIOMETRIC ANALYSIS ON TOP 50 CITED RANDOMISED CONTROLLED TRIALS IN SHOULDER AND ELBOW SURGERY

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Background: Shoulder and elbow surgery is a vast field of research. Some pieces of research are more influential than others and it can be difficult to assess when reviewing studies in isolation. The Fragility Index (FI) has become a recognised means of assessing significant findings in Randomised controlled trials (RCT). The purpose of this study is to investigate the academic impact and characteristics of the most cited studies within Shoulder and Elbow Surgery.

Methods: We performed a systematic search in the Web of Science (WoS) database in February 2022. The search items were "Shoulder Surgery" AND "Elbow Surgery" AND "Randomised Controlled Trial". Level 2 RCT's in the area of shoulder and elbow surgery were included. Only the top 50 cited RCT's were included.

Results: The top 50 most cited studies had a range of citations ranging from 66-661. The country with most citations was the USA with 14. The Journal of Shoulder and Elbow Surgery published almost half (24) of the top 50 most-cited studies. In addition 39 of the top 50 most-cited studies have been published since 2010. The most common Pathology studied in the top 50 cited studies is rotator cuff tears (22). The average patient numbers in the top 50 most cited studies is 92.04 with average follow up time 13.7 months. The FI was calculated on 24 studies with a mean FI of 4.8.

Conclusions: This study provides a list of leading publications in shoulder and elbow surgery. Many RCT's were fragile therefore caution is required when interpreting such studies. This may be concerning considering these are the most cited studies in this subspecialty.

EP.07.091

CLASSIFICATION OF SYMPTOMATIC SCAPULOTHORACIC ABNORMAL MOTION (STAM)

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Background: Discordant motion of the scapula may produce pain, instability, and limited motion. The patterns of scapulothoracic abnormal motion (STAM) vary between patients depending on etiology. The purpose of this study is to describe STAM and provide a reproducible classification system.

Methods: Patients receiving evaluation and treatment for STAM between 2020 and 2023 were included for analysis. Clinical periscapular muscle evaluation and surface electromyography (sEMG) was used to determine the activation of key muscles during shoulder elevation. Patients were categorized into classes based on their symptoms, physical examination, and features of sEMG.

Results: Periscapular muscle activation patterns and clinical features demonstrated seven distinct patient subgroups. Class 1 patients show mild STAM secondary to pectoralis minor and upper trapezius hyperactivation, with pain over the pectoralis minor insertion and mild limitation of range of motion (ROM). Class 2 patients show limited shoulder flexion associated with moderate to severe STAM secondary to pectoralis minor hyperactivation, upper trapezius hyperactivation, and serratus anterior hypoactivation, with Class 2A easily correctable by scapular assistance testing and 2(b) not easily corrected with scapular assistance test. Class 3 patients have severe STAM secondary to a paralytic serratus anterior. Class 4 patients have mild STAM secondary to drooping of the scapula that results from trapezius paralysis. Class 5 patients have severe STAM secondary to combined deficiency of the trapezius and serratus anterior most commonly due to muscle dystrophy. Patients in Class 6 have severe, fixed, excessive anterior tilt of the scapula on the chest wall with restricted motion and inability to reposition the scapula because of severe periscapular muscle co-contraction. Class 7 patients present with constant scapular motion, described as dancing scapula, with class 7A induced with shoulder motion and 7B occurring both at rest and with motion. This type is mostly related to severe discordant activation of the muscles around the scapula.

Conclusions: STAM unrelated to bone or joint abnormality can be the result of abnormal muscle activation around the scapula or muscle paralysis. Using clinical examination and sEMG of the periscapular muscles allowed classification of STAM into 7 classes. This classification may help in the future diagnosis and treatment of STAM.

EP.07.092

TREATMENT AND FUNCTIONAL OUTCOMES OF SHOULDER ADHESIVE CAPSULITIS SECONDARY TO COVID 19 VACCINE

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Background: Adhesive shoulder capsulitis is a cause of functional limitation and painful shoulder after the application of vaccines, recently described after various COVID-19 vaccines (SIRVA) around the world.

Shoulder injury related to vaccine administration (SIRVA) is described as shoulder pain with limited arcs of motion, 48 hours after vaccination in a patient with no prior history of pain, swelling or dysfunction in the shoulder prior to administration of the vaccine, with a duration greater than 7 days; this pathology previously described with the application of influenza vaccine, tetanus, pneumococcus (pneumococcal polysaccharide PPSV23) and recombinant zoster.

Methods: A follow-up of a series of cases was carried out in patients who have the diagnosis of frozen shoulder related to SIRVA (Shoulder injury related to vaccine administration), in the period from March 2021 to September 2022, treated at the Sports Traumatology Center of Mexico, who met the following criteria: progressive stiffness, persistent pain that increases with mobility, restriction of mobility (limitation to passive abduction, and external rotation) and presence of inferior translation (inferior glide +).

Results: A sample of 9 patients was obtained to whom the ASES, SIMPLE SHOULDER TEST, CONSTANT and SANE scales were applied to evaluate their functional results, with a mean age of 55.3 years \pm 9.3, of which 5 patients are female (55.6%) and 4 male (44.4%), with 1 patient with right shoulder condition (11.1%) and 8 left shoulders (88.9%), All patients had non-dominant side involvement consistent with the site of vaccine application. 8 patients were treated with oral corticosteroid and 1 intramuscular, all accompanied by physical therapy. The Wilcoxon test was applied to compare means of the pretreatment and post-treatment clinical scales, finding statistically significant differences in all, for VAS (p 0.018), for ASES (p 0.027), for Simple Shoulder Test (p 0.027), CONSTANT (p 0.028), SANE (p 0.027).

Conclusions: Treatment with oral corticosteroids is safe and effective in patients with SIRVA, accompanied by physical and functional therapy. It represents a diagnostic challenge due to the lack of information about it since the beginning of this pandemic, conditioning a delay in timely and effective treatment.

EP.07.093

RESULTS OF OSTEOLYSIS MANAGED WITH EXCISION OF THE ACROMIOCLAVICULAR JOINT WITH A DIRECT ARTHROSCOPIC TECHNIQUE

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Background: Acromioclavicular (AC) joint osteolysis is not common and no studies have determined the efficacy of current treatment. The aim is to retrospectively review the outcomes of AC joint excision in patients resistant to non-operative measures.

Methods: 16 patients underwent AC joint excision over a 2 year period, with all surgeries being conducted by a single senior surgeon. Patient outcomes were assessed using Constant and QuickDASH shoulder scores, as well as a patient-reported satisfaction rating on a visual analogue scale (VAS).

Results: Two years following lateral clavicle excision, a clinically relevant and statistically significant 35.0 point improvement in the Constant score was noted ($p < 0.05$). Similarly, a 23.74 point decrease in the QuickDASH symptom score was evident ($p < 0.05$). A mean satisfaction rating was recorded as 8.8 out of 10. With 56% of patients being professional athletes, the average time taken for a full return to sport was 6.3 months. Other factors such as pre-operative steroid injections, age and time taken to surgery were not found to have a significant influence on surgical outcomes.

Conclusions: In conclusion, AC joint excision with the direct arthroscopic technique was found to be an effective management option for the treatment of AC joint osteolysis.

EP.07.094

UPPER TRAPEZIUS SCAPULAR IMPINGEMENT: DYNAMIC ULTRASOUND EVALUATION IN SCAPULAR DYSKINESIA.

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Background: Abstract

The present paper is a demonstration that how with the Ultrasound we could find a sign that we called Upper Trapezius Scapular Impingement (UTSI).

The present protocol that we developed, with the guidance of experts in Diagnostic Ultrasound or Skeletal Muscle Ultrasound, allows us to identify Upper Trapezius Scapular Conflict (UTSI) using this diagnostic modality, in order to early identify this postural alteration that is part of the DET or STAM.

Conclusion

The evaluation with dynamic Musculoskeletal Ultrasound of CETS gives us a transcendental contribution for the diagnosis and evolution of Scapular-Thoracic Dyskinesia (TED). Case series studies are recommended to take advantage of this highly useful technique for the diagnosis of TED.

Methods: Using a high-resolution linear transducer, it is positioned in the long axis of the upper trapezius at its junction of the middle third and lateral two-thirds. A hyperechogenic image is sought and observed that represents the superomedial angle of the scapula, this due to poor posture causes a conflict and a decrease in the normal thickness of the upper trapezius, which, when correcting the posture, normalizes the thickness of the upper trapezius.

Results: The study is carried out with the correction of posture and comparative with the contralateral, managing to demonstrate the Scapular Conflict of the Upper Trapezius on the affected side that is clinically manifested with a STD or STAM.

Conclusions: The evaluation with dynamic Musculoskeletal Ultrasound of UTSI gives us a transcendental contribution for the diagnosis and evolution of Scapular-Thoracic Dyskinesia (STD). Case series studies are recommended to take advantage of this highly useful technique for the diagnosis of TED.

EP.07.096

MID-INTERVAL PLICA OF THE SHOULDER JOINT; DEFINITION AND TREATMENT

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Background: Plicae in the knee are remnants of septum of the fetal period and may produce pain, swelling, crepitus, and locking. Arthroscopic excision of the plica may improve symptoms in selected patients. We encountered patients with mid-interval plica of the shoulder, as in the knee.

Methods: It was observed in seven cases, five instability, one partial supraspinatus tear and one frozen shoulder. Six of the cases had rotation pain besides the pathology which was the indication for the arthroscopic surgery. In this presentation we will demonstrate our arthroscopic observation and the results of treatment.

A band-like thickening or wrinkling from the anterior superior capsule and the rotator interval to the middle of the upper border of the subscapularis is arthroscopically observed and documented in seven cases. One case was in a combination with sublabral foramen. Redness and signs of inflammation were present in four cases three of them with partial synovitis. Inflammatory foci abutted each other, especially in abduction and external rotation of the shoulder. We named this lesion Mid-interval plica of the shoulder and we will evaluate the pathogenesis and the effect of plica on the shoulder. In all the cases the plica was resected with the arthroscopic treatment of the primary pathology.

Results: The average age of the patients was 30 years. The average follow up was 15 months (6-28 months). The postoperative examination showed that the rotation pain which was present in some of the cases before surgery disappeared. If there was a relation between instability and the plica, will be investigated.

Conclusions: This study is the first to describe the presence of mid-interval shoulder plica in living subjects and correlates with previous anatomic studies. The younger age predominance correlates with the findings of plica in the knee. Our findings suggest that mid-interval plica may be a cause of intra-articular rotation pain in young hyper lax shoulder patients.

EP.07.097

THE SUBLABRAL FORAMEN; AN ANATOMIC VARIATION ; CAN IT BE CLINICALLY SYMPTOMATIC AND REQUIRES TREATMENT?

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Background: The sublabral foramen is an isolated variant of the anterior-superior capsulo-labral-complex considered to be a clinically asymptomatic. An arthroscopic observation of unclear unique symptomatic shoulders showed common fraying and thickening of the border of a present Sublabral Foamen. Treatment was done by resection and shaving of the superior and inferior labral stump. In this study the clinical picture and the treatment results of this pathology will be presented.

Methods: : 8 Patients with unclear shoulder symptoms have the same clinical findings of negative impingement sign and test, negative instability signs but in common the have rotation pain of the shoulder between 45 and 90 degrees of elevation and a relieve of symptoms with intra-articular injection of local anesthetic. During arthroscopy there was pathological findings other than the SUBLAF with abnormal thickening and fraying of its edges. The edges were resected and the labrum stumps were shaved. A follow up of the cases were done 12 to 42 Months.

Results: Five from the 8 patients were completely relieved and did sports as well as overhead activity without any problems. Two patients had still discomfort with overhead activity and on patient had subluxation symptoms was operated with arthroscopic L-type cut inferior capsular shift for instability.

Conclusions: The sublabral foramen may be more common than previously thought (Ilahi). Furthermore, this variant of anterosuperior glenoid labrum anatomy appear to cause symptoms which can be relieved with arthroscopic treatment. It is still to be cleared if cases of a cord-like middle glenohumeral ligament or a Buford complex may in some cases cause the same symptoms.

EP.07.098

BEST-FIT CIRCLE OF HUMERAL HEAD ON PLAIN X-RAYS FOR REPLICATION OF NORMAL ANATOMY IN SHOULDER ARTHROPLASTY

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Background: Anatomical restoration of the humeral head is critical for successful shoulder replacement. We hypothesized that the circle obtained via specific points on humeral head correlate with different projections of plain radiographs

Methods: Bilateral shoulder conventional radiographs of 200 patients without arthropathy or other abnormal findings of humeral head were evaluated. The best-fit circle was obtained based on three points, including medial and lateral endpoints of the anatomic neck and the lateral cortex below the greater tuberosity on AP and oblique radiographs. The best-fit circle was drawn based on five different x-ray projections of shoulder. The radius of each circle was statistically analyzed using intraclass correlation coefficients

Results: The assessment of differences in radius between right and left shoulders was strongly reliable (ICC values > 0.75) with no significant differences in radii ($P = 0.001$). Intraclass correlation coefficients for radii of the circle on both sides were: shoulder, AP 0.990 (95% CI 0.986-0.993, $p < 0.001$); glenoid, AP 0.992 (95% CI 0.989-0.995, $p < 0.001$); outlet, 0.996 (95% CI 0.994-0.997, $p < 0.001$); axillary, 0.994 (95% CI 0.991-0.996, $p < 0.001$); and 30° caudal tilt, 0.993 (95% CI 0.990-0.995, $p < 0.001$).

Conclusions: The best-fit circle on humeral head can be made using different projections of plain radiographs. This simple method to determine the ideal size of humeral head facilitates preoperative planning and postoperative evaluation during anatomical restoration of the shoulder .

EP.07.099

ANALYSIS OF THE REASONS WHY PATIENTS CANCEL SHOULDER SURGERY DESPITE RECOMMENDATION

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Background: Cancellation of surgery can result in wasted surgical resources and delay other surgeries. In shoulder surgery, some patients cancel scheduled surgery despite recommendation by a doctor. However, no study has been conducted to establish why scheduled shoulder surgeries at tertiary referral centers are canceled by patients. The aim of this study was to determine why surgeries at tertiary referral centers are canceled by patients and to document the characteristics of these patients.

Methods: From June 2017 to July 2019, patients scheduled for shoulder surgery were allocated to a surgery group (n=224) or a cancellation group (n=82) and classified by major shoulder elective surgery. These groups were compared with respect to patient characteristics, types of surgery, distance from hospital, traveling time to hospital, and waiting period before surgery. Reasons for cancellation and responses were analyzed using a telephone interview.

Results: Mean age was older, rate of trauma history was lower, and proportion of patients underwent arthroscopic rotator cuff repair was lower in the cancellation group (p=0.009, p=0.014, and p=0.017, respectively). In addition, mean distance from patient house to hospital and preoperative waiting time were both longer in the cancellation group (p=0.001 and p<0.01, respectively). The most common reason given for cancellation was "another medical condition (28.1%)" and the second most common was "symptom improvement (20.7%)".

Conclusions: Older age, arthroscopic rotator cuff repair surgery, longer distance from hospital, and longer waiting period significantly increased the chance of cancellation. The main reason for canceling surgery was other underlying medical condition. Therefore, when surgeons recommend shoulder surgery to patients, it is necessary to identify the underlying disease in advance. Surgeons should also consider the possibility of surgery cancellation by identifying patient's age, type of surgery, distance from hospital, and waiting time.

EP.07.100

REVERSE PROSTHESIS IMPLANTATION WITH NAVIGATED TECHNIQUE IN SEVERE GLENOID DEFICITS

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Background: 12 computer assisted reverse prostheses were implanted. 3 pcs with B2 glenoid, 1 pcs with A1 glenoid, 2 pcs with A2 glenoid, 2 pcs with Walch classification C glenoid and 2 pcs with confirmed anterior dislocation with loss of substance of the anterior 1/3 of the glenoid. The glenoid version and the inclination were evaluated using the special Orthoblu[®] software (Exactech, Gainesville, FL, USA) with a special CT for pre-operative study, allowing the version and the native inclination to be modified even with the corrective baseplate. The inclination and the pre and post implant version of the baseplate, the length of the screws, the surgical time, the hospitalization time, the post-operative pain in 72 hours were evaluated with the VAS scale. The advantages and limitations of this operative technique were analysed. Constan score and DASH score were evaluated at 1 year.

Methods: The purpose of this work is to show the preliminary results of the reverse prosthesis implantation technique with the aid of computer aided navigation according to our experience and to evaluate the clinical results at 1 year.

Results: The average surgical time of the implants was 90 +/- 20, the average hospitalization time was 3 +/- 2 days. Pre-op tilt was 3.4° +/- 6.6°, pre-op version 7.4° +/- 8.6°, Mean planned post tilt was 3.4 +/- 2, 8, the planned post mean release was 3.2° +/- 2.7°. The planned settings were achieved in all cases, no further plant modifications were necessary. All planned baseplates were implanted, 3 standard, 9 with posterior augmentation of 8°. The mean length of the screws was 32mm +/- 8mm. Postoperative pain was measured according to a VAS scale of 2 +/- 2. The Constant score went from 38 +/- 4 to 70 +/- 5 and the DASH score went from 28 +/- 3 to 58 +/- 5 ad 1 yy fi follow-up

Conclusions: The GPS navigation system is a reliable system, allows to achieve the planned glenoid positioning, allows implantation in severe glenoid deformities such as glenoids type C according to the Walch classification. The long-term clinical results are also exciting.

EP.07.101

SHOULDER GIRDLE SYNDROME FOLLOWING COVID-19 INFECTION AND VACCINATION -SYSTEMATIC REVIEW

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Background: Shoulder girdle syndrome or Parsonage Turner syndrome (PTS) is a debilitating condition, with acute onset excruciating pain around the shoulder girdle and arm leading to weakness and atrophy of muscles. Numerous reports have been published following COVID-19 infection and vaccination leading to PTS. The current review aims at collating the data and analysing them to identify the course of the disease and management strategy.

Methods: A comprehensive search was performed using OVID, EBSCO hosted Medline, CINAHL, PEDro, Cochrane and PubMed databases between Jan 2020 and October 2022. The search strategy identified 173 papers, of which 94 were relevant, after applying strict inclusion criteria, 33 articles were included in the study.

Results: The review identified 62 cases, of which 37 patients (60%) are post vaccination. 43 patients (69%) are males with a mean age of 51 years (range 17-84). Majority of these patients had mRNA vaccination (26/37). The mean incubation period for development of the symptoms were 14 days from vaccination or infection. The average time between onset of pain and neurology is 17 days. 77% of patients developed symptoms on the arm they had vaccination. Axillary nerve (21) was commonly involved followed by suprascapular nerve (15). 13 patients had sensory involvement, two patients have complete plexus involvement and one had bilateral upper-limb weakness. 81% of patients who had steroid therapy had complete or near complete recovery when compared to 55% in the supportive therapy group.

Conclusions: PTS affects middle aged males following covid vaccination or infection. Majority of the patients who had PTS had mRNA vaccines. Rotator cuff and deltoid are commonly affected. The outcome following use of steroid therapy in these patients are promising when compared to supportive therapy

EP.07.102

CREATION OF A LOW-COST ANATOMIC SHOULDER SPACER FOR DEEP INFECTIONS AFTER FAILED SHOULDER SURGERY

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Background: Infections after shoulder surgery are a challenging clinical situation to manage due to the organisms often present and delay clinical presentation. Several treatments options have been described, but in cases of joint destruction the use of a humeral antibiotic spacer can be used. Such spacers can be pre-fabricated or hand made.

Methods: We present a case of a 63 YO male patient with a proximal humerus fracture previously treated in another institution. He presents with pain, stiffness and erythema. He had new x rays where failure is observed in previous surgery. We decided to do the first of 2-stage treatment for deep shoulder infection. Due to the lack of economic resources we prepared a mold with a sawbone of a humerus head. We made a cut to the sawbone at the level of the surgical neck, we performed a split to the mold, very carefully we removed the material inside the halves of the humeral head. For the surgery, the mold was sterilized with ethylene oxide, a 24-hour process.

Results: We performed a delto-pectoral approach in previous incision. Purulent material and infected tissue were observed, and lack of rotator cuff. We removed osteosynthesis material and bone fragments. Tissue cultures were taken. We did an extensive debridement and irrigation of the joint cavity. For the spacer, we used surgical cement with gentamicin. Cement was placed on both halves of the humeral head and a metal guide in the center to give structure and length to the humeral stem, both halves of the sawbone were put together. When the cement was ready, we removed the mold and cement was placed around the guide. The spacer was inserted in the humerus and reduction to the joint cavity was performed. The wound was closed, a post-surgical patch and a sling to the upper extremity was placed

Conclusions: This technique offers several advantages to prefabricated antibiotic impregnated cement spacers. It is a low-cost technique, smooth articular surface, it confers stability to the construct, anatomic humeral head size to maintain soft tissue tension and length of the arm, and prepare the shoulder for a 2nd stage possible arthroplasty.

EP.07.104

NEUROPATHY IN THE UPPER LIMB AFTER COVID-19 INFECTION: THE EXPERIENCE OF BRAZILIAN ORTHOPEDICS

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Background: We performed a survey of the experience of Brazilian orthopedists in treating cases of peripheral neuropathy in the upper limb after Covid-19 infection. This study aims to present the data collected through a questionnaire sent by email to Brazilian orthopedists about peripheral neuropathies related to Covid-19.

Methods: Prospective cross-sectional study. Data were obtained through an electronic questionnaire, sent together with the consent form, by e-mail to members of the Brazilian Societies of Orthopedics and Traumatology, of Shoulder and Elbow Surgery, and of Arthroscopy and Sports Traumatology. For the analysis, the chi-square test and the logistic regression model with the Stepwise and Akaike selection methods were used.

Results: Patients who were in the prone position had a 2.93 times greater chance of having a Radial nerve injury (p-value = 0.01) and a 3.22 times greater chance of having an Ulnar nerve injury (p-value = 0.04). There was an association between ICU admission and involvement of the same bilateral nerve (p-value = 0.02), suggesting that the former was a protective factor for the latter when compared with patients who were not in the ICU. Obese patients were 8.23 times more likely not to recover completely (p-value = 0.00).

Conclusions: The prone position in the management of the patient with Covid-19 is associated with increased injury to the Ulnar and Radial nerves. Hospitalization in ICUs seems to have been a protective factor for the development of bilateral neuropathy of the same nerve. Almost one-third of the patients evolved with complete recovery of the condition. Motor and sensory involvement or just motor involvement seems to evolve with a lower chance of recovery from the neurological condition. The same applies for obese patients.

EP.07.105

MID-TERM OUTCOME STUDY OF ARTHROSCOPIC ROTATOR CUFF REPAIR AND REVERSE SHOULDER ARTHROPLASTY FOR WEIGHT-BEARING SHOULDER

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Background: For patients using wheelchairs or walkers, the weight-bearing on the shoulder after shoulder surgery is a concern. This study aimed to report the short and mid-term clinical and radiologic outcomes of arthroscopic rotator cuff repair (ARCR) and reverse shoulder arthroplasty (RSA) in weight-bearing shoulders.

Methods: From 2009 to 2021, ARCR and RSA cases in weight-bearing shoulders were retrospectively reviewed. Baseline characteristics and diagnosis for weight-bearing shoulders were recorded. In the ARCR group, the initial rotator cuff status and postoperative 6-month tendon integrity were confirmed by magnetic resonance imaging. In the RSA group, final radiologic outcomes (scapular notching and implant loosening) and complications were recorded. Final subjective satisfaction and arm usage for weight-bearing shoulders were recorded in both groups.

Results: In ARCR, 6 poliomyelitis (polio), 2 cerebrovascular accidents (CVAs), and 2 spinal cord injury (SCI) cases (4 men, 56.8 ± 8.0 years, 2 were lost) with a mean follow-up of 94.3 ± 37.8 (range, 28.0–163.6) months were analyzed. Initially, Patte types 1, 2, and 3 were observed in 6, 3, and 1 patient, respectively, and one patient with Patte type 1 showed tendon retear. Finally, all functional scores improved compared with the initial values. Among them, seven patients were followed-up over 5 years, all still used their arms for weight-bearing, and seven of the eight were satisfied. In RSA, two cases each of polio, CVA, and SCI (74.7 ± 9.0 years) with a mean follow-up of 80.2 ± 33.1 (range, 39.4–115.8) months were analyzed. Finally, all functional scores improved compared with the initial values, even though insignificant. Two cases of Sirveaux type 1 scapular notching were observed; however, no implant loosening or complications occurred. Four cases were followed-up over 5 years; all used their operated arms for weight-bearing and were satisfied.

Conclusions: Regarding shoulder surgery for weight-bearing shoulders, tendon retear was observed in one of the 10 patients who underwent ARCR, and no complications were observed in patients who underwent RSA. Despite the limited sample size, ARCR and RSA for weight-bearing shoulders showed good clinical and radiologic outcomes, good function for weight-bearing on the operated arm, and subjective satisfaction in the short- and mid-term follow-up.

EP.07.107

ACCUTE HUMERUS OSTEMIELITIS. CASE REPORT

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Background: 62 years-old male came to ER with right arm swelling and excruciating pain. Patient explained no previous traumatism, wound or hematoma on the area. He referred shoulder pain for the 3 previous months, so a couple of steroids i.m. shots and a US-guided subacromial injection were given on another institution. Patient has been diagnosed of Psoriatic Arthritis (PA) with chronic immunosuppressive treatment including methotrexate and infliximab. ER blood test showed high PCR and leukocytosis with left deviation. An urgent US was requested, describing tricipital abscess with possible bone affectation. Then, surgical drainage of the abscess was performed as patient's general status worsened since his arrival to the ER. Evolution after the first surgery was not satisfactory, so, a second one was needed: lateral head of the triceps was excised and the leaking point from the humeral cortex was found and enlarged. Pus was found inside the bone. Humeral shaft was progressively reamed. Vancomicine loaded cement balls were left inside the humerus and on the soft tissues. Two more extensive debridement surgeries were needed. In the last one high pressure lavage device was used inside the humerus, with a second distal bony window, to remove all liquid produced. Cultures were positive to *S. Aureus* Methicillin sensible i.v. cloxacillin was prescribed by Infectious Disease Department for 2 weeks followed by 3 months of oral levofloxacin and rifampicin.

Methods: To explain an unique clinical case and review of literature

Results: After 4 surgical debridement and extensive antibiotic treatment, patient finally improved, and no recurrence of the disease has happened. He has resumed his fully PA treatment.

Conclusions: Osteomyelitis (OM) is a severe bone infection. Humerus OM is an uncommon problem, so, treatments are imported from tibia or femur OM experience. To our knowledge, there are no studies focusing on medullary humerus OM. In this case, our patient was medically immunocompromised which made treatment much harder. Given the rising number of patients treated with selective immunomodulators nowadays, we should expect the number of acute OM to increase. Combination of aggressive surgical debridement and specialized Infectious Disease treatment is key to avoid cronification of such complicated infections.

EP.07.108

THE COVID-19 PANDEMIC IN SHOULDER AND ELBOW SURGERIES: THE DAMAGE FROM THE PATIENT'S PERSPECTIVE

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Background: COVID-19 affected the routine of surgical specialties, such as Orthopedics and Traumatology. The pandemic that remains in Brazil and in the world has led to the suspension of elective surgeries, difficulty in carrying out physical therapy rehabilitation or incorrect postoperative follow-up. This study aims to outline an analysis of the demographic profile of patients who considered that there was damage due to the COVID-19 pandemic in Shoulder and Elbow surgeries in the first year of the pandemic, as well as to compare the perception between patients treated surgically by elective or urgencies/emergencies, in addition to investigating the months with the greatest harm to patients and relating them to the phases of the pandemic.

Methods: The data were collected through electronic medical records (name, age, sex, city and date of surgery) and a brief personal questionnaire or through a telephone call. 494 patients surgically treated for shoulder and elbow orthopedic pathology within the previously stipulated Pandemic period (March 2020 to March 2021).

Results: More than a third of patients (34.01%) believe they have been harmed at some point. A total of 24.09% of patients declared impairment due to fear of attending follow-ups and only 1.21% of patients saw surgical rescheduling as an aggravating factor during the pandemic. Most surgeries were non-elective (59.92%). Regarding the health care, there was a higher proportion of patients who felt affected in the private health care. The month in which the highest percentage of people affected was March 2020, the beginning of the pandemic followed by March 2021, when the pandemic was in its second wave.

Conclusions: The pandemic had an impact on Shoulder and Elbow surgeries, from the patient's perspective. There were many cases of returns at inappropriate times and even non-returns postoperatively, making effective early intervention difficult when necessary. Knowing the degree of impairment in the population reinforces the need for measures to circumvent such outcomes, such as facilitating access to telemedicine. There were no significant losses related to surgical rescheduling in the eyes of the patients, or it was not a point considered harmful from their perspective.

EP.07.110

IN RELATION TO UNNECESSARY SURGERIES. DOES IT EXIST SMARMY MEDICAL PATERNALISM?

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Background: The worry of unnecessary surgery and the social cost of questionable medical care had increased the interest to find this inappropriate medical conduct origins. This work, explores the hypothesis that autonomy has been replaced by smarmy medical paternalism. And inquires over smarmy doctors reasons to proceed.

Methods: A search was made on Medline, EMBASE, Cochrane library and PUBMED. The terms/words used were unnecessary surgery, informed consent, publications were included from the beginning of May 2022, finding 400 choosing the investigations that compares medical and no-medical interventions to address this unethical conduct, excluding unnecessary publication about ethical dilemmas. Eliminating like this 380 articles then we review 17 articles and 3 books.

Results: There was no work founded describing smarmy medical paternalism

Conclusions: The term smarmy makes references to the doctor's power over the patient using sympathy as a tool. The sympathy feeling is instinctive, nevertheless, on the smarmy doctor this feeling is conscient, reflexive and calculated. The smarmy doctor does not feel uncomfortable on the contrary, the doctor experiences and absolute feeling. The doctor lacks values such as honesty, is not truthful nor authentic because there is inconsistencies between his attitudes and his behavior, looking for a personal gain or benefit even against the beneficence principle.

EP.07.111

IS ARTHROSCOPIC LOCALIZATION, REMOVAL AND TENDON DEFECT REPAIR OF CALCIFIC TENDINITIS ENUF OR SHOULD WE DO ALSO A SUBACROMIAL DECOMPRESSION?

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Background: In this study we will evaluate the arthroscopic treatment of therapy resistant calcific tendinitis by removal of calcium and repairing the defect through end to end repair or transosseous closure with decompression in selected cases based on measuring the space between the anterior acromion and the cuff with a special device.

Methods: Thirty-six patients with calcifying tendinitis were operated between 2012 and August 2016. This study retrospectively evaluated these cases with a preoperative duration of symptoms ranging between 6 months and 11 years. The average follow up was 5 years (ranging from 4 to 8 years). There were 22 women (61%) and 14 men (39%). The average age at the surgery was 56 years with a range of 42 to 73 years. Pre-operative radiographs (Supraspinatus outlet views) reveals average Anterior acromion-tendon distance of 8.6 mm ranging from 6 to 11 mm. An arthroscopic anterior acromioplasty was done if the measured space between the anterior acromion and the tendon after calcium removal was less than 12 mm, based on a previous study, and a trans-arthroscopic calcium removal and arthroscopic cuff repair was done in all cases. There were 32 small defects and 4 medium-sized defects. An end to end arthroscopic repair was done in 17 cases and transosseous repair using the giant needle in 19. All cases were done in an outpatient setting. All patients had significant impairment before surgery despite conservative treatment.

Results: There were no postoperative complications. All the patients returned to do active sport. According to Neer's classification 35 cases were rated excellent and one satisfactory. According to modified UCLA scoring 34 patients were excellent and two patients were good without fair or poor results. The improvement in the UCLA score was statistically significant. The average pre-operative total rating was 14.1 and the post-operative rating was 33.9.

Conclusions: Calcium removal and tendon repair combined with subacromial decompression in cases of narrow subacromial space based on space measurement has proven to be a very reliable strategy of treatment .

EP.08.02

DETECTION OF OSTEOCHONDRITIS DISSECANS OF ELBOW USING DEEP LEARNING ON ULTRASOUND IMAGES

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Background: Osteochondritis dissecans (OCD) of the humeral capitellum might be required surgery, but it is treated conservatively when the OCD lesion can be found in the early stage. OCD lesion is detectable by using ultrasonography, but the accuracy of diagnosis depends on the technical proficiency of the examiner. We are developing a computer-aided diagnosis (CAD) system using deep learning to improve the reliability and accuracy of OCD detection by ultrasonography. In this study, we propose a deep learning CAD system based on object detection model to automatically segment the humeral capitellum and detect the OCD lesion.

Methods: The participants consisted of 20 baseball players (mean age, 12.7 ± 1.4 years; range, 9-14 years). Ultrasound images of their elbows were used, including 10 OCD and 10 healthy elbows. In this study, we obtained a posterior short axis view of the humeral capitellum from each subject. A US movie was captured by sliding the probe on the humeral capitellum. From the obtained US movies, 50 images were captured per elbow, and 500 images were prepared from each group. Each image was annotated for humeral capitellum and OCD lesion. To detect the humerus capitellum and OCD lesion, we used a regional deep learning approach called You-Only-Look-Once (YOLO) v5. The performance of the proposed method was assessed by 5-fold cross-validation (400 for training, 100 for validation).

Results: For the detection of humeral capitellum and OCD lesion, an average mAP of 0.994 and 0.984 for the IoU limit of 0.5 respectively.

Conclusions: The performance of this proposed model has high precision. This CAD system may be helpful for OCD screening. However, it has not yet been used in clinical practice, and processing speed and real-time detection require further investigation.

EP.08.03

THE BIOMECHANICAL IMPACT OF ELBOW MOTION IN ELBOW STIFFNESS.

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Background: This study aims to understand the biomechanical characteristic or change in the stiff elbow in the resting (or neutral) and swing position of the arm using the cadaveric model. The hypotheses included that (1) the difference exists in the articular contact pressure of the elbow by comparing the nonstiff and stiff models in in vivo study; (2) The degree of stiffness would affect the increase of the joint loading of the elbow.

Methods: The biomechanical study included eight fresh-frozen specimens from individuals of both genders. Specimen was mounted on a custom-designed jig system with gravity-assisted muscle contracture for mimicking the elbow in standing position. The elbow was tested in two conditions (the resting and passive swing). The passive swing was performed by dropping the forearm from 90° of the elbow flexion. The specimens were tested sequentially in three stages of stiffness (stage 0, no stiffness; stage 1, 30° of extension limitation; and stage 2, 60° of extension limitation). A stiff model was sequentially created for each stage after data collection was completed in stage 0. The stiff model of the elbow was created by blocking the olecranon by inserting 2.0 K-wire into the olecranon fossa horizontally with the intercondylar axis.

Results: The mean contact pressures were 279 ± 23 , 302 ± 6 , and 349 ± 23 kPa in stages 0, 1, and 2, respectively. The increases of mean contact pressure in stages 2 versus 0 were significant ($P < 0.0001$). The mean contact pressures were 297 ± 19 , 310 ± 14 , and 326 ± 13 kPa in stages 0, 1, and 2, respectively. The peak contact pressures were 420 ± 54 , 448 ± 84 , and 500 ± 67 kPa in stages 0, 1, and 2, respectively. The increases in mean contact pressure in stage 2 versus 0 were significant ($P = 0.039$). The increases in peak contact pressure in stages 0 versus 2 were significant ($P = 0.007$).

Conclusions: The elbow bears the load created by gravity and muscle contracture in the resting and swing motion. The stiffness of the elbow joint increases the loadbearing in the resting position and swing motion.

EP.08.04

MORPHOMETRIC ANALYSIS OF THE LATERAL COLUMN OF THE DISTAL HUMERUS AND ITS RELEVANCE ON RADIO-CAPITELLAR ARTHROPLASTY DESIGN. A CT ANATOMICAL STUDY ON 50 ELBOWS

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Background: Despite being the basis of prosthetic design, few studies have analyzed the distal humerus anatomy. No data was reported about the anatomical features of lateral column and, in particular, about its medullary canal. The aims of this study were to perform a morphometric analysis of the distal humerus lateral column medullary canal (LCMC) and secondarily to investigate whether a better knowledge of the elbow anatomy may improve radiocapitellar (RCA) arthroplasty design.

Methods: Fifty CTs from 24 males and 26 females with a mean age of 43 years were examined. Two observers measured: 1) the capitellum sagittal (RS) and axial (RT) radii of curvature; 2) the sagittal (Sd) and coronal (Cd) diameters of the lateral column medullary canal (LCMC) in 5 different disto-proximal sites spaced 4mm apart; 3) the capitellum and LCMC axis offsets on the sagittal (capSO, axSO) and coronal (capCO, axCO) planes; 4) the sagittal (Si) and coronal (Ci) inclination of the LCMC axis. The statistical analysis was performed using the ICC test, the Pearson index and the Student t-test.

Results: The mean RS and RT were 1.07 cm and 1.30 cm, respectively. The mean Sd and Cd values were 1.17 cm and 1.58 cm, respectively, with a disto-proximal decrease on both planes. The capSO, capCO, axSO and axCO mean values were 0.76, 1.60, -0.16 and 0.79 cm, respectively. Si and Ci were 70° and 72°, respectively. A strong correlation was found between RS and RT as well as between adjacent levels of Sd and Cd. AxSO and axCO yielded a strong inverse correlation. Significant differences emerged in all the parameters according to patient gender. The ICC was always > 0.9.

Conclusions: The dimensions of the LCMC decrease disto-proximally, with the coronal diameters being greater than the sagittal diameters. The LCMC resembles a portion of an elliptic torus with an antero-medial concavity. The articular surface of the humeral capitellum is non-spherical, with two strongly correlated radii of curvature. The results of this study may be relevant to the stem design of radiocapitellar arthroplasty.

EP.08.05

THE ANATOMIC - MR IMAGING STUDY OF DISTAL TRICEPS BRACHII TENDON

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Background: The study aimed to describe the distal triceps brachii insertion on the olecranon and to correlate the findings with those seen in normal MR (Magnetic Resonance) anatomy of the triceps brachii insertion.

Methods: 14 un-paired fresh frozen elbows were included according to the institution guidelines and dissected. Histologic examination was performed to the distal triceps brachii insertion. The dimension of the distal triceps brachii tendon insertion was measured and defined based on its layer. The measurement of distal triceps brachii insertion was performed with image processing program (Image J, National Institute of Health, Bethesda, Maryland). T1-weighted elbow MR images (3.0 T) of a 102 patients were acquired and analyzed according to its sagittal plane.

Results: All specimens shows that distal triceps brachii tendon is with 3 distinct insertional areas in the olecranon which are: (1) capsular, (2) deep muscular, (3) superficial tendinous insertion with the areas of 80.7mm², 56.4 mm², and 175.2 mm², respectively. The superficial tendinous insertion was observed with a thickened portion, the "central cord" with 0.5 occupation ratio. MR analysis showed that 30% (31/102) of the distal biceps brachii insertion was with a cleft between the bipartite insertion of the superficial tendinous and the deep muscular insertion on olecranon which designated as the "lacuna" which was also found in 35% (5/14) of the specimens.

Conclusions: The distal triceps brachii has 3 distinct insertion on the olecranon. The superficial tendinous layer was separated with the deep muscular layer by a cleft in one third of the cases. Knowledge of this anatomy will help surgeon to understand the partial triceps injury and to avoid iatrogenic injury to the distal triceps tendon during surgery.

EP.09.001

RESULTS OF THE SURGICAL TREATMENT OF TERRIBLE TRIAD OF THE ELBOW AND ANALYSIS OF BONY AND LIGAMENTOUS LESIONS: A RETROSPECTIVE STUDY ON 45 PATIENTS.

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Background: Terrible triad injury (TTI) is one of the main patterns of complex elbow instability and represent a real challenge even for experienced elbow surgeons. Surgical treatment is mandatory to restore joint stability and ensure early mobilization to prevent stiffness. The aim of this retrospective study was to evaluate the clinical and radiographic results of surgical treatment of TTI analyzing the type of radial head and coronoid fracture and ligamentous injuries.

Methods: From 2015 to 2022, 45 patients affected by TTI were treated surgically. All patients underwent preoperative Rx and CT: radial head and coronoid fractures were classified according to the Mason and the O'Driscoll classification, respectively. Ligamentous injuries were evaluated intraoperatively. Functional outcome was performed with the Mayo Elbow Performance Score (MEPS) and a radiographic evaluation.

Results: 29 Mason type III and 16 type II radial head fractures were identified. 30 cases were treated with radial head arthroplasty, 11 cases with screws, 2 cases with anatomic plate and in 2 cases the removal of fragments was performed. According to the O'Driscoll coronoid classification there were 15 type 1.1 cases, 28 type 1.2, and 2 2.2 type fractures. 13 of these were treated with osteosuture, 30 with threaded wires and/or screws, in 2 cases conservatively. The medial collateral ligament was injured in 21 cases and required surgical repair in 2 cases. The lateral collateral ligament was always injured and repaired with suture anchors. The average MEPS was 96.6 points with 36 excellent, 8 good and 1 poor results. The mean flexion, extension, pronation, and supination were 136°, 14°, 75°, and 77°, respectively. Complications observed after surgery were 1 case of moderate stiffness due to the heterotopic ossifications; 4 mild stiffness; 4 with chronic mild lateral pain; 2 with transient PIN palsy. No patients underwent reoperation.

Conclusions: A correct identification of all osseous and ligamentous lesions in TTI, and thus an accurate preoperative planning, are mandatory to achieve a satisfactory result and to reduce the postoperative complications rate. The use of shared therapeutic algorithms is fundamental to achieve these goals.

EP.09.002

CLINICAL RESULTS OF INTERNAL BRACING IN POSTERO-LATERAL INSTABILITY OF THE ELBOW

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Background: A tear of the lateral ulnar collateral ligament (LUCL) with/without tear of the medial collateral ligament (MCL) leads to PLRI or bilateral elbow instability. The majority of these injuries can be treated conservatively. Indications for surgery are persisting instability, osseous lesions or extensive soft tissue damage. The hypothesis is that internal bracing allows early postoperative mobilization and thereby avoids stiffness without endanger stability. The aim of this study is to evaluate clinical results of internal bracing in postero-lateral Instability (PLRI) of the elbow with or without medial elbow instability.

Methods: Between 2013-2019 43 patients with a mean age of 38,8 years (18-67), were treated with internal bracing and included in this study.

After diagnostic arthroscopy and treatment of accompanying lesions refixation and internal bracing of the LUCL complex was performed with an absorbable tape and knotless anchors.

In cases with significant medial instability refixation and internal bracing of the MCL was performed in the same session. All patients were treated without a splint and immediately mobilized.

The Mayo Elbow Performance Score (MEPS), Oxford Elbow Score (OES), Visual Analogue Scale (VAS), and subjective evaluation of the postoperative result were evaluated.

Clinical stability of the elbow was evaluated with the Push-up Test, the Pivot-shift test, Stand-up test and the pincer grip.

Results: The mean Follow-up was $3,5 \pm 1,6$ years (2-8). Post-OP ROM improved significantly (extension/flexion) mean: 0/6/144 (range: 0/0-70/130-150) in comparison to Pre-OP mean: 0/21/122 (range: 0/0-70/60-150) $p < 0,05$. At FU the mean score results were: OES: $39,2 \pm 9$ (11-48) points, MEPS: $85,2 \pm 18,6$ (30-100) and the VAS was $1,5$ ($0-8 \pm 2,1$). Patients evaluated the operation postoperatively by school marks (1-6) by a mean of 1,9. There were no clinical signs of persistent instability in clinical testing in any patient.

Conclusions: Internal Bracing in posttraumatic instability of the elbow led to good subjective and objective score results. Early mobilization allowed to regain almost full ROM without persistent instability.

EP.09.003

THE FACTORS IN RESIDUAL LAXITY OF THE MEDIAL SIDE OF ELBOW JOINT AFTER ELBOW DISLOCATION

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Background: Surgical treatment of an unstable elbow is often performed from the lateral collateral ligament complex (LCLC). The medial repair is thought to be needed when the stability is not confirmed after lateral repair. This study aimed to investigate the factors affecting the degree of residual laxity in the medial side based on surgically treated cases of elbow dislocation.

Methods: From June 2006 to April 2016, 28 patients who underwent surgical treatment for instability after elbow dislocation were included. MRI was performed in all cases, and the anterior band of an ulnar collateral ligament (UCL) and anterior capsular rupture (ACR) were divided into proximal, interstitial, and distal rupture through MRI. The rupture of the flexor muscle was divided into partial and complete rupture. The mean distance from the valgus stress radiograph was measured at an average 4-year follow-up to determine the degree of residual medial laxity.

Results: UCL repair was performed in 13 cases. Anterior band tear of UCL occurred in all cases, which were divided into 24 cases of proximal tear and 4 cases of distal tear. The ACR was 3 cases in proximal and distal ruptures, respectively, and 22 cases had an interstitial rupture. Complete and partial ruptures of flexor muscle were 14 cases, respectively. The mean valgus stress view difference between the affected and unaffected sides was 0.5mm (range -1.5mm ~ 2.9mm). There was no statistically significant difference in the degree of medial laxity between the patients who underwent repair and those who did not ($p = 0.437$). The distal tear had a greater degree of medial laxity than the proximal tear among the non-surgically treated UCL group ($p=0.004$). There was no statistical significance in the site of the ACR ($p = 0.375$) and rupture of the flexor muscles ($p=0.653$).

Conclusions: In patients with UCL that were not repaired, the degree of medial laxity is higher with a distal tear. Therefore, in the case of a distal tear of the UCL on the MRI, Medial repair might be considered.

EP.09.004

TREATMENT OF POSTERO-LATERAL UNSTABLE ELBOW DISLOCATIONS WITH/WITHOUT FRACTURES

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Background: Elbow dislocation fractures with postero-lateral instability are sometimes encountered, but successful treatment becomes often a challenge for the surgeon, due to the potentially conflicting goals of restoring elbow stability and regaining a satisfactory arc of motion. We report on thirty one elbows who suffered from postero-lateral unstable elbow dislocations with/without fractures.

Methods: Ave. age of patients was 42.8 yrs.(range, 17- 82). Twenty four patients were treated within two weeks after injury, and seven were more than two weeks. Surgeries were all performed in one institution by plural surgeons. All patients were treated with open reduction and internal fixation for the concomitant fractures, repair or/and reconstruction for the damaged soft tissue. Ave. F/U period was 1.5 yrs. (range from 6 mos. to 8 yrs.). Our surgical strategy is following; Anterior supporting structures (coronoid fracture including capsule/brachialis or the ulnar side of the annular ligament) were fixed and repaired at first, then radial head fracture was fixed or replaced to prosthesis, latter, the LCL complex was repaired, and/or MCL if necessary. Furthermore if instability was still remained, "hinged external fixation" was applied. Passive ROM exercise was started after 3 days to 2 wks. postoperatively.

Results: Ave. ROM at F/U was -13.3° (range; -30°- 0°) extension, 131.6°(range; 110°-145°) flexion. Clinical examination at F/U revealed no evidence of elbow instability. Ave. MEPS was 92.7 points (range; 70 -100). Six "hinged external fixations" were performed as additional fixation.

Conclusions: Only by a combination of open and anatomical reduction for bone and soft tissue components, stable elbow was achieved in 4/5 cases. Finally our surgical strategy was useful for regaining stable elbow for postero-lateral unstable elbow dislocations in all cases. Based on recent our experience, if the ulnar side of the annular ligament is detached from the base of the coronoid, we believe that pulling it out posteriorly at there as one of anterior supporting structures might also be helpful for obtaining stability. More cases and longer-term assessment will be needed.

EP.09.006

MIXED REALITY ASSISTED PLACEMENT OF ELBOW INTERNAL JOINT STABILIZER: CASE REPORT

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Background: The internal joint stabilizer (IJS Skeletal Dynamics) is a unique device that relies on the transepicondylar axis of the distal humerus to obtain early stable concentric ulnohumeral range of motion in cases of unstable elbow fracture dislocations and other indications. The goal is to minimize external fixator complications while early active motion and protecting soft tissues that have been repaired. Although there is an available guide for placement of the transepicondylar axis pin, this can still be a challenging part of the case and it is critical the outcome.

Methods: Preoperative dicom images of a left elbow terrible triad injury in a 76 year old female were converted to a 3d hologram that demonstrated the planned transepicondylar axis for the axis pin as well as the planned radial head implant. These holograms were available via the Microsoft Hololens 2 to be manipulated by the surgeon intraoperatively assist the case.

Results: A mixed reality hologram allowed for precise execution and placement of the transepicondylar axis pin. All holograms were manipulated by the surgeon throughout the procedure with simple hand gestures while maintaining sterility. The patient's short term outcomes have been excellent (flexion-extension > 100 degrees, no limitations in pronation/supination).

Conclusions: MR holographic surgery creates new possibilities for planning and execution of many types of cases and can be seamlessly integrated into OR workflow. It does not require disposable or sterilizable implants, and provides the surgeon with additional tools to help execute the surgical plan. In this case, MR holograms were instrumental in assisting the surgeon to place the transepicondylar axis pin of the IJS.

EP.09.008

CONGRUENCE ANGLE AND LATERAL ULNAR TRANSLATION: A NOVEL MEASUREMENT TO ASSESS INSTABILITY AFTER SIMPLE ELBOW DISLOCATION

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Background: A dislocated elbow retained in flexion or the drop sign may require surgery. However, the clinical significance of drop signs is debatable, and additional techniques to assess remaining stability on static imaging have not been investigated. This study was to propose novel measurements to assess elbow instability after simple dislocation using axial imaging.

Methods: This retrospective study included patients with simple elbow dislocations who underwent lateral collateral ligament repair between 2011 and 2021. Preoperatively, plain radiographs were taken to measure ulnohumeral distance (UHD) and computed tomography (CT) scans were taken to evaluate UHD and novel measurements including congruence angle, lateral ulnar tilt, and lateral ulnar translation. At the final follow-up, a plain radiograph to assess UHD and varus stress test were performed to check remaining instability after at least 3 months of surgery. Two observers measured all parameters twice with a 4-week interval. We assessed (1) inter- and intraobserver reliability of novel measurements, (2) correlations between novel measurements and preoperative UHD, and (3) correlations between novel measurements and postoperative varus laxity and UHD.

Results: A total of 16 patients were analyzed. For interobserver reliability, congruence angle showed almost perfect reliability, and lateral ulnar translation showed substantial-to-almost perfect reliability. All measurements showed almost perfect reliability for intraobserver reliability. Preoperative UHD measured using CT (UHDCT) was significantly highly correlated with congruence angle ($P = 0.001$) and lateral ulnar translation ($P = 0.001$). Postoperative varus laxity was significantly moderately correlated with lateral ulnar translation ($P = 0.024$), and postoperative UHD was significantly highly correlated with congruence angle ($P = 0.018$) and moderately correlated with lateral ulnar translation ($P = 0.020$).

Conclusions: Novel measurements using the axial image of a CT scan showed good interobserver and intraobserver agreement. Congruence angle and lateral ulnar translation were correlated with preoperative UHDCT and showed signs of postoperative instability. To assess the remaining elbow instability after simple elbow dislocation, novel measurements using an axial image should be actively considered.

EP.09.010

THE INTERNAL JOINT STABILIZER OF THE ELBOW: A REVIEW OF THE CLINICAL AND BIOMECHANICAL EVIDENCE

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Background: The goal of surgical management for unstable elbow injury is restoration of joint concentricity and stability. Following internal fixation, instability may persist, or there may be concern for the durability of the fixation construct. Historically, these scenarios were treated with options such as transarticular pinning or external fixation. Recently, there is momentum for internal joint stabilization that allows postoperative mobilization. Our objective was to systematically review the literature to aggregate the clinical and biomechanical evidence for the internal joint stabilizer (IJS) of the elbow.

Methods: A systematic review was performed in keeping with the PRISMA guidelines. Articles were organized according to study type and device type. These groups were the following: retrospective clinical reports on the IJS, case reports on the IJS, retrospective reports of intraoperatively constructed internal joint stabilization, and biomechanical reports on the IJS.

Results: There were 7 retrospective clinical reports on the IJS totaling 130 cases at a mean term of follow up of 12.1 months. Across 6 articles, the mean Disabilities of the Arm, Shoulder, and Hand score was 24.2. All 7 articles reported the complication of implant failure with a pooled rate of 4%. Recurrent instability was reported by 6 articles with a pooled rate of 4%. Four of the 6 articles reported a 0% rate of recurrent instability.

Conclusions: The unstable elbow has consistently been an arduous task for surgeons. Surgical management is intended to provide adequate stability to counter the forces that are generated by early motion. Immobilization provides stability to allow healing but commonly leads to stiffness. Early mobilization mitigates the risk of stiffness but may disrupt a tenuous surgical repair. External devices have accomplished the goals of stability and motion capability, but complications reduce the utility of this option. A temporary internal device was developed to stabilize the elbow which allows the initiation of motion. The aggregate literature describes satisfactory clinical outcomes and biomechanical efficacy for the IJS. Additionally, case reports have expanded the understanding for case application, device position, and surgical approach for the IJS.

EP.09.011

FLEXED CT ARTHROGRAPHY SHOWS INTRA-ARTICULAR FINDINGS IN PATIENTS WITH RECALCITRANT LATERAL ELBOW PAIN COMPARED TO CONTROLS

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Background: Degeneration and tendinosis of the common extensor origin are generally considered the main causes of lateral epicondylitis. Evidence suggests that extra-articular as well as intra-articular and systemic factors may be the source of pain. We aim to compare the incidence of objective radiological signs associated to lateral ligamentous patholaxity in patients with and without symptoms of recalcitrant lateral elbow pain.

Methods: All scans of patients receiving CT-arthrography in flexion prior to invasive interventions were analysed retrospectively, from April 2019 to August 2021. Exclusion criteria were the presence of bony injuries, major cartilage lesions and gross ligamentous pathology at CT-arthrography or clinical history of infection, trauma, deformity or major instability. Eligible patients were divided into two groups depending on the presence (cases) or absence (controls) of clinical symptoms of lateral recalcitrant elbow pain. The presence of four areas of intra-articular pathologic findings was documented: 1) synovitis anterior or posterior to the radial head, 2) Chondral Erosion of the Lateral Aspect of the Radial Head (CELAR) or a specific Chondropathy the Lateral Aspect of the Capitellum (CLAC), 3) leakage of contrast agent through lateral ligamentous structures, 4) hyperdistention of the annular ligament, (Loose Collar Sign), possibly associated with abnormal widening and ballooning of the lateral capsule.

Results: 90 out of 120 patients screened. Symptoms related to the lateral aspect of the elbow were documented in 62 cases (68.9 %). Synovitis was the most frequently reported finding (83.3 %) within the study population. The presence of at least two, three and four intra-articular findings were found to be significantly more frequent in the cases as compared to the controls ($p = 0.0160$, $p = 0.0002$ and $p = 0.0179$ respectively). The presence of recalcitrant lateral elbow pain was associated with a higher odd of presenting positive intra-articular findings (3,27, 6,66 and 8,47 with the increase in the number of associated findings).

Conclusions: CT-arthrography is a valid diagnostic tool and should be implemented in the diagnostic evaluation of all patients complaining of recalcitrant lateral elbow pain. The presence of three intra-articular findings is suggested as a diagnostic cut-off to define intra-articular pathology associated with recalcitrant lateral elbow pain.

EP.10.001

ARTHROSCOPIC ASSESSMENT FOR LATERAL COLLATERAL LIGAMENT COMPLEX DEFICIENCY: A CADAVERIC STUDY

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Background: Arthroscopy can reliably assess elbow instability due to lateral collateral ligament-capsular complex (LCL-cc) injury.

Methods: Eight fresh human cadaveric elbows were placed in a simulated lateral decubitus position. Different probe sizes were used to measure the radiocapitellar joint (RCJ) gap and ulnohumeral joint (UHJ) gap (mm) from the posterolateral viewing portal. The elbow was flexed 90° with a neutral forearm rotation for the RCJ gap measurement and flexed 30° with full supination for the UHJ gap measurement. Sequential testing was performed from Stage 0 to Stage 3 (Stage 0: intact; Stage 1: the release of the anterior 1/3 LCL complex; Stage 2: the release of the anterior 2/3 LCL complex; and Stage 3: the release of the entire LCL complex) on each specimen. A comparison between stages with the intact elbow was performed using the mean gap of the RCJ and the lateral UHJ.

Results: The mean RCJ gap distance in Stage 2 and Stage 3 was significantly increased compared to that in Stage 0 (Stage 0 vs. Stage 2: $P = .008$; Stage 0 vs. Stage 3: $P = .010$). The mean UHJ gap distance of Stage 1, Stage 2, and Stage 3 was significantly increased compared to that in Stage 0 (Stage 0 vs. Stage 1: $P = 0.025$; Stage 0 vs. Stage 2: $P = .010$; Stage 0 vs. Stage 3: $P = .011$). In contrast, the release of the anterior 1/3 of the LCL complex (Stage 1) was not significantly increased compared to the mean joint gap distance of the RCJ ($P = .157$).

Conclusions: Arthroscopic measurement of the joint gap widening in RCJ and UHJ is a reliable assessment method in detecting LCL complex deficiency that involves the anterior 2/3 or more.

Study design: Controlled laboratory study, cadaveric study

EP.10.002

COMMON EXTENSOR ORIGIN REPAIR WITH FRACTIONAL LENGTHENING OF THE FOREARM COMMON EXTENSORS FOR 'TENNIS ELBOW'

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Background: This study looks at the outcomes of CEO repair and fractional lengthening of the forearm common extensors for recalcitrant tennis elbow. We also compare the results between compensable and non-compensable patients.

Methods: 98 elbows in 84 subjects were surgically treated between 2005 and 2021. All elbows had severe resistant symptoms, unresponsive to a minimum 6 months of conservative treatment with stretching and strengthening physio. All elbows showed either CEO tear in the common extensor tendon origin at preoperative imaging. CEO repair was with suture anchor fixation. Fractional lengthening (FL-CE) was through a small 2 cm incision and involved the ECRB-L, EDC, superficial head of the supinator and release of the PIN at the Supinator Tunnel if clinically indicated. All patients were allowed unrestricted elbow range of motion from day 1 and commenced stretches and resistance training from week 2 post-op. Outcome measures used were VAS pain score, ROM, grip strength, Maudsley, and quick DASH, measured at 2, 6, 12 and 52 weeks post-op. We also compared compensable (Co) versus non-compensable (NC) cases.

Results: With 2 lost to follow-up 96 elbows were available for a 12 month analysis. 44 (45%) cases were compensable. The mean VAS pain score was 8.9 pre-op and 3.2 at week 2 and 0.7 at 52 weeks. The DASH scores improved from 59 to 25 by week 2 and 11 by week 52. The DASH work module scores improved from 75 to 21 by week 2 and 12 by week 52. 78% cases had full elbow extension by week 2, 89% by week 12 and 97% by 52 weeks. Maudsley test was negative in 81% by 2 weeks and 99% by 52 weeks. 14 cases returned for opposite side surgery. At the time of surgery 49 (43 Co, 6 NC) cases were on medical leave or modified duties at work. Return to work (RTW) rate was 61% at 2 weeks and 100% at 52 weeks. There was no difference between the Co and NC groups.

Conclusions: CEO repair combined with common extensor fractional lengthening of the common extensors is effective for recalcitrant tennis elbow.

EP.10.003

COMPARATIVE STUDY BETWEEN SCALES: SUBJECTIVE ELBOW VALUE AND PATIENT-RATED TENNIS ELBOW EVALUATION APPLIED TO PATIENTS AFFECTED BY LATERAL EPICONDYLITIS

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Background: Objective To verify if the subjective elbow value (SEV) scale presents similar results to those of the Patient-rated Tennis Elbow Evaluation (PRTEE) scale in the evaluation of patients with lateral elbow epicondylitis (LEE).

Methods: Methods Thirty-seven patients were diagnosed with LEE in the outpatient service of our hospital through clinical history, physical examination, X-ray, and ultrasonography. The SEV and PRTEE scales were used and their results were compared using a significance 5% ($p < 0.05$).

Results: In total, 25 patients were female (67.6%); the mean patients' age was 47 years, 10 months-old, and 27 (79.4%) subjects performed activities associated with repetitive elbow or wrist movements. At the physical examination tests, 86.4%, 81%, and 67.5% of the patients presented positive results at the Cozen, Mills, and Gardner tests, respectively. The Mann-Whitney test was used to evaluate whether gender and laterality represented important factors in SEV results and found no statistically significant differences. Therefore, the fact that the patient affected by LEE was male or female did not influence the degree of elbow involvement ($p = 0.179$); similarly, whether the affected side was the right or left one did not represent a statistically significant factor ($p = 0.433$). The Spearman correlation analysis evaluated if there was a statistically significant relationship between the results obtained with the SEV and PRTEE scales; since this relationship actually existed, results were equivalent when both scales were applied ($p = 0.017$).

Conclusions: Subjective elbow value is a functional scale with statistically similar results to those of PRTEE in the evaluation of untreated LEE patients.

EP.10.004

THE LIVED EXPERIENCE OF PATIENTS WITH LATERAL ELBOW TENDINOPATHY A QUALITATIVE STUDY FROM THE OPTIMISE PILOT & FEASIBILITY TRIAL

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Background: Lateral Elbow Tendinopathy (LET), also known as Tennis Elbow, is a common condition whose burden may not be fully appreciated by healthcare professionals. Despite previous studies reporting the epidemiology, economic burden, and health outcomes of LET, to our knowledge there are no qualitative studies reporting the experiences of patients with this condition. The aim of this study was, therefore, to understand and describe the lived experience of individuals suffering from LET.

Methods: Qualitative semi-structured interviews were conducted as part of a mixed-methods randomised controlled pilot & feasibility trial of patients attending physiotherapy clinics in the UK. Patients with LET were purposively sampled to provide a representative sample based on age, sex, ethnicity, deprivation index and treatment allocation within the OPTimisE Pilot & Feasibility Trial (ISRCTN registration: 64444585, 19/7/2021). Interviews were analysed using thematic analysis.

Results: 17 patients were interviewed. Four themes were identified: (1) the cause of onset - attributed to sudden changes in activity, repetitive work, or compensating for other musculoskeletal conditions; (2) the level of disability - impact on function and quality of life was significant, particularly due to impacts on sleep due to pain, and difficulties performing daily tasks (related to work and hobbies) due to pain, though most were able to persevere with work; (3) self-help and understanding of the condition - limited and confused by the diagnostic term 'Tennis Elbow' that non-sporting individuals struggled to relate to, and uncertainty about the appropriateness and potential harm of online advice; (4) the healthcare experience - the treatment they received was highly variable and often perceived as ineffectual.

Conclusions: This study describes: patients' common perceived causes of LET; its impact on their ability to perform daily tasks, sleep, work and hobbies; the hesitancy of people to rely on online information without formal healthcare advice; the unrelatable nature of the common label of 'Tennis Elbow'; the wide array of treatment options provided with many lacking evidence of effectiveness. This highlights the need for research and guidance for healthcare professionals into the most cost-effective treatment strategy for this common but disabling condition.

EP.10.005

LCL COMPLEX INSUFFICIENCY IN RECALCITRANT LE; MRI EVALUATION WITH ARTHROSCOPIC FINDING

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Background: Subtle instability in chronic recalcitrant lateral epicondylitis (LE) has been described but only a few studies evaluated magnetic resonance imaging (MRI) to assess the integrity of the lateral collateral ligament (LCL) complex without the correlation with arthroscopic findings.

Methods: 49 cases of chronic recalcitrant LE were divided into two groups according to the involvement of LCL (Intact and Involved) based on the MRI confirmation by the radiologist. Patient information such as the history of steroid injection and symptom duration was extracted from the medical records. Arthroscopic images were retrieved to evaluate the integrity of the lateral capsule and concomitant plica.

Results: 24 and 25 cases were respectively included in LCL Intact and LCL Involved groups. 7 cases (28%) were with a complete tear of radial collateral ligament in LCL Involved group. Symptom duration (15 ± 9 vs 22 ± 13 months, $p=0.029$) and the number of steroid injections (3 ± 2 vs 5 ± 3 times, $p=0.040$) were significantly higher in LCL Involved group than that in LCL Intact group. The capsular tear was found in 5 cases (20%) in LCL Intact and 14 cases (56%) in LCL Involved group ($p=0.027$). The concomitant plica was observed for 15 cases (62%) in LCL intact and 7 cases (28%) in LCL Involved group. ($p=0.015$) RC joint widening was observed in 4 cases of LCL involved group.

Conclusions: Concomitant pathology was observed in the chronic recalcitrant LE which include the LCL complex insufficiency and pathologic elbow plica lesion. Multiple steroid injections may be considered as a risk factors for LCL insufficiency associated with refractory LE. Arthroscopic finding such as capsular tears and elbow drive-through signs may serve as a tell-tale signs for LCL complex insufficiency.

EP.10.007

RESULTS OF ANATOMICAL REINSERTION OF THE DISTAL BICEPS BRACHII TENDON WITH A SINGLE MINIMALLY INVASIVE TECHNIQUE

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Background: Distal biceps tendon rupture (DBTR) is a relative rare injury usually occurring with excess external extension force applied to flexed elbow. Recognition and treatment of distal biceps tendon ruptures is increasing, likely because of greater clinical awareness and the greater activity and demands of the middle-aged population. The aim of the study is to evaluate the outcomes of anatomical reinsertion with anterior mini-invasive technique.

Methods: 30 patients affected by DBTR were selected, including 7 professional athletes. The mean age was 44 years (18-65), the patients were all males. The mean interval between the lesion and surgery was 11 days (3-70). In all this cases a single mini anterior approach of about 3 cm over the radial tuberosity was performed. The tendon was repaired with suture anchors in all cases. During the follow-up examination, mobility, elbow radiographs, Mayo Elbow Performance Score (MEPS) and MRC scale for strength test, were evaluated.

Results: The mean follow up was 18 months (6-36). According to the MEPI, 26 excellent and 4 good results were observed. All patients recovered full range of motion. A 5/5 and 4/5 of muscle strength were observed in 25 and in 5 cases, respectively. No major complication occurred. 4 patients had a transient palsy of cutaneous lateral nerve. All patients returned to work and sport activities.

Conclusions: Mini-invasive technique of suture anchor reinsertion by single access showed a satisfactory results both in acute and chronic cases. Full strength recovery was found in the majority of cases, including professional athletes.

EP.10.008

PAIN MECHANISM OF RECALCITRANT TENNIS ELBOW. CONSIDERATION FROM SURGERY UNDER LOCAL ANESTHESIA

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Background: The cause of recalcitrant tennis elbow pain is still largely unknown. We performed tenodesis with bone marrow venting under local anesthesia for recalcitrant lateral epicondylitis. Here, we consider the pain mechanism of recalcitrant tennis elbow from intraoperative findings and postoperative clinical results.

Methods: Thirty-four patients (36 elbows) were treated with bone marrow venting at the painful area of the lateral epicondyle of the elbow and tenodesis using 2 soft anchors lateral to the capitellum (immediately distal to the painful area) and were followed up more than 1 years. Patients were assessed using the numerical rating scale for pain and the Quick Disabilities of the Arm, Shoulder, and Hand questionnaire, and objective evaluation included active range of motion.

Results: The mean preoperative and postoperative Quick Disabilities of the Arm, Shoulder, and Hand questionnaire scores were 41.7 and 0.8, respectively ($P < .001$). One elbow had a slightly positive Thomsen test at the final visit. Intra-articular symptoms can be improved by stabilization of the lateral soft tissue without treatment for intra-articular lesions. Patients experienced more pain at the bone-tendon junction of extensors than at the tendon parenchyma.

Conclusions: Intraoperative findings suggest that The main pain mechanism of recalcitrant tennis elbow is the bony hypersensitivity at the extensor tendon entheses, which is localized. Our clinical results support that the relationship between intra-articular lesions in recalcitrant lateral epicondylitis and minor instability due to degeneration of the origin of the common extensors, mainly the ECRB.

EP.10.009

DOES TIME BETWEEN TRAUMA AND SURGERY AFFECT THE CHOICE OF SURGICAL TECHNIQUE AND CLINICAL RESULTS IN DISTAL BICEPS TENDON RUPTURES?

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Background: Few studies analyzed the influence of delayed treatment on the choice of surgical technique and outcomes of distal biceps tendon ruptures (DBTRs). The aim of this study is to evaluate how trauma to surgery time (T-S) influences 1) the choice between primary repair (PR) and reconstruction with autograft (AR) and 2) clinical results.

Methods: 59 consecutive DBTRs treated surgically were analyzed. Patients were divided in 3 groups: group I (28 patients, T-S<21 days), group II(10 patients, 21<T-S<45 days) and group III(21 patients, T-S>45 days). Surgical treatment(PR vs AR) and clinical results were evaluated. The choice between PR and AR was taken intraoperatively based on the feasibility to perform a PR in extreme flexion. Clinical results were evaluated with MRC scale, ROM, MEPS and DASH. Statistical analysis was performed.

Results: Overall, mean T-S was 80 days; in particular, T-S was 9(range,2-19), 29(range,22-39) and 200(range,45-1095) days in group I,II and III,respectively. PR was performed in all patients treated within 45 days except one of group II where the tendon was severely degenerated after 36 days. In 17 out of 21 patients of group III,AR was performed(81%); in the 4 remaining patients treated with PR within 80 days, the tendon was found near the radial tuberosity, adherent to the peritendineous sheath. T-S significantly affected the choice of surgical treatment with statistical differences between group III and the other groups($p<0.05$).

Mean MEPS and DASH were 97,97,95 and 0.32,0.5 and 2.83 in groups I,II and III, respectively. Mean ROM was complete in group I; 2 cases in both group II and III had a mild deficit in P/S(10°). Four transient LACN paresthesiae were observed (1 in group I and 3 in group III). No significant clinical differences were observed among groups($p>0.05$).

Conclusions: T-S significantly affects the choice of surgical treatment in DBTRs. PR is achievable in 98% of acute and subacute ruptures, while AR is needed in over 80% of chronic tears. Beyond three months, all patients of this series underwent AR. Although a more complex surgical technique is needed in chronic setting, expected clinical results are similar to acute lesions, with a limited rate of minor complications.

EP.10.011

PLATELET-RICH PLASMA IN ELBOW TENDINOPATHY: OUR EXPERIENCE IN USING PRP TO FACILITATE DISCHARGE FROM SPECIALIST CARE

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Background: Background: Lateral and medial epicondylitis affects 1-3% of adults each year. It is due to repetitive eccentric overuse causing imbalance between microtrauma and poor tendon repair. Recovery is variable, and those with symptoms over 6 months are more likely to have recalcitrant symptoms requiring intervention. This places a significant clinical burden and expense on the tertiary healthcare system owing to multiple clinical visits and surgical intervention. The aim of this study is to evaluate the effectiveness of platelet rich plasma (PRP) in the treatment of lateral and medial epicondylitis to a patient acceptable symptom state where specialist care is no longer required.

Methods: Methods: A retrospective review of cases from October 2016 to November 2020 in a single centre was conducted who were treated with one autologous PRP injection for medial or lateral epicondylitis. 42 patients met the criteria (48 elbows, 6 bilateral). There was an equal split of medial and lateral epicondylitis. Patient's clinical presentation, duration of symptoms, and time from PRP injection to discharge were recorded. The primary outcome measurement was discharge time from PRP treatment to patient-acceptable symptom state. A successful outcome was defined as reaching the patient acceptable symptom state with no further interventions required.

Results: Results: Eighty three percent of patients who underwent PRP did not require further treatment and was discharged successfully. The average discharge time between PRP treatment to patient-acceptable symptom state was 3.8 +2.4 months overall. The subgroup of patients with 6-18 months of symptom duration had 3.4 +/- 2 months prior to discharge, with only 4.7% requiring further surgical intervention. This rose to 5.8 months in those with symptoms present for longer than 18 months, with 42.8% requiring further intervention.

Conclusions: Conclusions: The majority of patients in this study were successfully treated with PRP to an acceptable symptom state. PRP injections is a feasible and safe and cost effective (£104.60 per syringe) option in treating epicondylitis, and can facilitate discharge from specialist care, especially in more recalcitrant cases with symptoms greater than 6 months where outcomes are variable. It was less effective after 18 months of symptoms.

EP.11.001

BIOMECHANICAL COMPARISON OF ULNAR COLLATERAL LIGAMENT RECONSTRUCTION WITH INTERNAL BRACE AUGMENTATION VERSUS MODIFIED DOCKING TECHNIQUE

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Background: Ulnar collateral ligament (UCL) reconstruction (UCLR) is a common surgery among baseball pitchers. UCL repair combined with augmentation using high strength tape, referred to as an internal brace, was developed as an alternative to UCLR in select patients with the benefit of allowing these athletes to return to sport (RTS) faster. A combined UCLR with an internal brace may allow players indicated for an UCLR to RTS more expeditiously.

Methods: 24 cadaveric elbows were divided into 3 groups: 12 specimens into the modified docking (MD) group, 6 into the double docking (DD) group and 6 into the double docking with internal brace augmentation (DDA) group. This allowed a 1:1 comparison of the MD to the DD and the MD to the DDA. Valgus cyclic testing of native and reconstructed specimens was executed at 90 degrees of elbow flexion. After preconditioning, all specimens were cycled between 2 Nm and 10 Nm for 250 cycles. Reconstructed specimens continued to a torque test to catastrophic failure stEP. Outcome data included intra-cyclic stiffness, maximum cyclic rotational displacement, gap formation, and failure torque.

Results: Cyclic stiffness of the constructs remained constant throughout the entirety of the torque-controlled cycling phase. DDA group resulted in a 38% increase in cyclic stiffness from native testing (not statistically significant), and a statistically significant 54% increase from the MD ($p=0.002$). The DDA mean cyclic stiffness was significantly greater than Native ($p<0.001$), DD ($p=0.025$), and MD ($p<0.001$) groups. Between reconstruction groups, mean gap formation was greatest amongst the MD group ($2.51 \text{ deg} \pm 1.59 \text{ deg}$) and least for the DDA group ($1.01 \text{ deg} \pm 0.57 \text{ deg}$) but did not reach statistical significance.

Conclusions: Tape augmentation to the modified UCLR (DDA group) improved cyclic stiffness and reduced gap formation compared to the modified docking (MD) group.

EP.11.005

MRI FINDINGS OF ELBOW UCL TEARS IN BASEBALL PLAYERS AFTER PLATELET-RICH PLASMA (PRP) THERAPY

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Background: Platelet-rich plasma (PRP) therapy has been shown to be effective in treating ulnar collateral ligament (UCL) tears of the elbow of overhead throwing athletes. Magnetic resonance imaging (MRI) is the gold standard diagnostic tool for UCL tears. However, to our knowledge, there are no studies that consider MRI evaluation after PRP therapy.

Methods: Sixty-one (61) baseball players (12 professional, 9 amateur, 32 college, 7 high school) who underwent PRP therapy for UCL tears of the elbow from December 2016 to March 2022 were included. All recalcitrant to more than two months of rest and physical therapy. Players who had previous UCL surgery were excluded. MRI scans were taken before PRP therapy, and more than three months after PRP therapy (average 7.84 months). Images of UCL injury were classified into four grades by a musculoskeletal radiologist. Grade 0-intact, 1-swelling, 2-incomplete tears, and 3-complete tears. The change in MRI grading pre- and post-PRP therapy was classified as 'improved', 'no change' or 'deterioration'. Further, we analyzed the change in disability of the arm, shoulder, and hand (DASH) sports score and visual analog scale (VAS) score, categorized by the change of MRI grade. ANOVA was used to compare the three groups.

Results: Of the 61 cases, 59 were baseball players who underwent MRI evaluation pre-and post-PRP therapy. The change in MRI grade was 'improved' in 29 cases (49.2%), 'no change' in 26 cases (44.1%), and 'deterioration' in 4 cases (6.7%). The change in average DASH sport score from pre-PRP to post-PRP was 71.5 to 18.9, and the average VAS was from 52.4 to 13.2, respectively. The sample mean values (standard deviation) of MRI grade and DASH sports score pre- and post-PRP therapy was 51.6(6.4), 51.0(6.7), and 61.1(17.2) in the 'improved', 'no change', and 'deterioration' groups, respectively ($P = 0.49$). The VAS score sample mean values (standard deviation) were 45.3(4.9), 37.7(5.2), and 25.0(12.3) for 'improved', 'no change', and 'deterioration' groups, respectively ($P = 0.28$).

Conclusions: PRP therapy for UCL injury affected the objective evaluation of MRI image findings after therapy. The subjective evaluation of DASH sports score and VAS generally reflected MRI findings before, and after PRP treatment.

EP.11.006

RELIABILITY OF ULTRASOUND MEASUREMENT OF THE ULNOHUMERAL JOINT SPACE WITH AND WITHOUT FLEXOR PRONATOR MUSCLE CONTRACTION UNDER GRAVITY VALGUS STRESS

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Background: Dynamic contraction of flexor pronator muscles (FPMs) plays a key role in stabilizing the elbow joint against valgus force. Ultrasound assessment of FPMs as a dynamic stabilizer of the elbow has already been reported in the literature. However, reliability has not been assessed. This study aimed to determine the reliability of ultrasound measurement of the width of the ulnohumeral joint space with and without contraction of FPMs in valgus stress.

Methods: Eighteen (18) Japanese National Professional Baseball players were enrolled, and 36 elbows were studied. The width of the ulnohumeral joint space from the trochlea of the humerus to the sublime tubercle of the ulna was measured with and without isometric contraction of FPMs using ultrasound. All measurements were performed with the patient in supine position, shoulder in 90° of abduction, and forearm in the neutral position. Gravity valgus stress was applied to the elbow joint. Four examiners measured the ulnohumeral joint space using ultrasound, and inter examiner reliability was estimated with intraclass correlation coefficients (ICCs).

Results: The ICC was 0.94 (95% CI 0.91–0.96) under isometric contraction and 0.87 (95% CI 0.81–0.92) without contraction. These results show that ultrasound assessment scores from good to excellent for this purpose in the ICC.

Conclusions: Ultrasound is a reliable method for the measurement of the ulnohumeral joint width space with and without FPMs isometric contraction and under valgus stress force.

EP.11.007

INCIDENCE OF HETEROTOPIC OSSIFICATION AFTER ELBOW ARTHROSCOPY

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Background: HO formation after elbow arthroscopy is uncommon and rarely discussed as a complication. Little is known about this complication as most of the reported investigations are case reports and asymptomatic. This study aimed to assess the incidence of heterotopic ossification (HO) after elbow arthroscopy.

Methods: Data of consecutive patients receiving elbow arthroscopy from May 2011 to April 2022 at the ' center were retrospectively reviewed. HO identified on the radiograph was graded using the Hasting & Graham classification. The clinical outcomes were assessed using the pain Visual Analogue Scale (VAS), and the functional outcomes were evaluated using the Quick Disabilities of the Arm Shoulder and Hand (QuickDASH) questionnaire, the Mayo Elbow Performance Score (MEPS), and the Single Assessment Numeric Evaluation (SANE) before and after surgery. Paired t-test was used to evaluate the difference between preoperative and the last follow-up clinical outcomes. Bivariate logistic backward stepwise regression was used to determine factors affecting the incidence of HO. The primary outcome of this study is the incidence of HO formation, and the secondary outcome was the time and location of HO occurrence and the effect of HO on clinical outcomes after elbow arthroscopy.

Results: Of the 205 patients enrolled, 13 (6.3%) of them had HO with 10 formed on the medial compartment of the elbow. Ten (76.9%) were diagnosed at 8 weeks, and HO was not found at 2 weeks after surgery in any patient. The mean age at the time of surgery was 51.1 years (range, 13–75). The mean follow-up time was 64.0 weeks (range, 8.6–460.1 weeks). At the last follow-up, the functional outcomes of the 11 non-surgical patients were improved for QuickDASH, MEPS, and SANE (all $P < 0.001$). However, the VAS score slightly improved without statistical significance ($P = 0.064$).

Conclusions: Being a minor complication after elbow arthroscopy, most HO has minimal or no clinical effect and occurred at the medial compartment of the elbow. Patients should be monitored for a minimum of 8 weeks postoperatively for HO development.

EP.11.008

OUTCOMES FOLLOWING ARTHROSCOPIC POSTEROMEDIAL OSTEOPHYTE RESECTION AND RISK OF FUTURE ULNAR COLLATERAL LIGAMENT RECONSTRUCTION

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Background: Despite successful return to sport (RTS) outcomes after posteromedial osteophyte resection, one possible consequence of removing this osteophyte is increased stress on the ulnar collateral ligament (UCL), leading to a UCL injury. It is currently unknown how often overhead athletes who have an isolated posteromedial osteophyte resection progress to require UCL reconstruction (UCLR). Therefore, the purpose of this study was to report outcomes following arthroscopic resection of posteromedial osteophyte in overhead athletes and determine if overhead athletes who underwent arthroscopic posteromedial osteophyte resection for posteromedial impingement went on to require UCL surgery. The hypothesized that there would be a high rate of RTS following osteophyte resection and that players who underwent arthroscopic posteromedial osteophyte resection would have a >10% risk of requiring a subsequent UCLR or UCL repair.

Methods: All patients who underwent elbow arthroscopy from 2010-2020 at a single institution were reviewed. Patients were included if they underwent isolated arthroscopic posteromedial osteophyte resection without concomitant UCL surgery, were overhead athletes at the onset of posteromedial impingement symptoms and had no history of prior elbow surgery. Primary outcomes included RTS rate, complications, subsequent shoulder and/or elbow injury/surgery and several patient-reported outcome measures (Kerlan-Jobe Orthopaedic Clinic score, Timmerman-Andrews Elbow score, Conway-Jobe score).

Results: Overall, 36 overhead athletes were evaluated at 5.1 ± 3.4 years postoperatively, including 28 baseball pitchers, 3 baseball catchers, 3 softball players, 1 tennis player, and 1 volleyball player. 77% of overhead athletes RTS and had a mean KJOC score of 70 and satisfaction score of 75, with 89% of athletes having either an excellent (73%) or good (16%) Conway-Jobe score at long-term follow-up. Subsequent UCLR was required in 18% (n=5) of baseball pitchers at a median of 13 months postop. Three of the five UCLR were performed shortly after posteromedial osteophyte resection (6, 7, and 13 months postop), while the other two UCLRs were performed at 6.2 and 7.5 years postop.

Conclusions: Following arthroscopic posteromedial osteophyte resection, 77% of athletes were able to RTS. Baseball pitchers who undergo arthroscopic resection of a posteromedial osteophyte for posteromedial impingement have an 18% risk of subsequent UCLR.

EP.11.009

PROFESSIONAL PITCHERS WITH HIGHER COMBINED JOINT AND SEGMENT VELOCITIES REGARDLESS OF SEQUENCE DEMONSTRATE FASTER BALL VELOCITY AT THE COST OF INCREASED THROWING ARM KINETICS

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Background: Significant associations have been established among individual maximum joint and segment velocities with throwing arm kinetics and ball velocity. The purpose of this study was to observe how summative maximum joint and segment velocities, dependent and independent of sequence order, may impact ball velocity and throwing arm kinetics in professional pitchers.

Methods: Professional (n=338) pitchers threw 8-12 fastball pitches while evaluated with 3D-motion capture (480 Hz). Pitches (independent and dependent of sequence order) were classified as 'Overall Fast' or 'Overall Slow' with kinematic and kinetic parameters compared between groups. A regression model for ball velocity dependent on maximum joint and segment velocities was also calculated.

Results: In-sequence pitches with 'Overall Fast' velocity consisted of smaller mass ($p<0.001$, $d=0.9$) pitchers that achieved faster ball velocity by on average, 1.6m/s or 3.6 mi/hr ($p<0.001$, $d=1.1$). When comparing throwing arm kinetics, the 'Overall Fast' pitches had significantly higher absolute shoulder internal rotation torque ($p<0.001$, $d=1.1$), shoulder distractive force ($p<0.001$, $d=1.4$), elbow medial force ($p=0.014$, $d=0.7$), and elbow flexion torque ($p<0.001$, $d=0.7$). A multi-regression prediction model for ball velocity based on maximum joint and segment velocities achieved a $R^2=0.132$. Maximum lead knee extension velocity (B: 0.004 β :0.263 $p<0.001$) and maximum trunk rotation velocity (B: 0.003 β : 0.223 $p=0.045$) achieved the highest standardized regression coefficients. For every one standard deviation increase in maximum lead knee extension velocity (125 °/sec), ball velocity increased by 0.5 m/s (1.1 MPH).

Conclusions: Professional pitchers with increasing summative maximum joint and segment velocities demonstrated faster ball velocity at the cost of increased throwing arm kinetics, irrespective of sequence order. Pitchers and coaching staff should consider the trade-off between faster ball velocity and higher throwing arm kinetics with increasing summative joint and segment velocities.

EP.11.013

UNDERSTANDING THE FATE OF PARTIAL THICKNESS TEARS OF THE DISTAL BICEPS TENDON: A STUDY OF 111 PATIENTS FOLLOWED FOR A MEAN OF 10 YEARS

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Background: There is a paucity of literature reporting on management of partial thickness tears of the distal biceps tendon, and even less is known about the long-term outcomes of this condition. The primary purpose was to identify patients with partial-thickness distal biceps tendon tears and determine 1) patient demographics and treatment strategies, 2) long term outcomes, and 3) any identifiable risk factors for progression to surgery or a complete tear.

Methods: A fellowship-trained musculoskeletal radiologist identified patients diagnosed with a partial thickness distal biceps tendon tear via MRI between 1996 and 2016. Medical records were reviewed to confirm the diagnosis and record study details. Multivariate logistic regression models were created using baseline characteristics, injury details, and physical exam findings to predict operative intervention.

Results: 111 patients met inclusion criteria, with 53% of tears in the non-dominant arm and a mean follow-up of 10 years. 54 were treated operatively and were more likely to report missing time from work and greater loss of productivity. Only 5% of patients progressed to full thickness tears during the study period, at a mean of 35 months after initial diagnosis. Multivariate regression analyses demonstrated risk of progression to surgery with increased age at initial consult (unit OR 1.1), tenderness to palpation (OR 7.5), and supination weakness (OR 24.8). Supination weakness at initial consult was a statistically significant predictor for surgical intervention ($p=0.001$, OR=24.8).

Conclusions: In this long-term study of patients with partial thickness distal biceps tendon tears, clinical outcomes were favorable for patients treated either non-operatively or surgically. Approximately 50% of patients were treated surgically; patients with supination weakness were 24 times more likely to undergo surgery than those without. Progression to full thickness tear was a relatively uncommon reason for surgical intervention, with only 5% of patients progressing to full thickness tears during the study period and the majority occurring within 3 months of initial diagnosis.

EP.11.015

RECONSTRUCTION OF ARTICULAR INJURY OF THE ELBOW BY THE PERIOSTEUM-COVERED PEDICLE BONE GRAFT

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Background: Articular damage of the elbow sometimes occurs in osteochondral fracture or sports-related injury such as OCD. Arthroscopic loose bodies removal and debridement of the lesion is usually indicated however some poor cases were reported in case of a large lesion. Osteochondral autograft is treatment option but there are unavoidable donor-site problems. We already reported a novel procedure "anconeus muscle-pedicled bone graft with periosteum coverage" to reconstruct the articular lesion of the elbow in OJSM (2017). We piled up the cases and report the dates updated to prove the usefulness of this procedure.

Methods: Surgical indication is traumatic or sports-related articular injury of the elbow especially for the capitellum. We design the graft on the posterior humerus with excessive periosteum and elevate preserving anconeus attachment. The bony tunnel is perforated to the articular defect after debridement of the lesion. The periosteum-covered bone graft is push into the tunnel reaching to the articular surface. Since 1999 we performed 41 operations, and 33 elbows were followed more than 24months (24 to 93 with mean of 42months). All of them complained elbow pain and locking sensation limiting their daily or sports-related activity. The average articular defect size was 13.1mm (10 to 15mm) in diameter. Assessment was done clinically by Timmerman & Andrews elbow performance score (T&A score), and objectively by X-ray and MR images.

Results: All patients showed pain reduction and improvement of motion with bony union in three months. Average T&A score of 33 patients improved from 135 (65-175) points preoperatively to 187 (140-200) points at follow-up. Four cases showed loose fragments at follow-up and three of them complained elbow pain or catching sensation. Those symptoms resolved after arthroscopic debridement. Follow-up MRI was obtained in 28 patients and 17(61%) showed good revascularization and articular congruency. Eleven patients who were followed more than four years showed still painless and functional elbow for longer period.

Conclusions: In this procedure, quick bony union by vascularity from muscle-pedicle and good remodeling of cartilaginous tissue by periosteum is promising good and long-standing functional outcomes. It should be a new option for reconstruction of the elbow joint.

EP.11.016

OSTEOCHONDRITIS DISSECANS OF THE CAPITELLUM OF THE ELBOW: A COMPARISON OF PATIENTS TREATED NON-OPERATIVELY AND SURGICALLY AT LONG-TERM FOLLOW-UP

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Background: The purpose of this study was to (1) report the long-term outcomes associated with both operative and non-operative management of capitellar OCD, (2) identify factors associated with failure of non-operative management, and (3) determine whether delay in surgery affects final outcomes.

Methods: All patients diagnosed with OCD of the capitellum from 1995-2020 within a defined geographic cohort were included in the study. All medical records, imaging studies, and operative reports were manually reviewed to record demographic data, treatment strategies, and outcomes. Surgical treatment was considered delayed if it occurred more than 6 months after symptom onset.

Results: Fifty elbows with a mean follow-up of 10.5 years were studied. Of these, 7 (14%) were treated non-operatively, while 43 (86%) underwent surgical intervention (27 had early surgery and 16 underwent delayed surgery after > 6 months of non-operative treatment). When compared to non-operative management, surgical management resulted in superior MEPI Pain scores (40.1 vs 33, $p=0.04$), decreased persistence of mechanical symptoms (9% vs 50%, $p<0.01$), and better elbow flexion (141° vs 131° , $p=0.01$) at long-term follow up. Older patients had a trend toward increased failure of non-operative management ($p=0.06$). Presence of an intra-articular loose predicted failure of non-operative management ($p=0.01$; OR 13). Plain radiography and MRI had poor sensitivities for identifying loose bodies (27% and 40%, respectively). Differences in outcomes following early versus delayed surgical management were not demonstrated.

Conclusions: Patients with capitellar OCD that was treated nonoperatively failed nonoperative treatment 70% of the time. Elbows that did not undergo surgery had slightly increased symptoms and decreased functional outcomes compared to those treated surgically. In this cohort, the greatest predictors of failure of non-operative treatment were older age and presence of a loose ; however, an initial trial of non-operative treatment did not adversely impact the success of future surgery at long term follow-up.

EP.11.017

TIME COURSE CHANGE OF BONE MICROSTRUCTURE AT OSTEOCHONDRAL AUTOGRAFT SITE OF OSTEOCHONDritis DISSEANS OF THE HUMERAL CAPITELLUM ANALYZED BY HIGH-RESOLUTION PERIPHERAL QUANTITATIVE COMPUTED TOMOGRAPHY

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Background: The purpose of this study was to analyze time course changes of bone microstructure after osteochondral autograft transplantation (OAT) for osteochondritis dissecans (OCD) of the humeral capitellum using High-Resolution peripheral Quantitative CT (HR-pQCT).

Methods: The subjects were four junior high school baseball and softball players (all male, mean age: 13.6 years old) who underwent OAT for capitellar OCD. Under general anesthesia, 1 to 3 osteochondral plug grafts (6-8 mm in diameter) were transplanted from the ipsilateral knee joint. The patients were allowed throwing 3 months after surgery and returned to full sports activity 6 months after surgery. The elbow joints were scanned using HR-pQCT (XtremeCT II, Scanco Medical) before surgery (healthy side and affected side) and at 1, 2, 3, 6, 9, and 12 months after surgery (affected side). Trabecular bone volume fraction (BV/TV), trabecular thickness (Tb.Th) and other bone microstructural parameters in the subchondral bone of the capitellum were measured and compared at each measurement time point.

Results: The mean values of BV/TV were 24.4% on the healthy side and 26.4% on the affected side before surgery. BV/TV values of the affected side 1, 2, 3, 6, 9 and 12 months after surgery were 24.0%, 27.5%, 28.2%, 37.6%, 38.2% and 45.5%, respectively. Similarly, The mean values of Tb.Th were 204.8 μm on the healthy side and 218.4 μm on the affected side before surgery, and postoperative Tb.Th values at each time point were 213.7 μm , 241.5 μm , 248.6 μm , 249.4 μm , 266.7 μm and 270.9 μm , respectively.

Conclusions: One month post-operative bone microstructure of the operated sites was comparable to those of the healthy side. Two months after surgery, bone volume of the grafted site gradually increased over time, with a particular increase 6 months after surgery. Full return to competitive baseball or softball play should be allowed 6 months after surgery.

EP.11.019

FEATURES OF ELBOW OSTEOCHONDRITIS DISSECANS OCCURRED IN ATHLETE OTHER THAN BASEBALL PLAYER

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Background: Elbow osteochondritis dissecans (OCD) commonly occurs in overhead athletes. On the other hand, there are few studies reported on OCD occurred in athletes other than baseball player. The aims of this study were to evaluate the main elbow position to induce the pain and location of OCD other than baseball player.

Methods: We retrospectively reviewed the medical records of those patients, who consists of 3 males and 3 females with OCD occurred in athletes other than baseball player. The average age was 13 (range 11–16) years and average duration of follow-up was 15 (range 5–27) months. We evaluated main elbow position which induce the pain, sporting events, range of elbow motion, radiographic findings, treatment, surgical procedures and return to sports.

Results: The affected side were left in 2, right in 5 and 1 case was bilateral. Main elbow position to induce the pain were extension in 4 and flexion in 3. Sporting events were gymnastics in 3, basketball in 1, volleyball (setter) in 1, hand ball (goal keeper) in 1, judo in 1. Conservative treatment in 2elbows and surgery in 5elbows. The median preoperative elbow flexion-extension arch was 133° (1°–132°). The median postoperative elbow flexion-extension arch was 143° (7°–136°). Lesion were found at humeral capitellum of posterior in 3cases and anterior in 4cases. Surgical procedures were drilling in 4, loose resection in 1 and rib osteochondral autograft in 1. All patients were return to sports in competitive level.

Conclusions: OCD occurs in various location by each sport. We have to consider the pathology of OCD based on the feature of the sports.

EP.12.001

CT EFFECTIVELY DETECTS TRAUMATIC ARTHROTOMIES OF THE ELBOW

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Background: Failure to identify a traumatic arthrotomy of the elbow (TAE) can lead to septic arthritis with devastating complications. The gold standard for TAE detection remains controversial, and evidence is limited. While multiple clinical and cadaveric studies have validated the use of computed tomography (CT) to detect traumatic arthrotomies about the knee, other studies have called into question whether the use of CT to detect traumatic arthrotomy is applicable to the elbow. A prior cadaveric study utilizing a direct posterior (transtendon) traumatic arthrotomy model failed to detect traumatic arthrotomy via CT in 100% of cases¹¹. The aim of this study was to determine the sensitivity and specificity for detecting TAE with CT, utilizing a lateral traumatic arthrotomy model.

Methods: Ten fresh-frozen upper extremity transhumeral cadaveric specimens were utilized. Only specimens with an intact elbow joint and no known elbow surgery or injury were included. CT scans were performed to screen for intra-articular air prior to arthrotomy. A full thickness 10 mm incision was performed over the soft spot, just distal to the lateral epicondyle. The elbow was taken through full range of motion in flexion and extension, as well as forearm pronation and supination 10 times. CT scans were then repeated and screened for the presence of intra-articular air. Lastly, a saline load test was performed on all specimens, and the volume of saline required to detect the arthrotomy was recorded.

Results: Of the 10 specimens, 0% (n=0) demonstrated intra-articular air of the elbow joint on CT scan prior to arthrotomy, and 100% (n=10) demonstrated intra-articular air on CT scan following arthrotomy. CT scan demonstrated 100% sensitivity and 100% specificity for TAE. For the saline load test, 90% (n=9) were positive for TAE at an average of 12.1 mL providing 90% sensitivity.

Conclusions: In this cadaveric study utilizing a more commonly observed direct lateral traumatic laceration, CT scans were able to detect 100% (n=10) of TEAs providing 100% sensitivity and specificity. These results show that CT scans can effectively diagnose TAE.

EP.12.002

ELBOW HEMIARTHROPLASTY VS. OPEN REDUCTION INTERNAL FIXATION FOR ACUTE ARBEITSGEMEINSCHAFT FÜR OSTEOSYNTHESEFRAGEN/ORTHOPAEDIC TRAUMA ASSOCIATION (AO/OTA) TYPE 13C FRACTURES-A SYSTEMATIC REVIEW

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Background: Open reduction and internal fixation (ORIF) is the standard treatment for multifragmentary intra-articular distal humeral fractures. Fractures not amenable by ORIF are treated with total elbow arthroplasty (TEA). In recent years, elbow hemiarthroplasty (EHA) has been used as an alternative to TEA, as weight bearing restrictions and risk of component loosening are lower. We systematically reviewed the literature reporting functional outcomes and complication rates after either EHA or ORIF for Arbeitsgemeinschaft für Osteosynthesefragen/Orthopaedic Trauma Association (AO/OTA) type 13C fractures.

Methods: We searched PubMed, Embase, The Cochrane Library, and Scopus. The inclusion criteria were at least 5 patients, aged 50 years or older, AO/OTA type 13C fracture treated with ORIF or EHA, and evaluation with the Mayo Elbow Performance Score. Literature screening and data extraction were conducted according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement. The results were synthesized qualitatively using weighted means. No comparative statistical analyses were done.

Results: We included 27 articles, which included 96 patients treated with EHA and 535 patients treated with ORIF. We identified 1 randomized controlled trial and 26 case series. The weighted mean Mayo Elbow Performance Score was 86.9 (n = 89) in the EHA group and 84.7 (n = 535) in the ORIF group. There were 26 (33%) complications (n = 78) in the EHA group and 103 (38%) complications (n = 270) in the ORIF group. Complication rates were generally high in both groups.

Conclusions: We found comparable results of EHA and ORIF, which indicate that EHA is a viable treatment option for AO/OTA type 13C fractures not amenable by ORIF. Because of high risk of bias, interpretation of the results should be done with caution.

EP.12.003

PROXIMAL ULNA FRACTURES TREATED WITH PLATES: DOES PLATE TYPE INFLUENCE OUTCOMES OR COMPLICATIONS? ANATOMICAL VERSUS LCP VERSUS TIERS TUBE PLATES.

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Background: Proximal ulna fractures account for 1% of fractures of the upper extremity. We report a retrospective comparative evaluation of reductions with fixation of proximal ulna fractures by plates (single or double): one-third tube, PCL, or anatomic plate.

Methods: We reviewed 66 patients operated on between 2004 and 2019 with a minimum of 6 months of follow-up. We compared 3 groups: a group of 36 patients treated with anatomic plates, a group of 10 patients with LCP plates and a group of 20 patients with Tiers de Tube plates (MEPS and QDash score, occurrence of complications, osteoarthritis, ossifications).

Results: Sixty-five patients were reviewed with a 49-month follow-up (6 -180).

In the anatomic plate group, the MEPS was 77 (25-100), the QDASH 29.3 (0-86). There was 53% osteoarthritis, 34% post-traumatic stiffness, 17% pseudoarthrosis, 28% ossifications and 22% material removal. In the LCP group there was a mean MEPS of 72 (20-100), a QDASH of 36.6 (0-81), 60% had osteoarthritis, 30% post-traumatic stiffness, no pseudoarthrosis, 70% ossifications and 50% material removal. In the Tiers de Tube group there was a mean MEPS of 85 (50-100), a QDASH of 22.9 (0-61), 55% had osteoarthritis, 24% post-traumatic stiffness, 18% pseudoarthrosis, 47% ossifications, and 61% hardware removal. Functional results and complications were equivalent in both groups. However, there was a higher rate of hardware removal and more ossifications in the LCP and Tiers de Tube group.

Conclusions: Osteosynthesis of proximal ulna fractures yields reproducible clinical results. These tend to worsen with the presence of lesions associated with the ulnar fracture (Schatzker stage F, associated fractures). The double plate system allows for an increase in the number of screwing solutions and avoids placement on the ridge. One out of three patients is bothered by the material. The design of thin but resistant plates allows to respect the anatomy (PUDA), and to decrease the rate of material removal.

EP.12.004

PROXIMAL TRANS-ULNAR FRACTURE DISLOCATIONS OF THE ELBOW: A SYSTEMATIC REVIEW AND CLARIFICATION OF CLASSIFICATION SYSTEMS

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Background: Elbow dislocations in which the dorsal cortex of the ulna is fractured have been described in the literature as either Monteggia or trans-olecranon fracture-dislocations. The Mayo classification of proximal trans-ulnar fracture-dislocations categorizes these fractures in three types according to what the coronoid is attached to: Trans-olecranon fracture-dislocations (coronoid remains attached to the metaphysis), Monteggia fracture-dislocations (coronoid remains attached to the olecranon), and Trans-ulnar basal coronoid fracture-dislocations (coronoid is attached to neither). The purpose of this study was to evaluate the outcomes of these injury patterns in the current literature using this classification system.

Methods: We conducted a systematic review and identified 17 studies with a total of 296 elbows. Elbows presenting with a basal subtype 2 or Regan/Morrey III coronoid fracture and Jupiter IIA and IID injuries were classified as trans-ulnar basal coronoid. Patients with Monteggia or trans-olecranon fractures were classified as such if the coronoid was not fractured or if there was only a coronoid fracture classified as O'Driscoll tip, anteromedial facet, basal subtype I, or Regan Morrey I/II.

Results: There were 49 trans-olecranon, 82 Monteggia, and 165 trans-ulnar basal coronoid fracture-dislocations. The mean follow-up time was 3.5 years. The all-cause reoperation rate for basal coronoid was 28%, compared to 17% for Monteggia and 21% for trans-olecranon fracture-dislocations. The mean flexion extension arc for basal coronoid was 100°, compared to 116° for Monteggia and 105° for trans-olecranon. Mean pronation supination arc was 66° for Monteggia, 99° for basal coronoid, and 110° for trans-olecranon. The mean Mayo Elbow Performance Score (MEPS) was 84 for trans-ulnar basal coronoid, 92 for Monteggia, and 95 for trans-olecranon fracture-dislocations. Trans-ulnar basal coronoid had improved Disabilities of the Arm, Shoulder and Hand (DASH) and American Shoulder and Elbow Surgeons (ASES) scores (22, 82) compared to trans-olecranon (15, 89) and Monteggia (DASH 13). Basal coronoid fractures had an increased rate of complications (OR 2.8; 95% CI 1.2-7.3, $p=.02$).

Conclusions: Trans-ulnar basal coronoid fracture-dislocations are associated with an increased rate of complications and reoperations, decreased flexion-extension arcs, and worse patient reported outcomes than trans-olecranon or Monteggia fracture-dislocations.

EP.12.006

EFFECT OF COMPUTERIZED TOMOGRAPHY ON ASSESSMENT AND SURGICAL PLANNING FOR OLECRANON FRACTURES

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Background: Current classification systems for olecranon fractures (OF) have demonstrated inconsistencies in inter- and intra-observer reliability. In recent years, utilization of computed tomography (CT) imaging for evaluation of OF has increased. Currently, the effect of CT imaging on the management of OF is poorly understood. This study sought to determine effects of CT on classification and surgical treatment of OF, and evaluate factors associated with articular impaction.

Methods: Seven orthopaedic surgeons first retrospectively evaluated radiographs of 46 olecranon fractures. Each fracture was classified according to Colton, Mayo, AO/OTA systems. Observers were asked questions regarding their treatment plan and if articular impaction was present. This process was repeated at minimum six weeks with addition of CT. Descriptive and comparative statistics were performed, and intra-class correlation coefficients (ICC) calculated.

Results: Inter-rater agreement was near-perfect for all classification systems using radiographs and did not substantially change with addition of CT. There was moderate agreement regarding articular impaction using radiographs (ICC 0.44; 95% confidence interval [CI], 0.19-0.65); this improved significantly to near-perfect with addition of CT (ICC 0.82; 95% CI, 0.72-0.89). Articular impaction was statistically significantly associated with AO classification, with a high prevalence of impaction in AO/OTA 2U1B1e fractures ($p < 0.03$). Agreement was substantial for choice of fixation construct using radiographs (ICC 0.71; 95% CI, 0.57-0.82); this improved with addition of CT (ICC 0.79; 95% CI, 0.69-0.87). Utilization of CT changed fixation plans in 25% of cases. Agreement regarding need for a void filler was fair using radiographs (ICC 0.37; 95% CI, 0.07-0.61); this improved to substantial with addition of CT (ICC 0.64; 95% CI, 0.45-0.78).

Conclusions: Utilization of CT for evaluating OF led to significant improvements in inter-observer agreement for presence of articular impaction. Impaction was significantly associated with fracture pattern but not with patient-related factors. Addition of CT improved agreement regarding fixation construct and led to notable improvement in agreement regarding need for void filler.

EP.12.007

THE BOYD APPROACH: AN ALTERNATIVE APPROACH TO TREATING SIMPLE TO COMPLEX ELBOW FRACTURES AND DISLOCATIONS

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Background: The Boyd approach is a single-incision posterior approach to the proximal radius and ulna based on a lateral anconeus muscle reflection and release of the lateral collateral ligamentous complex. This approach remains a lesser utilized technique following early reports of proximal radioulnar synostosis and post-operative elbow instability. Although limited by small case series, recent literature does not support these early reported complications. This study presents a single surgeon's outcomes utilizing the Boyd approach for the treatment of simple to complex elbow injuries.

Methods: Following Institutional Review Board approval, a retrospective review of all patients with simple to complex elbow injuries treated consecutively using a Boyd approach by a Shoulder and Elbow surgeon was conducted from 2016 to 2020. All patients with at least one post-operative clinic visit were included. Data collected included patient demographics, injury description, post-operative complications, elbow range of motion, and radiographic findings including heterotopic ossification and proximal radioulnar synostosis. Categorical and continuous variables were reported using descriptive statistics.

Results: A total of 44 patients were included with an average age of 49 years old (range 13-82 years old). Commonly treated injuries were Monteggia fracture-dislocations (32%) and terrible triad injuries (18%). Average follow-up was eight-months (range 1-24 months). Final average elbow active flexion was from 20 degrees (range 0-70 degrees) to 124 degrees (range 75-150 degrees). Final supination and pronation were 53 degrees (range 0-80 degrees) and 66 degrees (range 0-90), respectively. There were no cases of proximal radioulnar synostosis. Heterotopic ossification contributing to limited motion beyond a functional level occurred in two (5%) patients who elected conservative management. There was one (2%) case of early post-operative posterolateral instability due to repair failure of injured ligaments which required revision using an internal brace. Five (11%) patients experienced post-operative neuropathy, including four (9%) with ulnar neuropathy. Of these, one underwent ulnar nerve transposition, two were improving, and one had persistent symptoms at final follow-up.

Conclusions: This is the largest case series available demonstrating the safe utilization of the Boyd approach when treating simple to complex elbow injuries. Post-operative complications including synostosis and elbow instability may not be as common as previously understood.

EP.12.011

RELIABILITY OF SCHATZKER AND MAYO CLASSIFICATIONS FOR ULNAR PROXIMAL FRACTURES

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Background: Fracture classification must allow reliable and reproducible communication between different stakeholders. It must be a logical and understandable system that does not lead to too many categories to master. The objective of this study is to determine the intra- and inter-examiner reliability of the Schatzker and Mayo classifications.

Methods: We performed an intraobserver and interobserver study on 39 radiographs of injured elbows randomly selected from 74 cases used in a series for the analysis of predictive factors for humero-ulnar osteoarthritis in proximal ulnar fractures. Ten reviewers each performed 2 readings of these examinations spaced 3 months apart. At each reading, we analyzed the lesion type of the fracture according to the classifications of Schatzker and Mayo. Inter- and intraobserver reliabilities were measured using Cohen and Fleiss' Kappa coefficients.

Results: Schatzker's classification for the first assessment time has fair interobserver agreement (Schatzker T1, Fleiss: 0.394), as does the second assessment time (Schatzker T2, Fleiss: 0.351). The mean intraobserver agreement coefficient among the 10 raters for the Schatzker classification was rated as good (0.61). The Mayo classification for the first assessment time has a fair interobserver agreement (Mayo T1, Fleiss: 0.278), as does the second assessment time (Mayo T2, Fleiss: 0.292). The mean intraobserver agreement coefficient between the 10 raters for the Mayo classification was assessed as fair (0.52).

Conclusions: The proximal ulna fracture classifications appear to have poor reproducibility in our center because they have a low interobserver agreement coefficient. Nevertheless, their use remains reliable since the measured intraobserver coefficient is considered good.

EP.12.012

MIXED REALITY TRAINING AND HOLOGRAPHIC ASSISTANCE IMPROVES PLACEMENT OF TRANSEPICONDYLAR AXIS PIN FOR ELBOW INTERNAL JOINT STABILIZER

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Background: The internal joint stabilizer (IJS Skeletal Dynamics) is a unique device that relies on the transepicondylar axis of the distal humerus to obtain early stable concentric ulnohumeral range of motion in cases of unstable elbow fracture dislocations. The axis pin placement can be a challenging part of the case and it is critical the outcome. Our hypothesis is that patient specific preprocedure mixed reality (MR) training followed by drilling the transepicondylar k-wire placement with MR holographic assistance can improve guide pin placement enough to more accurate than with the standard IJS guide alone.

Methods: 20 distal humeral models will be 3D printed to mimic the amount of exposed distal humerus from a lateral approach to the elbow in the setting of a fracture dislocation. 4 resident volunteers will be selected to drill the transepicondylar k-wire to replicate the desired preoperative plan. There will be no difference in overall experience level in each group. Ten will be performed with the standard Skeletal Dynamics guide and ten with the MR training / assistance. An MR training app allows participants to practice virtual placement of transepicondylar wire and then compare it to desired preprocedure plan. 10-15 minutes of training is completed prior to placement of the wires. The app would be used again as a holographic guide during wire placement. The models will be converted back to a 3D digital files and aligned using the iterative closest point (ICP) method. Measurements will be taken in each axis to determine the deviation from the surgical plan in startpoint, inclination, and anterior to posterior version in degrees.

Results: The study is still ongoing. It will be completed by April 2023. Preliminary results indicate that the MR training and holographic guide demonstrates more accuracy for the start point, and less deviation from the planned transepicondylar axis.

Conclusions: MR training and assistance can improve surgeon placement the transepicondylar axis pin of the IJS. By reducing outliers for these challenging cases, improved outcomes may be possible especially for lower volume surgeons.

EP.12.013

MAYO CLASSIFICATION OF OLECRANON FRACTURES REVISITED - ASSESSMENT OF INTRA- AND INTEROBSERVER RELIABILITY BASED ON CT SCANS

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Background: Olecranon fractures are common injuries that require accurate diagnosis for treatment planning due to joint involvement. Numerous classification systems for olecranon fractures exist without any classification being able to establish itself as the most reliable one. Hence, the objective of this study was to evaluate the intra- and interobserver reliability of the widely used Mayo classification for olecranon fractures based on CT examination.

Methods: Radiographic and CT images of 20 olecranon fractures were classified by 4 surgeons at two time points 30 days apart. All images were randomized and presented in a different order at each assessment. Intra- and interobserver reliability was assessed using kappa coefficients.

Results: Mean intraobserver reliability between X-rays at the 2 time points was substantial and between CTs almost perfect (0.76 and 0.82, respectively). Mean interobserver reliability was fair for X-rays and moderate for CTs (0.32 and 0.44, respectively).

Conclusions: The results of this study indicate a very good intraobserver reliability for both X-rays and CT imaging with a slightly better agreement when using the CT. Despite the more detailed imaging compared with radiography, only moderate interobserver reliability was found for the classification of olecranon fractures based on CT imaging. This might lead to inconsistent fracture classification in both scientific and clinical setting.

EP.12.015

DOES AN ISOLATED UNRECONSTRUCTIBLE RADIAL HEAD FRACTURE IN WHICH RADIAL HEAD RESECTION CAN BE PERFORMED EXIST? ANALYSIS OF 168 SURGICALLY-TREATED PATIENTS

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Background: Treatment of unreconstructible radial head fractures (RHF) is often challenging since it is affected by the presence of other associated bone and soft tissues lesions. Radial head arthroplasty is indicated to preserve elbow stability, while RHR may be reserved for isolated fractures; However, it is not yet clear how frequently isolated and unreconstructible RHF occur in clinical practice, and how often a diagnosis of isolated RHF is due to the underestimation of associated lesions. The aim of this study is to analyze the prevalence of isolated and unreconstructible RHF in which radial head resection (RHR) alone might be performed without compromising elbow stability.

Methods: A consecutive series of 168 surgically-treated patients was analyzed. All patients had one or more fractures of the elbow, including a RHF. 111 cases with reconstructible RHF were excluded. 57 unreconstructible RHF were analyzed and classified according to Mason. Associated bony lesions were classified according to their location and type, while soft tissue lesions were evaluated intraoperatively or with fluoroscopy.

Results: Of 57 patients with unreconstructible RHF, 17% had a Mason II fracture and 83% had a Mason III fracture. Fifty-four out of 57 patients (95%) had associated bony and/or ligamentous injuries. Seven patients (13%) had only one associated lesion: LCL(57%),MCL(29%) or fractures of the proximal ulna(14%). The remaining 47 patients(87%) had two or more associated lesions: collateral ligaments(93%), coronoid(57%), posterolateral capsule(28%), proximal ulna(18%), epicondyle muscles(9%), olecranon(8%), anconeus(7%), distal radius(4%), capitellum(2%), and triceps(2%). As regards ligamentous injuries, 24% were LCL injuries, 17% MCL injuries and 59% combined LCL+MCL injuries. As regards coronoid fractures, 30% were coronoid type I fractures, 59% type II fractures and 11% type III fractures according to the Regan-Morrey classification.

Conclusions: RHR as an isolated surgical procedure in unreconstructible RHF is extremely rare in clinical practice since 95% of these fractures are associated with two or more bony and ligamentous injuries; of these, coronoid type II fractures and collateral ligament tears are the most frequent. RHR should always be associated with an accurate reconstruction of other primary elbow constraints and a careful evaluation of elbow stability recovery at the end of surgery.

EP.12.016

OSTEOCHONDRAL ALLOGRAFT TRANSPLANTATION FOR COMPLEX DISTAL HUMERAL FRACTURES ASSISTED BY 3D COMPUTER PLANNING AND PRINTING TECHNOLOGY

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Background: The surgical treatment of comminuted distal humeral articular fractures (DHF) is challenging and is jeopardized and according to the Literature has high rate of complications.

Methods: This retrospective study describes the use of 3D modelling osteochondral allograft (OCA) implant for the treatment of complex DHF. Inclusion criteria were the presence of an articular multi-fragmented DHF treated with frozen OCA. Clinical, self-reported and radiographic outcomes were collected every 6 months. CT were performed at 2 years FU.

Results: Four patients met the inclusion criteria. At a mean follow-up of 37.3 months (24-49) MEPS, DASH and VAS were 90 (80-100), 11.8 (0-25) and 1 (0-3) points, respectively. No significant complication or reoperation was recorded. Graft integration was observed in 3 cases. In all cases, we observed low grade of os after 2 years of follow-up.

Conclusions: OCA transplantation can be considered a reliable and safe procedure in patients affected by a complex DH and the use of 3D modelling improves clinical and radiological outcomes.

EP.12.017

PREVALENCE OF BONE, TENDON AND CAPSULE-LIGAMENT INJURIES ASSOCIATED WITH RADIAL HEAD FRACTURES: ANALYSIS OF 168 SURGICALLY-TREATED PATIENTS

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Background: Radial head fractures (RHF) are one of the most frequent elbow injuries and are often associated with other lesions that affect RHF treatment. The results of the few studies that have analyzed the prevalence of these associated lesions are conflicting. The aim of this study is to analyze the prevalence of bone, tendon and capsule-ligament lesions associated with RHF.

Methods: A consecutive series of 168 surgically-treated RHF was analyzed. All patients had one or more elbow fractures, in which the radial head was involved. RHF were classified according to Mason, while other bony lesions were distinguished according to location and type. Ligamentous lesions were visualized intraoperatively or assessed indirectly with fluoroscopy. A statistical analysis was performed.

Results: Of the 168 patients, 7% (11 patients) had a Mason type I, 54% (91 patients) a Mason type II and 39% (66 patients) a Mason type III fracture. 73% of Mason I fractures had associated lesions. One patient had only one associated lesion (meta-diaphyseal ulna fracture) while the other patients had two or more associated lesions: LCL (57%), proximal ulna (28%), capitellum (28%), epicondyle muscles (20%), MCL (14%), MCL+LCL (14%), anconeus (14%), coronoid (14%), or olecranon (14%). 85% of Mason II fractures had associated lesions. 23% had only one associated lesion: LCL (44%), MCL (28%), capitellum (17%), or posterolateral-capsule (PL) (11%). 77% had two or more associated lesions: MCL + LCL (70%), coronoid (65%), PL capsule (50%), epicondyle muscles (22%), LCL (20%), anconeus (17%), MCL (8%), proximal ulna (8%), capitellum (7%), interosseous membrane (2%) and triceps (2%). 94% of Mason III fractures had associated lesions. 16% had only one associated lesion: MCL (50%), LCL (40%), coronoid (10%). 84% had two or more associated lesions: coronoid (67%), MCL + LCL (65%), LCL (27%), MCL (19%), complex proximal ulna (17%), epicondyle muscles (15%), PL capsule (7%), anconeus (4%), capitellum (4%), interosseous membrane (4%) and triceps (2%). No significant differences were found among groups for demographic characteristics. Significant differences emerged about the prevalence of MCL, proximal ulna, olecranon, coronoid and PLC lesions.

Conclusions: 88% of RHF are associated with other bony and ligamentous lesions and their prevalence is directly proportional to the complexity of the fracture. The most frequent injury is a RHF combined with a collateral ligaments lesion and coronoid fracture. In RHF, associated lesions must be carefully investigated in order to distinguish an isolated RHF from complex acute instability and to select appropriate treatment.

EP.12.018

CORRELATION BETWEEN THE FRACTURE MAPPING OF ARTICULAR RADIAL HEAD FRACTURES AND ASSOCIATED ELBOW INJURIES

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Background: The hypothesis of this study was that there could be associated elbow injury according to the pattern of articular radial head fracture. For precise the pattern of articular radial head fracture, fracture mapping program was used. The purpose of this study was to analyse the correlation between the fracture pattern of articular radial head fractures and associated elbow injuries.

Methods: This study was a retrospective review of consecutive patients for articular radial head fracture from January 2010 to January 2022. Total 80 patients of articular radial head fracture who were evaluated elbow computerized tomography scan (CT) and Magnetic resonance imaging (MRI) were included. From CT and 3D mapping program, the patterns of radial head fracture were analyzed. Fracture patterns were classified by dividing the joint surface of the radial head into anterior lateral (AL), anterior lateral (AM), anterior lateral (PL), and posterior lateral (PM) quadrant, and the quadrant of involved fracture fragment was specified as clockwise. Associated elbow injuries from MRI were classified into 6 categories as follows: radial collateral ligament (RCL), lateral ulnar collateral ligament (LUCL), medial collateral ligament (MCL), common extensor, common flexor muscle, trochlear and capitulum and it was statistically analyzed whether there was any correlation between the fracture pattern and associated injuries.

Results: In total 80 patients, 29 cases (36.3%) of PL-AM pattern (anterolateral quadrant) were most common and 16 cases (20%) of AL-PM pattern (anteromedial quadrant) were second, and the other patterns were analyzed within 10%. In associated elbow injuries, the ratio of high-grade injuries of MCL and common flexor tendon in the AL-MP pattern was analyzed to be statistically significantly lower. ($p < 0.01$, $p = 0.03$)

Conclusions: The AL-PM pattern (anterolateral quadrant) was the most common in articular radial head fractures. Although it is difficult to identify the complex mechanism of elbow injuries from the only articular fracture pattern of radial head, the low correlation between high grade injury of the MCL and common flexor and the AL-PM pattern involving the anteromedial quadrant could be considered due to axial varus force rather than rotation force.

EP.12.019

OSTEOSYNTHESIS AND RADIAL HEAD ARTHROPLASTY ACHIEVE COMPARABLE AND FAVORABLE RESULTS IN TERRIBLE TRIAD INJURY: A SYSTEMATIC REVIEW USING PROPENSITY SCORE MATCHING

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Background: Terrible triad injuries of the elbow are complex injury patterns which have historically been problematic for surgeons. Replacement of the radial head (RHA) has increased, with a substantial rise in the presence of elbow instability. The driving forces behind this increase in arthroplasty utilization appear to include the favorable outcomes of RHA in older adults and the short-term failure rates reported for open reduction internal fixation (ORIF). The terrible triad literature reports data across wide ranges of patients ages and the treatment allocation for the radial head is commonly based on fracture severity. These observations raise the question of selection bias which can hinder comparative efficacy. Our objective was to perform a systematic review comparing RHA and ORIF in terrible triad injury using propensity score matched analysis.

Methods: Study inclusion required a table with individual patient reporting of the following: patient age, patient gender, follow-up term, radial head fracture classification, and a numeric Mayo Elbow Performance Score (MEPS). Propensity score matching provides statistical analysis based on individual patient covariates in order to better control potential confounding factors.

Results: For the overall sample, RHA (N=77) and ORIF (N=97) demonstrated favorable outcomes with low rates of revision at a mean follow up of 36 months. Propensity score matched analysis of 16 pairs yielded no significant differences between RHA and ORIF for MEPS ($p=0.90$, RHA 91.2, ORIF 89.4) and for Disabilities of the Arm Shoulder and Hand scores (DASH) ($p=0.80$, RHA 13.2, ORIF 15.4).

Conclusions: Mason III fractures in terrible triad injury demonstrated favorable clinical outcomes and low rates of revision for ORIF and for RHA. Additionally, MEPS and DASH scores were not significantly different between these treatment options. The literature has demonstrated a shift in RH fracture management which may not be completely validated by the current data. Across the pooled data of 97 ORIF cases, 1 case was revised due to malunion, and 1 case required reoperation due to failure of the LCL repair, equating to a reoperation rate of 2.5%. Therefore, our results suggest a low rate of ORIF reoperation at a mean age of 42 and follow up of 36 months.

EP.12.020

ARTHROSCOPY ASSISTED SURGERY FOR CORONOID FRACTURE

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Background: We investigated surgical methods and outcomes of arthroscopy-assisted reduction and internal fixation for coronoid fractures

Methods: This is a retrospective study of 9 patients who underwent surgery since 2019 and were followed for more than 4 months after surgery. They were the average of 25 years old (13-51) at the surgery, and followed for 8 months (5-16) on average. Surgery was performed mainly under arthroscopy, the coronoid fragment was reduced and fixed with screw or pull-out technique. We evaluated (1) injury pattern, (2) arthroscopic reduction and fixation method, (3) additional treatment, (4) range of motion, (5) Mayo Elbow Performance Score (MEPS), and (6) complications.

Results: One case had only coronoid fracture, and the remaining eight cases were complicated by the dislocation. Three cases had free fragments in the joint and one case had radial head fracture. The O'Driscoll's classification included one case of Type 1 Subtype 1, two cases of Subtype 2, four cases of Type 2 Subtype 2, one case of Subtype 3, and one case of Type 3 Subtype 1. As for arthroscopic reduction methods, a hook was used to pull the bone fragment in seven cases. In one case of Type3, screw fixation was used applied. In the remaining eight cases, non-absorbable suture was passed through the anterior joint capsule, pulled out to the dorsal side of the ulna through the bone holes, and tightened to fix the bone fragment. Additional treatment was added for the radial head fixation in one case and for the lateral collateral ligament complex in five cases. Bone union could be achieved in all cases. four cases had the heterotopic ossification, but it was small in size and had no influence on the elbow function. The average range of motion of the elbow was 140 degrees in flexion and 4 degrees of extension limitation. MEPS averaged 97 points.

Conclusions: Arthroscopy assisted surgery for coronoid fracture is a minimally invasive method, and can address intra-articular pathologies, such as free fragments. Good outcomes can be promising.

EP.12.021

ARTHROSCOPIC PARTIAL RADIAL HEAD EXCISION OF POSTTRAUMATIC PARTIAL RADIAL HEAD NON UNITED FRACTURE AND CAPSULAR -ANNUAL LIGAMENT REPAIR AS AN ALTERNATIVE TO HEAD REPLACEMENT OF HEAD RESECTION

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Background: This study describes a new technique for treating partial radial head fracture by arthroscopic excision of a partial head fracture and ligament tightening as an alternative to complete radial head resection. The main complication of radial head fracture is elbow stiffness consequence of ligament injuries due to the surgery. There is no publication in the literature dealing with partial head fracture through arthroscopic removal of the fragment and tightening of the capsule.

Methods: Five cases with 30 to 50% fragment fracture from the radial head in 4 females and one male were operated. With a 30° 4mm scope the arthroscopic surgery was done by removing the fragment and suturing the capsule using special instruments (chop needles) followed by immobilization for 6 weeks.

Results: The time to surgery following injury was one week to two weeks. The patients had 3 weeks rehabilitation after 6 weeks from surgery. They were able to move the elbow in all directions with a full range of motion 2 months after the surgery. The 4 months postoperative follow up showed an average supination was 70° and pronation was 75°. There were no instability of the head and no complications. The patients were able to go back to normal manual work 3 months after surgery.

Conclusions: Arthroscopic resection of the fractured radial head fragment and tightening repair of the ligament and capsule followed by immobilization has good postoperative clinical outcome and is a good alternative to head replacement or head resection.

EP.12.022

COMPARISON OF SIMPLE PROXIMAL ULNA FRACTURES AND MONTEGGIA/ TRANSOLECRANIAL FRACTURES: WHAT IMPACT DO LESIONS HAVE ON FUNCTIONAL OUTCOMES AND OSTEOARTHRITIS?

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Background: Proximal ulna fractures account for approximately 1% of fractures of the upper extremity and 10% of fractures of the elbow. Two groups of patients, one with a simple proximal ulna fracture, and one with a Monteggia fracture or transolecranal dislocation fracture were compared to assess functional outcomes and the occurrence of complications.

Methods: Sixty-five patients operated on for proximal ulna fracture with plates between 2004 and 2019 were retrospectively evaluated with a minimum of 6 months' follow-up (6 - 180) (amplitudes, MEPS and QDash score, complications, osteoarthritis, ossification). 2 groups were compared: with simple fracture (38 patients) and with Monteggia lesion or trans-olecranal fracture/luxation (27 patients).

Results: Simple fracture group: the MEPS reached 85 (69-100), the QDASH 22.7 (4.55-56.4), the flexion extension wheel 130° (108-140). There was 39% arthrosis, 11% pseudarthrosis, 19% post-traumatic stiffness, 33% ossifications and 36% material removal. For the group with Monteggia fracture or transolecranal dislocation fracture, the MEPS reached 80 (6-96), the QDASH 31.8 (2.27- 45.5), the flexion extension wheel 110° (80-120). There was 88% post-traumatic osteoarthritis, 19% pseudarthrosis, 48% post-traumatic stiffness, 48% ossifications and 37% material removal.

Conclusions: Monteggia fractures and transolecranal fracture/luxation in proximal ulna fractures are associated with poorer functional outcomes and early onset of osteoarthritis despite anatomic reduction and single or double plate fixation. Cartilage lesions and malreductions combine to explain these results, which should be known in order to best inform patients.

EP.12.024

ELBOW TERRIBLE TRIAD DISGUISED AS A MONTEGGIA FRACTURE: AN ATYPICAL PRESENTATION

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Background: A Monteggia fracture is classically described as a proximal middle third ulna fracture associated with a radial head dislocation. These are rare fractures and may be associated with other concurrent lesions of the elbow.

One of the mainstays during surgical procedure is to assess radial head reduction and elbow stability, addressing other injuries found

Methods: Case report.

Results: We describe the case of a 52-years-old male, military doing office work, with no relevant past medical history, who sustained a fall from height, with left elbow trauma. On physical examination he presented with gross deformity, a punctiform wound on the lateral aspect of the elbow, pain and was unable to move the elbow. No abnormalities were found on neurovascular examination. X-ray showed a Monteggia fracture associated with a radial head fracture (Bado IIC). Surgery was performed with ORIF of ulna with a LCP 3.5 mm plate, radial head fragments excision and reduction. Elbow stability was intra-operatively tested and deemed stable. Elbow was splinted on 90° of flexion with a posterior long arm splint. 4 weeks post-operative on the x-ray he presented with a posterior elbow dislocation and notorious heterotopic ossification on the anterior aspect of the elbow. A second-time surgery was then performed and a open reduction of elbow joint with external fixation and excision of major fragments of heterotopic ossification were done. During surgical approach it was found a coronoid process fragment (Regan & Morrey I) previously neglected. The patient completed 3 weeks of elbow external fixation. After this period, a third-time surgery was performed and external fixation was removed and a hinged elbow brace applied. At 6-month follow-up, the patient had no pain or cubital nerve paresthesias, with a elbow ROM of 20 - 120° (extension-flexion) and marked limitation on pronation-supination. Despite these objective outcomes, patient referred a DASH score of 16 and a Mayo Elbow Performance Index of 85, performing is daily activities with minimal restrictions.

Conclusions: A fracture-dislocation is not a injury to be underestimated, with a careful examination and surgical planning, addressing all injuries deemed potentially risk factors for elbow instability, being mainstays of a satisfactory clinical outcome.

EP.13.001

COMPARISON OF OUTCOMES OF ALLOGRAFT-PROSTHETIC COMPOSITE RECONSTRUCTION, IMPACTION GRAFTING, AND IMPLANT REVISION ALONE FOR REVISION TOTAL ELBOW ARTHROPLASTY

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Background: Failures and revision total elbow arthroplasties are more common with the increased prevalence of total elbow arthroplasties. In orthopedics surgery, total elbow reconstructions for patients with massive bone loss are challenging. Management of bone loss in failed total elbow arthroplasty includes allograft-prosthetic composite reconstruction and impaction grafting. This study aims to assess the outcome of revision total elbow arthroplasty in different methods.

Methods: Between 2003 and 2020, we retrospectively identified patients who underwent revision total elbow arthroplasty with bone loss. Indications for revision total elbow arthroplasty included aseptic implant loosening with a fracture or cortical breach, aseptic implant loosening without fracture, and infection-related implant failure with infection control. The outcomes measurement included the Mayo Elbow Performance Score (MEPS), radiographic union, and overall revision and complication rates.

Results: At last, twenty-seven patients were included. Thirteen patients underwent revision total elbow arthroplasty with an allograft-prosthetic composite, five underwent revision total elbow arthroplasty with an impaction grafting, and nine underwent implant revision alone. At the last follow-up, the mean MEPS improved from 32 preoperatively to 82 points in the allograft-prosthetic composite group. The mean MEPS improved from 35 preoperatively to 85 points in the impaction grafting group. The mean MEPS improved from 50 points preoperatively in the implant revision alone group to 89 points. There was no significant difference in postoperative MEPS between or among the three groups. However, a high complication rate (5/13 patients, 38%) was noted in an allograft-prosthetic composite group compared with the impaction grafting group (1/5 patients, 20%) and implant revision alone group (1/9, 11%). Radiographically, bone union was achieved in 11/13 85% of patients with allograft-prosthetic composite within six months.

Conclusions: Functional outcomes showed significant improvements after the majority of revisions. There was no significant difference in postoperative MEPS between the different methods. However, complications, including infection and component loosening, are a problem.

EP.13.002

MID TO LONG TERM RESULTS OF PRESS-FIT RADIAL HEAD ARTHROPLASTY: COMPARATIVE STUDY BETWEEN AN ANATOMICAL AND A BIPOLAR IMPLANT IN 97 CONSECUTIVE PATIENTS

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Background: radial head arthroplasty (RHA) is a valid treatment option in unreconstructible radial head fractures and post-traumatic elbow disorders. Several studies reported satisfactory outcomes of loose-fit and cemented implants in the long term, while clinical results and causes of implants failure of press-fit implants are less-known. The aim of this study is to report clinical results and causes of failure of two press-fit implants in the mid-long term.

Methods: We conducted a retrospective comparative study on 97 consecutive patients affected by traumatic (74) and post-traumatic (23) elbow diseases in which RHA was performed. Patients were divided into group 1 (56 patients) with bipolar RHA with conical stem (RHS, Tornier), and group 2 (41 patients) with anatomical RHA with cylindrical stem (ARHS, Acumed). At the last follow-up patients were evaluated radiographically and clinically with the Mayo Elbow Performance Score (MEPS), the patient-American Society Elbow Surgeons-elbow form (p-ASES-e) and the Quick-DASH (Q-DASH). The Mann-Whitney-U was used to perform a statistical analysis.

Results: Mean follow-up was 6 years (2-14) with 17 patients over 9 years and 51 patients between 4 and 8 years. No statistically significant differences were found between groups for anthropometric features, initial diagnosis and follow-up length. At the last follow-up, mean flexion, extension, pronation and supination were 138.3°, 11.8°, 81.4° and 81.5° and 133.5°, 18.9°, 80.5° and 77.3° in group 1 and 2, respectively, with statistically significant differences between groups only in flexion ($p=0,03$) and extension ($p=0,02$), although not clinically relevant. MEPS, Q-DASH and p-ASES-e were 95.9, 4.4 and 94.8 in group 1 and 92.2, 9.9 and 92.0 in group 2, without statistically significant differences. Two patients underwent reintervention due to implant-related causes during the follow-up. The first suffered a bipolar implant disassembly due to a new trauma after 5 years: only the head component was replaced as the stem appeared integrated. The second patient showed asymptomatic progressive loosening with impending fracture of the radial neck after 9 years; it was revised with a cemented long stem.

Conclusions: The two RHA analyzed in this series showed satisfactory outcomes in most patients in the mid-long term, without significant differences between anatomical and bipolar implant. All but one implants appeared well integrated at last follow-up without any differences between the two RHA analyzed.

EP.13.003

CAPUT MAGNA RADII: A RADIOGRAPHIC SIGN OF PRIMARY ELBOW OSTEOARTHRITIS

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Background: Severe degenerative changes can develop in the articular cartilage of the radiocapitellar (RC) compartment while the UH joint being completely spared and little or no abnormality reflected on the radiograph. Still, radiological changes in the RC compartment in elbow osteoarthritis (OA) were poorly discussed.

Methods: Baseline characteristics and preoperative X-rays of consecutive patients having elbow OA or lateral epicondylitis between January 2012 and January 2020 were retrospectively reviewed. The radial head ratio (the diameter of the radial head to the diameter of the radial neck) was calculated on the anteroposterior and lateral views X-ray. CT was performed to stage elbow OA using Kwak's classification. Radial head ratio was compared between patients with osteoarthritis and those with lateral epicondylitis and then among patients at different OA stages.

Results: A total of 99 patients with elbow OA and 44 with lateral epicondylitis formed the OA study and non-arthritic control groups, respectively. Radial head ratio was significantly higher in patients with elbow OA than in the control group on the anteroposterior view ($p = .01$). Similar finding was seen on the lateral view but without significant difference. Regarding different osteoarthritis stages, comparing to stage I, a significantly higher radial head ratio was found at stages II and III on the anteroposterior view (I vs. III, $p = .003$; I vs. II, $p = .007$). On the lateral view, radial head ratio was significantly higher at stage III but not at stage II comparing with stage I (I vs. III, $p = .002$).

Conclusions: Caput magna radii is a radiographic sign of primary elbow OA and correlates with the severity of OA.

EP.13.004

ELBOW HEMIARTHROPLASTY FOR ACUTE DISTAL HUMERAL FRACTURES AND THEIR SEQUELAE: MEDIUM- AND LONG-TERM FOLLOW-UP OF 41 CASES

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Background: The earliest distal humeral hemiarthroplasty (EHA) implants, which date back to the late 1940s, were performed in patients with severe elbow joint injuries as an alternative to arthrodesis. After some clinical reports and case studies with a short follow-up, published in the 1990s, a new anatomically convertible EHA model was introduced in 2005 and became a common surgical option to treat complex elbow fractures and their sequelae. We describe the mid- and long-term outcomes of EHA performed to treat acute intra-articular fractures or their sequelae.

Methods: From 2006 to 2017, 51 patients underwent EHA for acute intra-articular fractures or their sequelae. A total number of 41 patients with a minimum follow-up of 2 years, 24 with acute lesions and 17 with sequelae, were identified retrospectively. Clinical evaluation was according to the Disabilities of the Arm, Shoulder, and Hand (DASH) score and the Oxford Elbow Score (OES) and Mayo Elbow Performance Score (MEPS). Radiographic follow-up was with standard radiographs.

Results: Mean follow-up was 92.2 months (range, 24-151). Mean patient age at surgery was 62.8 years. The mean MEPS was 87.1 points, with excellent results in 26 cases, good results in 9 cases, fair in 2, and poor results in 4. The mean DASH score was 15.9 and the mean OES was 40.5, with satisfactory results in 30 cases. Twenty patients experienced complications and 2 required revision surgery.

Conclusions: EHA is a valuable surgical option in selected patients with comminuted distal humeral joint fractures that cannot be reconstructed with stable fixation and in those with malunion of the articular surface of the humerus. EHA offers potential advantages, especially in active elderly patients and in those aged less than 70 years. It is essential to achieve joint stability, restoring medial and lateral ligament function besides the integrity of the coronoid process. An intact olecranon surface without signs of degenerative changes is also critical for EHA success. Our mid- and long-term experience with EHA is favorable, with a high proportion of satisfactory results and long survival rates for both lesion types. In selected patients with acute and post-traumatic injuries, EHA is a valuable surgical option.

EP.13.005

HOW MANY ELBOWS HAVE SYMPTOMS, SYNOVITIS, OR JOINT DESTRUCTION IN THE ELBOW JOINT IN THE CURRENT STATUS OF RHEUMATOID ARTHRITIS?

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Background: The medical situations in rheumatoid arthritis (RA) has dramatically changed, and several reports claim that surgical treatment is much less required nowadays. Conversely, operations including elbow joint arthroplasty are still conducted in many institutions. Therefore, we aimed to investigate how many elbows are patient-reportedly disabled, radiographically destructed and ultrasonographically inflamed in the current medical status.

Methods: Patients were consecutively recruited from the Kyoto University Rheumatoid Arthritis Management Alliance cohort. We collected data on patient self-assessment, as well as radiographic and ultrasonographic (US) assessments of the elbow, with the aim of investigating the associations between US-detected synovitis (gray scale; GS, and power doppler; PD), joint destruction (Larsen grade), and patient-reported outcomes (PREE), especially in the elbow.

Results: A total of 548 patients were recruited and analyzed. The mean age was 63.7 years, the medians of DAS 28-ESR and HAQ were 2.63 and 0.375, respectively. The means of ROM of the elbow and grip strength of the right side were 130 and 17.6 kg, respectively. The median of the PREE was 6.0 in the right side and 5.7 in the left side. The percentages of Larsen grade 2 or more was 31.4%. The percentage of GS grade 2 or more, and PD grade 2 or more were 9.4% and 0.4% in the humeroradial joint, and 8.0% and 2.2% in the humeroulnar joint, respectively. GS and PD grades were strongly associated with elbow pain (t values; 7.79 in GS grade and 4.12 in PD grade). The strongest associations with PREE were found in DAS28-ESR (t value; 12.4) and Steinbrocker's stage (t value 6.42) in demographic data, and Larsen and GS grades were strongly associated with PREE (t values; 7.53 and 7.17, respectively). Grip strength and ROM of the elbow were negatively associated with PREE (t values; -11.5 and -7.36, respectively).

Conclusions: A third and a tenth of the current RA patients have radiographic joint destruction and US-detected synovitis in the elbow, respectively. Radiographic joint destruction, US-detected synovitis, grip strength and ROM of the elbow are strongly associated with patient reported outcome of the elbow.

EP.13.006

REVISION TOTAL ELBOW ARTHROPLASTY WITH THE SEMICONSTRAINED COONRAD/MORREY PROSTHESIS

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Background: Revision total elbow arthroplasty (TEA) has increased, especially in young patients with high functional expectations. The objective of this study was to evaluate the long-term results of revision TEA with a single semiconstrained prosthesis.

Methods: Thirty-four revision TEAs were performed with a Coonrad/Morrey prosthesis in 32 patients; 2 patients had bilateral procedures. The mean patient age was 61 years (range, 22 to 76 years), and the revision TEA was performed at a mean time of 7.8 years (range, 1.6 to 21 years) after the primary TEA. Etiologies for revisions were humeral and ulnar aseptic loosening (n = 14), ulnar aseptic loosening (n = 8), humeral aseptic loosening (n = 6), septic arthritis (n = 4), and unstable unlinked prostheses (n = 2). Clinical and radiographic evaluations were performed with systematic preoperative infection workup and quantification of bone loss. The mean follow-up was 11.4 years (range, 2 to 21 years).

Results: The MEPS at the last follow-up was excellent in 6 cases, good in 18, fair in 8, and poor in 2, with a mean improvement between the preoperative values at 42.4 ± 16.1 points and the postoperative values at 81.8 ± 12 points ($p < 0.001$). The mean pain scores improved significantly from 6.7 ± 1.3 points preoperatively to 1.4 ± 1.4 points postoperatively ($p < 0.001$). The flexion-extension arc increased significantly ($p = 0.02$) from $74^\circ \pm 27^\circ$ preoperatively to $100^\circ \pm 31^\circ$ postoperatively. The total number of complications was 29 in 19 revision TEAs (56%). Twenty of the 29 complications simply required monitoring without surgical intervention. Six repeat surgical procedures were required, and 3 implant revisions (9%) were performed.

Conclusions: Revision TEA with a semiconstrained prosthesis can provide good clinical results that can be maintained during follow-up. The rate of complications is high. Proper evaluation of the risk-benefit ratio is essential for each revision TEA and should be discussed with the patient.

EP.13.007

ELBOW ARTHROPLASTY TRENDS IN PATIENTS WITH RHEUMATOID ARTHRITIS RECEIVING DISEASE MODIFYING ANTIRHEUMATIC DRUG THERAPY

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Background: Total elbow arthroplasty (TEA) is often utilized to manage advanced arthropathies of the elbow secondary to inflammatory conditions such as Rheumatoid arthritis (RA). Recent literature has shown that utilization of TEA is decreasing in patients with RA, in part due to early medical management involving disease-modifying antirheumatic drugs (DMARDs). The purpose of this study was to compare the utilization of TEA between patients with and without DMARD therapy from 2010-2020.

Methods: A retrospective cohort analysis was performed using the PearlDiver database to investigate the trends of patients with RA undergoing TEA from 2010-2020. Patients who underwent TEA between 2010- 2020 and had a diagnosis of RA were identified using Current Procedural Terminology (CPT) and International Classification of Disease (ICD) 9 and ICD-10 codes. Two cohorts were created: those with DMARDs prescription claims and those without. A linear regression, CAGR analysis, and chi square analysis were conducted to compare trends and demographic variables between cohorts.

Results: From 2010-2020 the incidence of TEA in RA patients without DMARD prescriptions has plateaued, while there has been a statistically significant decreasing rate of TEA observed in RA patients with DMARD prescription claims. For patients with a diagnosis of RA and DMARDs prescription claims, the highest incidence of TEA was seen in the age group of 60-69, while patients with a diagnosis of RA and no DMARDs prescription claims had the highest incidence of undergoing TEA in the age group of 70-79

Conclusions: The incidence of patients undergoing TEA with a diagnosis of RA and DMARD prescription claims has shown a statistically significant decrease from 2010 to 2021, while no significant difference was observed for patients without DMARD prescription claims. This suggests that DMARDs therapy may help to mitigate the progression of disease in RA patients and delay the need for elbow arthroplasty.

EP.13.010

DISTAL HUMERUS FRACTURES: OSTEOSYNTHESIS VS TOTAL ELBOW ARTHROPLASTY

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Background: To evaluate and compare functional outcomes at 60 months from treatment of distal humerus fractures with osteosynthesis vs total elbow arthroplasty in patients aged more than 60 years.

Methods: Two groups of patients with distal humerus fractures classified as AO132C2/AO13C3 were evaluated in retrospective, both after 60 months from treatment; either osteosynthesis or total elbow arthroplasty (TEA). 36 patients in both groups (A: osteosynthesis and B : TEA), each one including 18 patients, were clinically evaluated by range of movement and the Mayo Elbow Score or MES, a functional scale. They were compared with descriptive statistics and central tendency measurements, Chi2 as well as using inferential statistics (Mann-Whitney's U) to obtain the results taking $p=0.05$ as statistically significant.

Results: When group A and B were compared there was a mean age of 61 to 63 years, with a gender ratio of men to women 10:8/5:13 (56:44%/ 28:72%) respectively, being the main extremity affected in 28 to 39 %. There was no statistical significance between surgical differing between the groups.

Rehabilitation compliance after surgery between groups was 83 to 89% ($p=0.154$). Range movement evaluation in twelve months was an extension of 18.56° to 6.1° ($p=0.001$ IC 95%), flexion of $102^\circ/117.22^\circ$ ($p=0.010$ IC 95%), function at twelve months with MES was 76 to 91 points ($p=0.001$ IC 95%).

Conclusions: Total elbow Arthroplasty offers better clinical and functional outcomes in comparison with osteosynthesis and plates in AO 132C2- C3 distal humerus fractures.

EP.13.011

THE FUNCTIONAL OUTCOMES IN 21 PATIENTS AFTER MORE THAN 12 YEARS WITH A BIPOLAR RADIAL HEAD PROSTHESIS

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Background: Treatment of unreconstructible comminuted fractures of the radial head remains controversial. Radial head arthroplasty is an alternative treatment for unreconstructible comminuted fractures with traumatic elbow instability. The purpose of this study was to evaluate the results of the bipolar radial head prosthesis after more than twelve years.

Methods: Twenty-one patients (nine females and twelve males; mean age, 47 years old (26-76) with an un-reconstructible comminuted radial head fracture and associated elbow injuries were treated with a bipolar radial head prosthesis (Tornier®). There were seven Morrey type-III and fourteen Morrey type-IV injuries. Seven of these injuries were isolated, and fourteen of them were associated with other elbow fractures and/or ligamentous injuries. The outcome was assessed using the Mayo Elbow Performance Index (MEPI) at a mean follow-up of fifteen years and six months (12 to 21 years).

Results: There were ten excellent results, eight good, and three fair according to the MEPI. The mean elbow flexion arc was 110 degrees and forearm rotation arc was 155 degrees. All elbow joints remained stable and no implant required revision. There was no evidence of overstuffing of the joint. Seven patients had radiographic changes of lucency around the neck and stem of the prosthesis that was not associated with pain, five patients had heterotopic ossification, and three patients had proximal migration of the prosthesis against the capitulum of the humerus.

Conclusions: Arthroplasty with a bipolar radial head prosthesis for unreconstructible radial head fractures associated with elbow joint instability had satisfactory results during midterm of follow-up. However, high prevalence of radiographic changes suggesting osteolysis is noted and more than twenty-year follow-up is necessary to use this prosthesis.

EP.13.012

ELBOW STIFFNESS INCREASES THE LOAD BEARING IN SHOULDER AND ELBOW JOINT DURING ARM SWING OF A GAIT

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Background: The arm swing plays a role in gait by assisting the forward movement with trunk balance maintenance. This study evaluates the biomechanical characteristics of the shoulder and elbow and their alteration in elbow stiffness during gait. The hypotheses included that (1) elbow stiffness would affect the joint dynamic loading of the elbow during gait; and (2) elbow stiffness would affect the joint dynamic loading of the shoulder during gait.

Methods: The study included computational musculoskeletal modeling and simulation based on motion tracking. Fifteen participants without musculoskeletal or gait disorders were included for computational modeling. The subjects were sequentially tested in four stages (normal, no brace; stage 0, brace with no extension blocking; stage 1, 45° extension blocking; and stage 2, 90° of extension blocking). A three-dimensional (3D) motion tracking system using three Azure Kinect (Microsoft, Redmond, WA, USA) was used to obtain information for the 3D location of each joint. Computational modeling using The Any Modeling System was performed to calculate the joint moment and range of motion during the arm swing of the gait.

Results: In the computational modeling results, the elbow range of motion (ROM) of flexion-extension in stages 1 and 2 significantly increased compared with stage 0 in the non-dominant arm as the control. Moreover, shoulder ROM of flexion-extension in stage 2 significantly increased compared with stage 0. The joint moment of the elbow in flexion-extension significantly increased in stages 1 and 2 compared with stage 0 in the dominant and non-dominant arms. The joint moment of the shoulder in flexion-extension in stage 2 significantly increased compared with stage 0 in the dominant and non-dominant arms.

Conclusions: The elbow bears the load created by gravity and muscle contracture in the dynamic arm swing movement. Elbow joint stiffness increases the loadbearing of the elbow joint in the dynamic arm swing motion. The ipsilateral and contralateral shoulder joint seems to compensate for the decreased elbow motion by increasing the ROM of the shoulder joint. Therefore, the moment of both shoulder joints was also increased.

EP.13.013

OUTERBRIDGE-KASHIWAGI ARTHROPLASTY IN ELBOW ARTHROSIS

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Background: Elbow arthrosis is caused by this extremity's overuse or by a previous or repetitive trauma. The American Academy of Orthopedic Surgeons states that the elbow's functional range for daily activities without limitations is of 100°. Articular replacement has one of the highest revision indexes. Due to this fact, it is very important to offer alternatives for treatment. The Outerbridge-Kashiwagi Method (OKM) is a simple procedure that enables liberation and decompression with osteophyte resection produced in olecranon, coronoid and respective fossa.

The objective of this study is to demonstrate the efficacy of the OKM as an alternative treatment for total articular replacement in elbow arthrosis.

Methods: We included 15 patients who underwent OKM. Initial evaluation and continuous follow-up for 12 months were done using two functional scores: Mayo Elbow Score (MES) and Oxford.

Results: The median age was 58.6 years in preoperative evaluations, flexion range 86.9° (70-104°), extension range 11.6° (0-30°), pronation 49° (40- 54°), supination 56° (46-70°), mean MES of 33.6 points (20-45), and initial Oxford 26.3 points (24-29). During our follow-up, MES 12 weeks after surgery was 80.6 points, with an average of 70-90 points compared to the preoperative values, with a statistical significance of $p=0.001$ (CI 95% from 52-41). 24 weeks after surgery we recorded a MES of 85 points (80-90), $p=0.004$ (CI 95% 1-7).

Conclusions: The OKM notably remarkably improved the elbow's functionality, pain and movement. This was objectively recorded by the functionality scores with statistical significance.

EP.13.014

TOTAL ELBOW ARTHROPLASTY FOR ACUTE DISTAL HUMERAL FRACTURES WITH HUMERAL CONDYLE RESECTION OR RETENTION: A LONG-TERM FOLLOW-UP

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Background: Open reduction and internal fixation is the gold standard for the operative treatment of intra-articular distal humeral fractures. However, in elderly patients the approach involves a high rate of complications.

We reviewed the long-term outcomes of 13 primary total elbow arthroplasties (TEAs) performed to treat acute fractures in non-rheumatoid patients who at the time of trauma were aged less than 70 years. The aim of the study was to establish whether condyle retention enhances hinge stability and influences outcomes in these patients, who are younger than those who typically undergo TEA.

Methods: Thirteen consecutive patients with acute distal humeral fractures aged 61 to 67 years received a linked semiconstrained Coonrad-Morrey prosthesis. The medial and lateral condylar bone fragments were resected (7 patients) or stabilized to the diaphysis using k-wires or plates (6 patients).

Results: At a mean follow-up of 12 years, the mean Mayo Elbow Performance Score was 88 and patient satisfaction was 85%. Nine patients (70%) did not require surgical revision. All revisions involved the group managed by condyle resection.

Conclusions: TEA can be considered in elderly subjects with acute distal humeral fracture. In our patients, resection of the medial and lateral condyle fragments did not influence outcomes, although clinical observation suggested that it involves greater mechanical stress on the hinge, heightening the long-term risk of bushing wear. Condyle fixation with plates or k-wires seems to afford longer implant survival and is recommended in younger patients with higher functional demands.

EP.13.015

MATCHED RADIAL HEAD PLASTY FOR RADIOCAPITELLAR OSTEOARTHRITIS: SURGICAL TECHNIQUE AND CASE SERIES

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Background: Radiocapitellar arthritis can cause pain, loss of motion and function of the elbow. Current surgical treatment options are limited. The senior author has been implementing an original and simple surgical technique to address this problem, in which the radial head is partially resected and recontoured to decompress the narrowed joint.

Methods: A retrospective review of the clinical and radiographic results of this procedure.

Surgical technique: Elbow arthroscopy is performed in a usual manner, and osteocapsular arthroplasty (synovectomy, removal of osteophytes and loose bodies, capsule release) of the ulnohumeral joint is performed as needed. Moving to the radiocapitellar joint, through the anterior portals and later the posterolateral (soft spot) portals, the degenerative articular surface and subchondral bone of the radial head are shaved using a burr to a depth of 5 mm (one burr's width). Later, the center of the new surface is burred to a depth of 10mm, recreating a concave surface to match the shape of the capitellum.

Results: between 2017 and 2021 a total of 8 patients underwent matched RH-plasty, all together with a ulnohumeral osteocapsular arthroplasty. In all cases RC joint narrowing was observed on preop AP radiographs. Clinical follow up was at median 20 months (range 6-66). Range of motion improved slightly: extension 34 to 22; flexion 119 to 126; supination 66 to 74, full pronation. Radiographically, mean RC joint space improved from 1.7mm to 4.6 mm. There were no significant complications. In two cases, the initial improvement following surgery lasted less than a year, and the patients were referred to total elbow arthroplasty.

Conclusions: This small case series mostly demonstrates the safety and potential of this new surgical treatment. A prospective trial with larger population would be needed to assess its efficacy.

EP.13.016

REVISION OF FAILED RADIAL HEAD ARTHROPLASTY

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Background: Revision of radial head arthroplasty (RHA) may be indicated in cases of prosthesis loosening and malposition. Inherent difficulties in revision surgery include poor bone stock and disrupted soft tissue envelope. Although cases of RHA used for revision of failed RHA are rare, there is reasonable expectation for the surgeon to encounter these more frequently due to the increasing incidence of primary RHA. Further, there is an increasing demand for postoperative recovery of function; thus, surgeons may consider revising a failed RHA to a new RHA. We report on series of failed RHA which were revised to a new radial head prosthesis.

Methods: A retrospective review was performed at multiple institutions for a single radial head prosthesis used for revision of a failed radial head prosthesis. Clinical and radiographic outcomes were collected with a minimum of 1 year of follow up.

Results: Across 11 patients at a mean follow up of 45.1 months, the mean Mayo Elbow Performance Score was 81.7, mean Disabilities of the Arm, Shoulder and Hand scores were 24.4, and mean visual analog scale for pain was 0.6. Radiographic analysis yielded no evidence of capitellar wear nor stem loosening.

Conclusions: A radial head prosthesis can produce satisfactory results when used for revision of a failed prosthesis. Inherent difficulties in revision surgery include the potential for reduced bone stock and a disrupted soft tissue envelope. Elements of prosthesis design may contribute to effectively managing revision surgery. These include a long stem that purchases distal to the bicipital tuberosity, an ingrowth surface restricted to the collar and proximal aspect of the stem to mitigate stress shielding, and the ability to align the radial head with the forearm axis of rotation. Anatomic alignment reduces capitellar contact stresses and therefore reduces wear on the capitellar surface. Further, stability of the prosthesis is maintained in conjunction with this alignment capability. In revision surgery where stiffness is a common complication, a more physiologic radiocapitellar relationship may afford the opportunity to maximize pain free range of motion.

EP.13.017

A CASE OF POSTERIOR INTEROSSEOUS NERVE PALSY AND ULNAR NERVE PALSY ASSOCIATED WITH CHARCOT'S ELBOW JOINT

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Background: We report a case of posterior interosseous nerve palsy and ulnar nerve palsy associated with Charcot's elbow joint caused by syringomyelia due to Arnold Chiari malformation.

Methods: 50-year-old female, history of syringomyelia associated with Arnold Chiari malformation

Results: Without any trigger, he became aware of swelling from the right upper arm to the elbow joint and difficulty in extending the right fingers. One month after the onset of the disease, he was referred to our department.

MRI and ultrasonography showed compression of the posterior interosseous nerve at the entrance of the supinator muscle due to synovitis.

Surgery and postoperative course: Two months after the onset of the disease, a synovectomy and posterior interosseous nerve dissection were performed. The posterior interosseous nerve was strangulated at the entrance of the supinator muscle due to a bulge of synovitis arising from the elbow joint. The synovitis and intra-articular free were removed to relieve nerve compression. At 3 months postoperatively, the patient's elbow joint extension limitation and hand extension strength had improved. At 4 months postoperatively, sensory disturbance and muscle weakness in the ulnar nerve area appeared, and plain radiographs showed progressive destruction of the elbow joint. Nerve dissection was performed 6 months after surgery.

Conclusions: In this case, synovitis associated with joint destruction caused the articular capsule to bulge and the posterior interosseous nerve to be compressed. Early diagnosis and early surgical intervention resulted in a relatively good course of posterior interosseous nerve palsy. However, due to the characteristics of Charcot's joint, ulnar nerve palsy developed as the joint destruction progressed, and careful follow-up and lifestyle guidance are necessary.

EP.13.018

PRIMARY TOTAL ELBOW ARTHROPLASTY FOR DISPLACED INTRA-ARTICULAR DISTAL HUMERAL FRACTURES

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Background: Displaced intra-articular distal humeral fractures are a challenging injury in elderly patients. High rates of complications had led to the increasing use of total elbow arthroplasty (TEA) for primary treatment. The purpose of this study was to evaluate the functional and radiological results of TEA for displaced intra-articular distal humeral fractures in the mid-term period.

Methods: We retrospectively reviewed eight cases of primary TEA for distal humerus fractures of AO classification type C. All patients had a minimum 2-year follow-up. Using implant was all K-NOW (TEIJIN NAKASHIMA MEDICAL CO., LTD). Six cases of unlinked type and two cases of linked type were used. Campbell posterior approach was used in all cases.

Results: All patients were women, and mean age was 72.3 years (range: 64–80 years) at time of elbow arthroplasty. Mean follow-up time was 75 months (range : 63–84 months) . The waiting period from injury to surgery was 9.3 days. Fracture type was C1 in 2 cases and C3 in 6 cases. At the latest follow-up, joint stability had been achieved in all eight patients. The mean range of motion was 115.4°(flexion), -30°(extension). The mean Mayo Elbow Performance Index (MEPI) was 86.3(75~95). Two cases had loosening, and one of them was required revision.

Conclusions: Osteosynthesis is the basic treatment of choice for distal humerus fractures. However, in elderly with a comminuted fracture on osteoporotic bone, osteosynthesis fixation can be compromised. Significant pain relief and improvements in elbow function and stability can be achieved with elbow arthroplasty in patients with displaced intra-articular distal humeral fractures.

EP.13.019

RESURFACING ELBOW BY CARTILAGE GRAFT FROM RIB OR TRICEPS FASCIA

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Background: to report functionnal outcomes and radiological evolution of cartilage graft Background : Articular defect in high demanding patient can be treated by osteochondral graft. We report 11 cases of rib cartilage autograft to solve the difficult problem of limited destroyed articular zone at elbow level.

Methods: 2 cases of advanced osteochondritis dissecans and 1 case of necrosis of lateral condyle (post chemotherapy) have been treated by a block-shaped graft harvested from the transitional area between the rib and its associated cartilage was implanted to the osteochondral defect. 8 posttraumatic arthritis on articular zone of olecranon bone have been resurfaced by perichondrium or triceps fascia.

All patients followed prospectively have been reviewed with a minimum follow up of 3,6 years (2,2-8). Revascularization of the graft depicted on T1-weighted magnetic resonance imaging and congruity of the reconstructed articular surface depicted on T2-weighted imaging were assessed at 6, 12 months postoperatively and at the longest follow up.

Results: Functional recovery was good, and all patients were satisfied with the final outcomes (EVA =0 to 1, Mayo elbow score > 80, QDash < 15 : in all cases). No patient showed obvious radiographic changes of osteoarthritis. All patients were satisfied with the final outcomes and had good functional recovery.

Complications after total elbow prosthesis under 50 year old are 60%. Resurfacing allows the osteochondral defect to be repaired with uniform hyaline cartilaginous articular surface without any effect to other joints. Donor site no longer causes pain at 3 weeks days after surgery. As reported by Nishinaka N & al (jSES 14), Shimada K & al (JBJS A 12) Sato K & al (Thues 08) this technique is reliable

Conclusions: As reported by Nishinaka N & al (jSES 14), Shimada K & al (JBJS A 12) Sato K & al (Thues 08) this technique is reliable

EP.13.020

INTERPOSITION ARTHROPLASTY FOR POST-TRAUMATIC OSTEOARTHRITIS OF THE ELBOW: OUR RESULTS

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Background: Post traumatic elbow osteoarthritis is a disabling condition, especially for young and worker population. Patients complain elbow stiffness, pain and restriction of functional motion. When non-operative treatment fails, total elbow arthroplasty is considered but with several activity restrictions and limitations for manual workers. Interposition arthroplasty (IA) is an alternative surgical option, considered a salvage procedure for end-stage elbow arthritis in high-demand patients. The purpose of our study was to assess whether our case series of patients undergone elbow interposition arthroplasties have the same functional results of other in literature.

Methods: Consecutive patients who underwent interposition arthroplasty for post traumatic elbow osteoarthritis from 2013 to 2020, at the Orthopaedic Department of Faenza Hospital were retrospectively selected for the study. Inclusion criteria were end-stage of osteoarthritis and high demand patients with sufficient bone stock. Main outcomes were MEPS and the Italian validated version of the Oxford Elbow Score (OES), available from 2020. Mayo elbow performance Score (MEPS) and range of movement (ROM) data were collected from last follow up visit. The OES questionnaire was administered and completed by phone interview from 2020.

Results: Between January 2013 and December 2020, eight interposition arthroplasty procedures were performed in seven patients (4F and 4M, mean age 57 ± 7.3 years, 5 dominant side involved). Mean follow up was 49 ± 13 mo. Fascia lata allografts were used for all elbows. Additional procedure of ligament reconstruction with allograft were performed. In only one case of hinges external fixator was applied at the end of procedure. Mean MEPS were 82.5 ± 15.8 points, ROM was 100° in the FE arc and 107° in PS at final follow up. The mean OES score at final FU was 76.6 ± 6.2 , the mean values for elbow function, social-psychological and pain domain of OES were respectively: 86.7; 71.1; 71.9. One patient developed elbow instability and pain that required another surgery.

Conclusions: Our results suggest that IA is a viable option for end-stage of elbow osteoarthritis with good results at final FU in term of pain and function. Despite, technically demanding, IA delays elbow arthroplasty and allows to return to social and work activities.

EP.13.021

INFECTED TOTAL ELBOW ARTHROPLASTY: MANAGEMENT AND RESULTS. ABOUT 11 CASES.

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Background: Infections after total elbow arthroplasty (TEA) are more frequent than after other joint arthroplasties. Therapeutic management varies depending of the patient status, the time of diagnosis of the infection, the status of the implant and the remaining bone stock around the implants.

Methods: Between 1997 and 2017, 180 TEA were performed in our department. Eleven (6%) sustained a deep infection and were revised. Etiologies were: rheumatoid arthritis in 6, trauma sequela in 4 and osteosarcoma in 1. Patients were of 59 years on average (22-87). Delay between TEA and the diagnosis of infection was 66 months (0.5-300). Infection was stated as acute (<3week) in one, subacute (between 3 week and 3 months) in 1, and chronic (>3 months) in 9. Isolated bacteria were: Staphylococcus (10), Streptococcus (1), C. acnes (1), Proteus mirabilis (1) and poly microbial (2). A simple lavage with debridement was performed in 3 cases (Group 1), a 2-stage revision in 4 (Group 2), and a definitive removal of the prosthesis in 4 (Group 3). Adapted antibiotics were prescribed for all patients during at least 6 weeks.

Results: All patients were reviewed with 59 months average follow-up. Eight patients were cured of their infection with the initial therapeutic strategy. For 2 patients of Group 2, infection reccurrency required a new surgical procedure with one simple lavage/debridement for one, and 3 lavage/debridement for the other. For one patient of Group 1, failure of lavage/debridement required removal of the implants. MEPS reached 72 points: 67 points for patients of Group 1, 76 points for patients of Group 2, and 74 points for patients of Group 3. Complication rate was 36% (4): 2 ulnar nerve impairment, one radial nerve palsy, and one humeral stem loosening.

Conclusions: An adapted therapeutic strategy can allow suppression of the responsible bacteria after infection of TEA. Sometimes, several procedures are necessary. Better functional results were obtained when the prosthesis could be retained or replaced, but satisfactory results could also be obtained after resection arthroplasty when the humeral columns have been preserved to stabilize the joint.

EP.13.022

EVALUATION OF THE RISK OF NERVE INJURY BEFORE ELBOW ARTHROSCOPIC SURGERY

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Background: Nerve injury is a tragic complication of elbow arthroscopic surgery. To reveal the risk of nerve injury, the relationship between the median and radial nerves and the capsule the elbow was investigated with ultrasonography in the actual patients.

Methods: Thirty-five patients who underwent elbow arthroscopic surgery were enrolled. Using ultrasonography, the distances of the median and radial nerves to the capsule at the several bony landmarks were assessed on the day before the surgery. The patients were divided into two groups according to hydrarthrosis on MRI: nine patients in the hydrarthrosis group and 26 patients in the non-hydrarthrosis group.

Results: The median nerve located closer to the capsule at the trochlear in the hydrarthrosis group than in the non-hydrarthrosis group. The radial nerve located closer to the capsule at the radial neck in the hydrarthrosis group than in the non-hydrarthrosis group, while at the radial head, the nerve located closer in the non-hydrarthrosis group than in the hydrarthrosis group. In the hydrarthrosis group, nerves 2 mm or less to the capsule were found in two patients at the trochlear of the median nerve and in seven patients at the radial neck of the radial nerve. In the non-hydrarthrosis group, they were found in one patient at the joint space and in three patients at the radial head of the radial nerve.

Conclusions: The distance between the nerves and the capsule vary according to the hydrarthrosis. The risk of nerve injury in the elbow arthroscopic surgery should be recognized.

EP.13.023

INTRAOPERATIVE MODIFICATION OF TOTAL ELBOW ARTHROPLASTY IMPLANTS

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Background: Modification of total elbow arthroplasty (TEA) implants may be necessary in selected patients with substantial anatomic bone deformity or those undergoing revision surgery. This study investigated the prevalence and consequences of implant modifications during TEA at our institution. We hypothesized that TEA implant modification would be more common in revisions than in primary replacements, and that it would not be associated with worse clinical outcomes.

Methods: Elbows that had undergone TEA by any of three surgeons at our institution with use of intraoperative implant modification between January 1992 and October 2019 were retrospectively reviewed for the type of modification and complications. Complications were classified as "definitely related", "probably related", "possibly related" or "non-related" to the implant's modification according to the consensus review by the three senior surgeons. A survey was sent out to surgeons outside of our institution to investigate whether intraoperative modification to TEA implants is a common clinical practice.

Results: A total of 106 implant components were modified during 94/731 (13%) TEA procedures in 84/560 patients. Implant modifications were performed in 60/285 revision cases (21%) compared to 34/446 (8%) primary cases ($p < 0.0001$). Among the 55 index surgeries available for complication analysis, 40 complications occurred in 28 index surgeries, making the complication rate after an implant modification 51%. Of these 40 complications, 23 were considered independent of any implant modification. Of the remaining 17 complications, nine were considered "non-related" to the implant modification, six were "possibly related", and two were "probably related" to the implant modification. Therefore, the complication rate "possibly related" or "probably related" to implant modification is 15% (8/55). No complication was classified as "definitely related" to the implant modification. No implant breakage or malfunction occurred after any modification. 442 survey responses were received representing 29 countries, of which 144 surgeons (39%) performed modification to implants during TEA procedures.

Conclusions: This study confirmed our hypothesis that modification of TEA implants is a common practice at our institution, particularly in revision arthroplasty. Implant modification may be necessary in some cases but should be exercised with extreme caution.

EP.13.024

ELBOW ARTHROPLASTY LOW GRADE MICROORGANISMS PERIPROSTHETIC INFECTION. A CASE REPORT AND LITERATURE REVIEW

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Background: We present the case of a 60 year-old female who suffered a right distal humerus fracture. After ORIF, immediate postoperative course was tedious: stiffness, discomfort and slow surgical wound healing. Finally, open debridement and removal of hardware was necessary. On this time, surgical cultures were negatives.

Seriated Xr showed bone resorption of some fracture fragments. 1 year after surgery, patient referred pain, loss of motion and joint effusion. Open debridement and removal of hardware was performed: cultures came back positive to P. Acnes and B. Fragilis. Antibiotic treatment started. One month after, a new aggressive open debridement was needed. Then, half of the distal humerus and the lateral column had to be removed, because vitality of the bone was on jeopardy. Antibiotic loaded cement spacer was placed.

Then, patient appeared to the clinic with joint effusion and pain. Then, high suspicion of secondary infection led us to plan a 2 stages elbow arthroplasty procedure. 2 surgical samples cultures came back positive to C. Acnes. Antibiotic treatment (oral amoxicillin) was decided by Infectious Disease Department and lasted for 6 months. Finally, a linked total elbow arthroplasty was implanted.

Methods: To explain a unique clinical case and review of published references.

Results: After 1 year of total elbow arthroplasty reimplantation surgery, patient is pain free and has full ROM. No joint effusion or swelling of the elbow has been noticed.

Conclusions: Chronic upper extremity periprosthetic infections are still a challenge because they are hard to diagnose. Microorganisms involved in those infections are slow growing and present with indolent progression, with no obvious clinical signs and even normal serological markers. Patients might only experience stiffness or discomfort. In this case we believe that the infection started at the very beginning, due to the bone fragments resorption. Patient needed 2 aggressive debridement and a 2 stages procedure to get rid of her infection (including an antibiotic loaded cement spacer and long i.v. antibiotics period). At the end, result was satisfactory.

First step to diagnose a low-grade infection is so suspect it. When immediate postoperative course is not satisfactory low grade microorganism infection should be suspected

EP.14.001

A MACHINE LEARNING-BASED APPROACH FOR PREDICTING CLINICAL IMPROVEMENT AFTER SURGICAL TREATMENT OF CUBITAL TUNNEL SYNDROME

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Background: Cubital tunnel syndrome (CuTS) has a wide spectrum of underlying causes and shows a various courses during treatment. Therefore, this study was aimed at exploring the potential predictive factors associated with the poor clinical course of surgical treatment for carpal tunnel syndrome using machine learning algorithms.

Methods: A list of patients who underwent surgical treatment for carpal tunnel syndrome from January 1, 2005 to December 31, 2021 was obtained from a single institute. Among a total of 242 patients, 120 patients were included in the final target population by comparing clinical outcomes at one year after surgery. CuTS was confirmed using electrodiagnostic study, and its severity was evaluated by phone calls and classified into three groups: full recovery, partial recovery, and poor recovery. The dataset was randomly split into training (70%) and validation (30%) set.

Results: Of the 120 patients, 66 patients with complete recovery, 34 patients with partial recovery and 20 patients with poor recovery were included. Random forest (RF) showed the highest external validation accuracy in the multi-class classification at 77.6% (95% confidence interval [CI] 69.8–81.2). RF also had an optimal model training accuracy of 77.3%. Extreme gradient boosting (XGB) and Gboost had the second-highest external validation accuracy of 75.6% (95% CI 69.0–80.6). For the RF and XGB models, mass index was the most important variable, and age was the second most important.

Conclusions: Our CuTS prediction algorithm has good discriminative ability and can applied to evaluating clinical improvements and help decision making before surgical treatment.

EP.14.002

ARTHROSCOPIC RELEASE OF ELBOW CONTRACTURE GUIDED WITH MIXED REALITY

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Background: Arthroscopic elbow release is one of the most technically demanding upper extremity procedures, with a great part of the procedure is performed outside the fibrotic capsule. The largest challenges are navigating safe entry into the joint while avoiding numerous neurovascular structures, and resecting and reshaping heterotopic ossifications from degenerative elbow osteophytes. 3D imaging is crucial and is typically available on a flat 2D screen. Mixed reality brings new imaging and viewing possibilities, as well as more relevant anatomical guidance during the procedure. In this study, we propose using a holographic mixed reality system to aid in arthroscopic elbow surgery.

Methods: CT scans were obtained of stiff elbows with contractures containing osseous components indicated for elbow arthroscopy. 3D models of the elbow were then generated into holograms using a mixed reality viewing system (RSQ HOLO, RSQ Technologies, Poznan, Poland). Holograms were assessed for all bony deformities to be removed both preoperatively and intraoperatively. During the procedure, the elbow holograms were superimposed with the patient's anatomy before arthroscopic portals were created and instruments inserted. Precise 3D compound range of motion measurements were made before and after the procedure using the mixed reality system.

Results: Mixed reality support during the procedure allowed for precise 3D planning and near-direct visualization of osseous areas to be addressed during the procedure with enhanced understanding of anatomic landmarks and reference points. This proved to be very effective in confronting any possible and sometimes hidden osseous conflicts and sequential removal with gains in intraoperative range of motion. All manipulations of the holograms could be performed easily while maintaining sterility with simple and natural hand gestures. Holographic calipers allowed for precise measurement of preoperative and direct postoperative range of motion.

Conclusions: Using mixed reality in elbow arthroscopy allows for easier comprehension of anatomy during the procedure. A significant part of a successful elbow release lies in proper 3D spatial understanding and eye-hand control. Enhanced visualization systems like this may lend towards a more broad adoption of elbow arthroscopy by lowering the barrier of difficulty of the procedure.

EP.14.004

NEUROFIBROMA AS A CAUSE OF SECONDARY COMPRESSION OF THE POSTERIOR INTEROSSEOUS NERVE

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Background: Neurofibromas are benign peripheral nerve sheath tumors that can develop as solitary tumors, occurring most commonly in young adults. The clinical presentation is varied, and may give, for example, paresthesia in the sensory territory of the affected nerve. Compression of the posterior interosseous nerve (PIN) in the forearm affects the nerve supply of the forearm extensor compartment. Symptoms of superficial sensory branches and PIN at the same time without injury prior to division of the radial nerve are rare.

Methods: The describe the case of a 54-year-old patient, seen at the outpatient clinic with a mass on the epicondyle of the left elbow, with a slow growth in the last two years, showing symptoms of PIN compression and paresthesia's over approximately 5cm² distally to the mass.

Results: The mass was approximately 2cm long, consistent, non-pulsating, non-expanding, slightly painful on palpation and non-movable in relation to adjacent tissues. A magnetic resonance imaging was performed which showed a mass superficial to the aponeurosis, which was homogeneous and solitary. The electromyographic study showed a slight increase in PIN conduction time.

It was surgically excised, obtaining complete remission of the PIN compression symptoms and anesthesia in the area that previously presented the paresthesia.

The result of pathological anatomy and immunocytochemistry identified the mass as a neurofibroma.

Conclusions: With this case, the describe a neurofibroma as a form of PIN compression, in a patient with no personal or family history of neurofibromatosis, at an unusual age and recent growth, also presenting symptoms of alteration of one of the superficial branches of the sensory radial nerve. The complementary exams are useful in the differential diagnosis and the pathological anatomy in the final diagnosis. The complete excision, normally, solve the compressions symptoms.

EP.14.005

OSTEOID OSTEOMA OF THE ELBOW DIAGNOSED WITH BASEBALL ELBOW - CASE REPORT

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Background: Osteoid osteoma (OO) generally involves the diaphysis of the long bone. Intra-articular lesion accounts for approximately 10% of OO. Additionally, the involvement of the elbow is rare and accounts for approximately 3% of OO. Therefore, intra-articular OO at the elbow can be misdiagnosed common disorders, such as synovitis, monoarthritis, and tendinitis, that contributing to delay in diagnosis.

Methods: We report a patient with intra-articular OO at the elbow that was diagnosed little league elbow.

Results: case report: A fourteen-year-old boy presented with right elbow pain after throwing. His sports history was baseball. He visited outpatient clinic where he was diagnosed with little league elbow. Though, he stopped pitching and accepted physical therapy, his symptoms had not improved. The nocturnal pain and rest pain were less responsive to NSAIDs treatment. After 8 months, he was admitted our hospital. Physical examination of the right elbow revealed a flexion contracture of 30 degrees and free flexion to 120 degrees. Radiograph was interpreted as normal. Magnetic resonance imaging showed proliferated synovial tissues. Plane CT scan demonstrated erosion in the subchondral lesion of the posterior trochlea. He was suspected to have arthritis of the elbow and examined using blood test. The data was normal. He was diagnosed with synovitis resulted in elbow contracture and was performed arthroscopy. At the subchondral of the posterior trochlea, a red solitary lesion considered a tumor was noted after the resection of the lesion. The punch was used to excise tumor. Histological examination showed osteoid osteoma. Removal of the nidus resulted in relief of pain and improvement in the range of motion of the elbow.

Conclusions: Intra-articular OOs have atypical symptoms such as synovitis, limited range of motion, and contracture. It is often difficult to identify the OO, and therefore, intra-articular OO can be misdiagnosed with sports injury in the case of athlete. OO should be suspected when rest pain and nocturnal pain are appeared.

EP.14.006

INTRAMUSCULAR HEMANGIOMA OF THE BICEPS MUSCLE WITH ABSCESS FORMATION

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Background: Intramuscular hemangiomas are rarely considered in the differential diagnosis for musculoskeletal pain. There are rare benign vascular neoplasms, especially, there are extremely rare and only few cases have been published. Furthermore, Intramuscular abscesses, particularly in the biceps muscles are an extremely rare phenomenon. Moreover, Intramuscular hemangioma with infectious abscess is located in biceps muscle has not been published. So, we report a case of intramuscular hemangioma with abscess formation of the biceps muscle.

Methods: 56-year-old male, presented with left upper arm pain and swelling, heating sense, redness, and limitations of elbow flexion and forearm supination. The level of C - reactive protein test (CRP) was high level (25.43mg/dL). The visual analogue scale (VAS) was 10 when he move his left upper arm and elbow before surgery. X-ray revealed 3 small phleboliths. MRI showed an ill-defined enhancing lesion (2.5 × 2.7 × 9.8 cm) within the left lateral part of biceps muscle with increased T1-weighted signal throughout and a small, round low-signal-intensity focus within the lesion, consistent with an intramuscular hemangioma and geographic non enhancing area in the medial part of the biceps muscle, consistent with an infectious myositis with abscess formation.

Results: Surgical excision was performed via flexor approach with curvilinear incision under general anesthesia. Skin incision and delicate dissection were conducted to achieve complete resection of intramuscular hemangioma with abscess and to preserve the surrounding functional neurovascular structures. Above mass, Abscess formation was seen, pus drainage was done. The pathologic mass was found within the lateral part of muscle belly of biceps brachii and to extend to the biceps brachii tendon. On intraoperative observation, the mass was a spongy and angiomatous tumor with relatively ill-defined margins. Long arm splint was applied and maintained for 2 weeks after operation. Histopathology of the excised tumor demonstrated that the mass was a intramuscular hemangioma.

Conclusions: Optimal management of intramuscular hemangioma with abscess is critical, including precise evaluation, good microsurgical technique and early functional exercises, which may result in a satisfying outcome.

EP.14.007

SURGICAL REPAIR OF A COMPLETE FULL-SUBSTANCE BICEPS BRACHII RUPTURE IN YOUNG WAKESURFING ADULT: A CASE REPORT

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Background: The complete intrasubstance rupture of biceps brachii muscle is a very rare injury and little literature is available on this topic. Most of these injuries occurred in parachutists in the 2000s or later described as part of wakeboarding. The trauma mechanism describes in most of all cases a high energy trauma with either direct impact of a static line or a sudden extension movement in the elbow. A small comparative study from the year 2002 showed better results after primary suture of the muscle than conservative treatment. However, due to the low number of cases, the evidence for or against surgical treatment remains weak.

Methods: One patient was treated with surgical repair for a complete rupture in the mid portion of biceps brachii, following the instruction of Kragh et al. 2002 using mason allon sutures. Postoperative care involved an elbow splint with 90, 60 and 30 degree extension limits for two weeks each. Photo documentation was performed pre- and intraoperative and at 3, 6, and 24 months follow up control. After two years we added MRI examinations and MAYO and DASH Score as well as strength measurements for flexion and supination.

Results: At the two year follow up control, a dent was visible and palpable at the site of suture, but the patient satisfaction was very good. We examined unrestricted mobility and the strength was limited by a maximum of 10% compared to the opposite side. Functional scores showed no relevant differences. The MRI showed no muscle fatty degeneration and only small areas of scarring.

Conclusions: In this case, the muscle rupture was primary sutured and the patient showed excellent functional results and high satisfaction after two years. The evidence remains weak, but nevertheless a primary muscle suture should be aimed for young and active patients. In this case the patient injured himself while wakesurfing due to a rope that was chosen too long and therefore wrapped his arm during the fall. In addition to surgical treatment, preventive measures should also be considered. The rope should be chosen as short as possible and good instruction should be provided by trained personal.

EP.14.009

FOUR CASES OF SYNOVIAL CHONDROMATOSIS OF THE ELBOW JOINT

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Background: Synovial chondromatosis is a benign tumor that grows within the synovial membrane of joints and is commonly seen in the knee and hip joints.

In this report, we describe four cases of synovial chondromatosis in the elbow joint.

Methods: The patients were two males and two females, ranging in age from 30 to 61 years (average 47 years). They visited our clinic 1 to 10 years after the onset of the disease and complained of pain during movement and a pulling sensation at the initial visit. All patients had limited range of motion, with automatic flexion of 110 to 130 degrees and extension of -20 to -40 degrees. 1 patient had ulnar neuropathy. Simple x-rays showed intra-articular free bodies in three cases. There was no obvious arthropathy in any of the cases. Simple MRI showed low-signal T1-weighted and high-signal T2-weighted synovial enhancement and low-signal free bodies in all cases. One patient underwent arthroscopic surgery, and three patients underwent direct visualization to remove the free and synovectomy as much as possible. Two patients underwent direct-view surgery via an anterior plus medial approach and one via a medial plus lateral approach. One patient with ulnar neuropathy underwent an anterior migration. Histopathology of the synovial membrane obtained during the direct-view surgery was consistent with synovial chondromatosis.

Results: Two to three months after surgery, extension restriction was eliminated in three patients, and in the remaining patient, extension remained limited at -10 degrees, but improved from the preoperative level. Flexion limitation improved in all patients. No apparent recurrence has been observed at 6 months to 2 years postoperatively.

Conclusions: The treatment plan for synovial chondromatosis is often based on the Milgram classification. All of our patients had intrasynovial lesions and intra-articular free bodies, and were judged to have Milgram's classification stage 2, so we performed synovectomy as much as possible in addition to removal of the free bodies. Although the postoperative follow-up period was short, good postoperative results were obtained after free removal and synovectomy.

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ADVANTAGES OF 70° ARTHROSCOPE IN VISUALIZATION OF THE MEDIAL ELBOW COMPARTMENT

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Background: Most of the elbow injuries, in particular the medial collateral ligament issues, need a challenging therapeutic management even for expert surgeons. After the failure of conservative treatment, the first choice of the physician should be a minimally invasive surgical technique like the arthroscopy. Elbow arthroscopy is considered one of the most difficult surgeries. The surgeon should have the best possible view to perform this complicated procedure. This study aimed to assess the visualization improvement of humeral insertion of medial collateral ligament (MCL) using a 70° scope instead of traditional 30° scope during elbow arthroscopy. Quantification of the the amount of medial gutter that is accessible with the 70°- instead of 30°-scope is the main objective.

Methods: Patients with elbow injuries treated with elbow arthroscopy were enrolled in this single-center study. MCL features were evaluated by using both the 70°- and the 30°-scope during elbow arthroscopy. During the procedure, a needle was inserted at 45° in respect to the axis of the forearm, directed towards the intra-articular humeral emergence of the MCL. Four areas were previously established: the of the needle, the lanceolate part of the needle, the tip of the needle and the medial portion of the trochlea. We therefore took note of which area was visible on arthroscopy using the two different scope

Results: Direct visualization of the MCL was achieved in all patients using a 70°-scope. Once the needle was in, the tip of the needle was detected in all patients using the 70° lens. On the other hand, using the 30° scope, only the lanceolate part of the needle was detected, and not in all patients. After the procedure, all patients returned to their normal daily activities

Conclusions: Arthroscopic procedure are considered a minimally invasive surgical approach that allows treatment of lots of elbow injuries. The 70° lens allows a safer and more effective procedure with a direct visualization of the humeral insertion of the MCL.

ICES E-POSTER

SHOULDER - Shoulder Rehabilitation

IEP.01.01

GROUP-SUPERVISED NEUROMUSCULAR TRAINING PROGRAMS FOR THE TREATMENT OF SHOULDER ROTATOR CUFF RELATED PAIN AND LOW BACK PAIN IN MILITARY PERSONNEL – PRELIMINARY RESULTS OF A RANDOMIZED CONTROLLED TRIAL

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Background: Rotator cuff-related shoulder pain (RCRP) and low back pain (LBP) are the most prevalent musculoskeletal (MSK) disorders among military personnel in the Canadian Armed Forces (CAF). Although evidence supports exercise-based rehabilitation programs for their management, access to rehabilitation services has been hindered due to recent CAF resources limitations. To overcome this issue, two supervised-group programs (SGP) have been developed: one for RCRP and one for LBP. However, their clinical effectiveness has yet to be evaluated. The objective is to compare the effectiveness of SGP to that of usual physiotherapy care (UPC) on functional limitations and pain in soldiers with RCRP or LBP.

Methods: In this randomized clinical trial, CAF soldiers suffering from RCRP or LBP were randomly assigned to either the 12-weeks SGP (education and strengthening, neuromuscular and proprioception exercises in a group setting; level of supervision adapted to soldier's needs) or UPC (one-on-one education, manual therapy and proprioception, strengthening, neuromuscular and stretching exercises) intervention. The primary outcome (functional limitations – pain interference subscale of the Brief Pain Inventory [BPI-PI]) and secondary outcome (pain severity – BPI pain severity scale [BPI-PS]) were assessed at baseline, 6 and 12 weeks. Sub-analyses were conducted for RCRP using the QuickDASH. Two-way repeated-measures ANOVAs were used to compare both interventions for all analysis.

Results: These preliminary results include seventy-two soldiers with LBP (n=45) and RCRP (n=27) that completed their 12-week follow-up (SGP n=35, UPC n=37). Participants in both UPC and SGP groups showed clinically and statistically significant improvement of functional limitations (BPI-PI, Time effect p=.021), and there was no between-group difference (Time x Group p=.91). Similar results were obtained for pain severity (BPI-PS-Time effect p<.001, Time x Group, p=.52). As for sub-analyses, participants with RCRP in both UPC and SGP groups showed similar significant improvement as measured with QuickDASH (Time effect p=.01, Time x Group p=.77).

Conclusions: Preliminary results suggest that SGP is as effective as UPC in reducing functional limitations, and pain in soldiers with RCRP and LBP. SGPs provide a novel approach to manage prevalent MSK disorders among military personnel, which could improve timely access to rehabilitation care.

IEP.01.02

BLOOD FLOW CHANGES PRE AND POST REHABILITATION OF THORACIC OUTLET SYNDROME(TOS) IN OVERHEAD ATHLETES

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Background: TOS is a complex disorder with signs and symptoms resulting from compression and/or traction of the brachial plexus and subclavian vessels supplying the upper limb. Overhead throwing athletes have a potential risk of TOS, because their costoclavicular space is narrow at the elevated arm position. Compression of the subclavian artery at the costoclavicular space is confirmed by measuring the peak systolic velocity (PSV) of the 2nd part of the axillary artery using pulse Doppler. We have reported a significant improvement in blood flow in the second part of the axillary artery following post-operative measurement after TOS surgery. However, the changes in blood flow post-rehabilitation for TOS remain unclear. The objective of this study was to investigate whether blood flow improves during rehabilitation for TOS in overhead athletes who were diagnosed with TOS.

Methods: In the current study, 73 overhead athletes (64 male and 9 female) with TOS, with a mean age of 16.9 (range 14-39) years old, were involved. Using pulse Doppler ultrasound, PSV of the second part of the axillary artery was measured in 90 degrees abduction-external rotation (ABER position) and maximum elevation (elevation position). The timing of the PSV measurements was before rehabilitation and at the time of return to sports. In this study, 0 cm/s of PSV (indicating ischemia) was considered as positive. We investigated whether there was a change in the positive rate of PSV after treatment. The rehabilitation program included periscapular strengthening exercises with a focus on shrug exercises and stretching of the scalenus muscles. Statistical analysis was performed using Fisher's exact test.

Results: At pre-rehabilitation, 19 patients (26%) were positive for 0 cm/s of PSV in the ABER position and 22 patients (30%) were positive in the elevation position. At post-rehabilitation intervention, 9 patients (12%) were positive in the ABER position and 11 patients (15%) were positive in the elevation position. Both the ABER and elevation positions showed significant improvement after rehabilitation intervention ($p < 0.02$).

Conclusions: Pulse Doppler examination demonstrated that appropriate rehabilitation which include periscapular strengthening exercises, provided successful decompression of the neurovascular bundle at the costoclavicular space. This result would provide an important information of feasibility of conservative treatment for TOS.

IEP.01.03

ARTIFICIAL INTELLIGENCE FOR SHOULDER SURGERY, HOW TO CREATE AN ASSISTANT AND USE AI

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Background: Artificial intelligence (AI) and chatbots are increasingly being used to help patients after surgery. This technology can provide a range of services, from providing information about post-operative care to offering emotional support. AI and chatbots can be used to provide personalized advice and support to patients, as well as to monitor their progress and provide reminders about medications and other treatments.

This section was entirely written by an AI, the text was summarized to fit the abstract.

Methods: Using openAi (openai.com - <https://beta.openai.com/playground/p/default-chat>) we tell the robot assistant how to behave with a patient after shoulder surgery being polite and asking about how the patient is feeling. We instructed the AI to give different orientations depending on the timing of the surgery (before and after 4 weeks). The AI was told to give orientations about using the sling, wound healing, fever and bruises around the shoulder.

With only a text of 220 words, we provided the information for the AI to interact with the patient. The time to create this AI as a proof of concept was 20 minutes.

Results: With only some paragraphs of text explaining the AI about the surgery and how it should deal with the patient, the AI used Natural Language Processing to understand the patient's questions. The first question for the patient as if he could remove the sling. The AI could understand that information requires knowing when the surgery was done, and it asked correctly about the surgery date. The provided information was correct. Another question that needed past language understanding for the AI was about temperature and fever, and the bot could understand the patient's temperature and suggest the correct decision.

Conclusions: With the new Natural Language Processing used by AIs, surgeons can simply tell with their own words what the main information and concerns are after surgery and the robot can interact and understand the patient's needs without the need for coding. As surgeons, we must be aware of this technology to help our job and the patient satisfaction, but also be aware of the ethical implications.

IEP.01.04

MANIPULATION UNDER ANESTHESIA VERSUS NON-SURGICAL TREATMENT FOR PATIENTS WITH FROZEN SHOULDER CONTRACTURE SYNDROME: A SYSTEMATIC REVIEW.

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Background: Frozen shoulder contracture syndrome is a poorly understood condition that typically involves substantial pain, movement restriction, and considerable morbidity. Manipulation under anesthesia is an invasive procedure, strongly debated, with the potential to rapidly reduce symptoms, restore the range of motion and shorten mean recovery time.

Methods: A systematic review of literature was conducted to investigate the efficacy of manipulation under anesthesia compared to other non-surgical therapeutic strategies for patients with frozen shoulder contracture syndrome. A literature search was performed in MEDLINE, EMBASE, PEDro, Cochrane Central Library and Scopus. Only randomized controlled trials were included and assessed for critical appraisal through the Cochrane Collaborations tools.

Results: Five randomized controlled trials were included. The overall risk of bias (RoB) was high in 4 out of 5 of the included studies. Manipulation under anesthesia was found to be not superior in terms of reduction of pain and improvement of function when compared to cortisone injections with hydrodilatation (mean regression coefficient manipulation under anesthesia -2.77 vs injection -2.75; 95%CI (-1.11 to 1.15)) and home exercise (mean difference 95%CI: 0.2 (-0.64 to 1.02)) in short terms (at 3 months), and cortisone injections with hydrodilatation (mean regression coefficient manipulation under anesthesia 3.13 vs injection 3.23; 95%CI (-0.90 to 1.11)) in long term (>6 months). Moreover, if compared to structured physiotherapy, manipulation under anesthesia highlighted higher Oxford Shoulder Score at final 1-year follow up (mean difference 95%CI: 1.05 (-1.28 to 3.39); p=0.38).

Similar results were obtained for disability, with statistically no significant long-term (>12 months) differences between manipulation under anesthesia and home exercise (mean difference 95%CI: 0 (-3.2 to 3.2)) or structured physiotherapy (mean difference 95%CI: -0.50 (-5.70 to 4.70); p=0.85). Only two trials reported adverse events.

Conclusions: This systematic review suggested that limited and inconsistent evidence currently exists on the efficacy of manipulation under anesthesia compared to other non-surgical strategies in the management of patients with frozen shoulder contracture syndrome. Future research should focus on clinical trials with higher methodological quality.

IEP.01.05

CHANGES IN SHOULDER RANGE OF MOTION WITH TENSILE FORCE OF THE DORSAL SCAPULAR MUSCLES

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Background: Tightness of muscles around the scapula often restrict the scapular motion, consequently restricting shoulder range of motion (ROM). In the scapular muscles, the tightness of the pectoralis minor is commonly studied as a muscle restricting scapular upward rotation and posterior tilting during shoulder elevation. However, there is few studies determining whether the tightness of the dorsal scapular muscles (e.g. latissimus dorsi, trapezius, rhomboids, and levator scapulae) can affect shoulder ROM. The purpose of this study was to determine which dorsal scapular muscle affects shoulder ROM.

Methods: Eight fresh-frozen cadaver of whole was fixed on the table in a prone position, and eight shoulders were utilized. A six-degree-of-freedom electromagnetic tracking device was used for measurement of the shoulder complex and glenohumeral angles. Sensors were placed on the pelvic girdle, scapula, lateral epicondyle of the humerus. Motion axes were set up based on recommendation proposed by the International Society of Biomechanics. The ranges of passive flexion, extension, abduction, horizontal adduction, external rotations at the side, abduction, and flexion in the shoulder complex and glenohumeral joint were measured. The upper and lower latissimus, upper, middle, and lower trapezius, rhomboid minor and major, levator scapulae muscles were loaded with 10N and 20N of tensile force. Each passive shoulder motion was performed with 4 Nm applied at the distal humerus, and then ROM was measured.

Results: In the upper latissimus dorsi, tensile force significantly decreased ranges of flexion and external rotation at flexion in the shoulder complex, and range of flexion in glenohumeral joint. In the middle trapezius, tensile force significantly decreased ranges of horizontal adduction and external rotation at the side in the shoulder complex. In the rhomboid minor, tensile force significantly decreased ranges of flexion in the shoulder complex and glenohumeral joint. In the rhomboid major, tensile force significantly decreased range of external rotation at flexion in glenohumeral joint.

Conclusions: This study suggest that tightness of scapular dorsal muscles can restrict ranges of the glenohumeral joint as well as shoulder complex. The quantitative knowledge of muscle tension and limited ROM can be applied to the rehabilitation to improve shoulder ROM.

IEP.01.06

A SHOULDER/ELBOW TRIAGE AND ASSESSMENT MODEL OF CARE REDUCED A PUBLIC ORTHOPAEDIC SHOULDER/ELBOW CLINIC WAITLIST WITH HIGH PATIENT SATISFACTION

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Background: Patients referred to public orthopaedic clinics can experience long waiting times before assessment. This study aims to evaluate the effectiveness of a collaborative Shoulder/Elbow Triage and Assessment (SHELTA) model of care involving orthopaedic surgeons and physiotherapists to reduce the waitlist and improve service and clinical outcomes for patients on an orthopaedic shoulder/elbow clinic waitlist.

Methods: Patients on the waitlist were triaged by surgeons and physiotherapists and invited to an assessment by experienced physiotherapists. Patients were treated nonoperatively or transferred to orthopaedic management based on clinical discussion and/or agreed criteria. The primary outcome was the number of patients on the waitlist. Secondary outcomes included adverse events, patient satisfaction, re-referral and conversion to surgery rates. Pain, function and patient global impression of change were recorded for participants managed nonoperatively.

Results: From July 2019 to December 2019, the waitlist reduced from 451 to 298 patients with no adverse events. Seventy-nine patients could not be contacted and 25 no longer required assessment, and were removed from the waitlist. Nonoperatively managed participants reported satisfaction with the service, a median score of 6 on a 7-point Patient Global Impression of Change scale, change in pain of -2.5/10 (95% CI -3.3, -1.7; $P < 0.001$) on a numerical pain rating scale, and change in function of -17.4/100 (95% CI: -24.1, -10.8; $P < 0.001$) on the QuickDASH, indicating improvement. Re-referral rate at one year was 3.8%.

Conclusions: The SHELTA model of care effectively reduced the number of patients on an orthopaedic shoulder/elbow clinic waitlist with good service and clinical outcomes.

IEP.01.07

THE EFFECT OF FASCIAL MANIPULATION ON THE SHOULDER RANGE OF MOTION AND EXTERNAL ROTATION STRENGTH: A RANDOMIZED CONTROLLED STUDY ON ASYMPTOMATIC HANDBALL PLAYERS

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Background: The shoulder is at high risk of injury in overhead athletes. The aim of this prospective study was to determine whether and how Fascia Manipulation® by Stecco® (FM) impacts the range of motion (ROM) of internal rotation (IR), horizontal adduction (HADD) and the strength of external rotation (ER) which represents the main risk factors for shoulder injuries among handball players.

Methods: The selected sample was randomly divided into the investigated group (N=29) with FM (one treatment) and the control group (N=27) without FM. IR, HADD ROM and ER strength were measured before, immediately after, and one month after the performed FM. The subjective assessment of tightness in the dominant shoulder joint was documented.

Results: In the investigated group we observed a statistically significant increase in IR ROM by 14° ($p < 0,001$) and HADD by 14° ($p < 0,001$), as well as the strength of ER (by 22,28 N/kg, $p < 0,001$) immediately after performing FM and compared to the control group ($p < 0,001$). The positive effects of FM were observed even one month after the treatment (increase in IR ROM by 12° ($p < 0,001$), HADD ROM by 11° ($p < 0,001$) and strength of ER (by 31,41 N/kg, $p < 0,001$). Compared to the control group, subjects' subjective assessment of tightness/stiffness was lower immediately after ($p < 0,001$) and still one month after the FM ($p = 0,002$).

Conclusions: This study describes the effect of FM on asymptomatic handball players, whereby the FM positively impacts major injury risk factors--limited IR and HADD ROM, and shoulder ER weakness, without adding an exercise training program. In addition to prevention in handball, we recommend manual treatment of fascial structures with an emphasis on the posterior-inferior part of the shoulder joint and consideration of the kinetic chain during treatment.

IEP.01.08

SURFACE ELECTROMYOGRAPHY EVALUATION IN REVERSE SHOULDER ARTHROPLASTY - COMPARISON BETWEEN GOOD AND POOR SHOULDR FUNCTION GROUPS

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Background: In the patients with poor active shoulder elevation after reverse shoulder arthroplasty (RSA), inappropriate compensatory scapular elevation movement, so-called shoulder shrugging movement, prior to shoulder joint movement during shoulder elevation was observed in clinical practice. Muscle activities in this scapular abnormal movement are not well known. Surface electromyography (EMG) is an useful minimal invasive examination to investigate the involved joint movement. The purpose of this study was to compare muscle activities using surface electromyography in around shoulder joint and periscapular muscles between good shoulder function and poor shoulder function groups after RSA.

Methods: Eighteen shoulders in 18 patients (13 males and 5 females, mean age 77.0 ± 6.4 years) who underwent RSA were involved in this study. Patients were divided into two groups based on the shoulder function at 3 months postoperatively. Good group (group G) was above 90 degrees of active elevation without shoulder shrugging and poor group (group P) was below 90 degrees of active elevation with shoulder shrugging. Surface EMG evaluation of deltoid, pectoralis major, trapezius, and serratus anterior muscles was performed; EMG integral values were calculated at 30°, 60°, and 90° of shoulder elevation at the scapular plane. Muscle activation ratio (R-muscle value) was calculated and comparison between two groups was statistically analyzed.

Results: R-muscle values in the posterior deltoid fibers at 30°-60° of shoulder elevation were significantly higher in the group P compared to group G (0.03 ± 0.07 in the group P, 0.15 ± 0.05 in the group G respectively) those in the lower trapezius fibers were significantly lower in the group P compared to group G (0.05 ± 0.07 in the group P, 0.19 ± 0.10 in the group G respectively).

Conclusions: Posterior deltoid fibers might be antagonist muscle and lower trapezius fibers might be agonist muscle for shoulder elevation in RSA. To make progress shoulder elevation function in RSA to decrease the muscle activity of posterior deltoid fiber and to increase that of lower trapezius fibers are important.

IEP.01.09

TENDON TENSION ESTIMATION FOR EXERCISE THERAPY AFTER SHOULDER ROTATOR CUFF TEAR REPAIR: MUSCULOSKELETAL MODELING SIMULATION USING A SUPRASPINATUS SHORTENING MODEL

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Background: Shoulder rotator cuff tear repair (ARCR) is performed with a shortened tendon. Tendon shortening increases mechanical stress, leading to re-tear and pain. However, no experiments documenting changes in tendon tension exist. Therefore, the amount of mechanical stress during exercise therapy is unknown. The purpose of this study was to create a musculoskeletal modeling simulation model (MS) with shortened supraspinatus tendon and to quantify the mechanical stress during exercise therapy during shoulder elevation in order to reconsider post-treatment after ARCR.

Methods: MS used the Bergman Model of the Any Modeling System ver7, 2 (Any Technology A/S, Aalborg, Denmark). The MS model was a normal model (NM) and a model with the supraspinatus tendon shortened by 10 mm to 40 mm (10 mmM, 20 mmM, 30 mmM, 40 mmM) were created. The exercise task was a reciprocal 0-90° scapular plane elevation of the right shoulder joint in a seated position (8 seconds). The main outcome was the tendon tension (N: Newton) and muscle activity (%) of the supraspinatus muscle, and the secondary outcome was the muscle activity of the 38 periarticular muscles of the shoulder joint.

Results: Maximum tendon tension (N) was NM: 8N, 10mmM: 20N, 20mmM: 29N, 30mmM: 20N, 40mmM: 21N. Maximal supraspinatus muscle activity (%) was NM: 20%, 10mmM: 20%, 20mmM: 34%, 30mmM: 30%, and 40mmM: 15%. Secondary outcomes showed muscle activation similar to previous studies.

Conclusions: Tendon shortening was 1 N at NM at 0° of elevation and continued to increase when shortened, resulting in a large mechanical stress of 22 N at 40 mmM. Next, in the NM, the contractile element was high at approximately 45° of elevation. In the shortened model, the passive element occurred at 0° of elevation, and the passive element became lower as the angle of elevation increased. In other words, the passive component was responsible for the tendon tension required when the angle of elevation increased. In summary, patients with small tendon shortening should pay attention to exercise therapy with a high elevation angle, while those with large tendon shortening should pay attention to exercise therapy and lifestyle with a low elevation angle.

IEP.01.10

CLINICAL OUTCOMES IN PATIENTS WITH RETEAR AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR: A META-ANALYSIS

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Background: Rotator cuff retear is a major concern after arthroscopic rotator cuff repair (ARCR); however, the effects of retear remain unclear. Therefore, the purpose of this study was to assess the clinical outcomes of postoperative retear and intact tendons after ARCR.

Methods: We searched PubMed, Cochrane Library, Scopus, and PEDro databases for studies performed from January 2000 to June 2020. Clinical outcomes included the Constant score, American Shoulder and Elbow Surgeons (ASES) score, University of California Los Angeles shoulder (UCLA) score, pain score, range of motion, and muscle strength. Meta-analysis using random-effects models was performed on the pooled results to determine significance.

Results: The initial database search yielded 3141 records. After removed of duplicates, 26 of which met the inclusion criteria. Patients in the retear group had significantly lower Constant score [- 8.51 points (95% CI, - 10.29 to - 6.73); $P < 0.001$], ASES score [- 12.53 points (95% CI, - 16.27 to - 8.79); $P < 0.001$], UCLA score [- 3.77 points (95% CI, - 4.72 to - 2.82); $P < 0.001$], and significantly higher pain score [0.56 cm (95% CI, 0.10 to 1.01); $P = 0.02$] than the intact group. In addition, the retear group had significantly lower flexion [- 10.46° (95% CI, - 19.86 to - 1.07); $P = 0.03$], abduction [- 14.84° (95% CI, - 28.55 to - 1.14); $P = 0.03$], and external rotation [- 7.22° (95% CI, - 13.71 to - 0.74); $P = 0.03$] range of motion, and flexion [- 1.65 kg.f (95% CI, - 2.29 to - 1.01); $P < 0.001$], abduction [- 1.87 kg.f (95% CI, - 3.02 to - 0.72); $P = 0.001$], and external rotation [- 1.66 kg.f (95% CI, - 3.25 to - 0.07); $P = 0.04$] muscle strength.

Conclusions: Our data showed that postoperative retear had significantly decreased functional scores, ROM (flexion/abduction/external rotation), muscle strength (flexion/abduction/external rotation), and increased degree of pain. Therefore, these results suggest that retear after ARCR leads to poorer clinical outcomes after ARCR.

IEP.01.11

SUBSCAPULARIS TEARS INFLUENCE THE BEHAVIOR OF THE MIDDLE DELTOID, INFRASPINATUS AND TERES MINOR MUSCLES WITH ROTATOR CUFF TEARS

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Background: Burkhart previously reported that transverse force couple, related to the infraspinatus (ISP), Teres minor (TMin), and Subscapularis (SSC) muscles, is also coordinated via the middle deltoid muscle. The aim of this study was to investigate the functional behavior of the middle deltoid, residual ISP, and TMin muscles, during scaption in patients with rotator cuff (RC) tears with and without SSC tears using real-time tissue elastography (RTE).

Methods: Twenty-six patients who were diagnosed with RC tears were included in this study. Participants were classified into three groups based on the intraoperative tear size assessment for the SSC as follows: SSC-intact, SSC-1/3 tear, and SSC-whole tear groups. Muscle elasticity outcomes from RTE of the middle deltoid, ISP and TMin muscles were obtained at rest and during contraction during scaption at 30°, 60°, and 90°. Activity value was defined as the difference between the elasticities measured at rest and during contraction. The slope based on muscle activity and shoulder scaption from 30° to 90° was calculated as a surrogate for the rate of muscle activation. Stepwise multiple regression analysis and one-way ANOVA with repeated measures were used for statistical analysis. $p < 0.05$ was considered statistically significant.

Results: Stepwise multiple regression analysis revealed that only the rate of activation, described by the slope, of the middle deltoid muscle was significantly correlated with SSC tear classification ($R^2 = 0.414$, $p < 0.001$). Activity value of the middle deltoid muscle in the SSC-intact group linearly increased with increasing elevation angles ($p < 0.02$), while the outcomes in SSC-1/3 and whole-tear groups remained almost constant with increasing scaption. Activity value of the ISP muscle remained almost constant with increasing scaption angles for all groups. Activity value of the TMin muscle in the SSC-intact group was highest at 30° and decreased with increasing shoulder angle positions ($p = 0.011$), while the outcomes in SSC-1/3 and whole-tear groups remained almost constant with increasing scaption angles.

Conclusions: SSC tears influence the behavior of the middle deltoid muscle and residual ISP and TMin muscles, potentially changing the behavior of the shoulder force couples.

IEP.01.12

EFFECT OF UPPER ARM EXTENSION RATE ON DELTOID MUSCLE STIFFNESS AND SHOULDER FUNCTION AFTER REVERSE SHOULDER ARTHROPLASTY

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Background: Deltoid muscle was relaxed preoperatively due to upward migration of humeral head in rotator cuff tear shoulders such as cuff tear arthropathy. Deltoid muscle is stretched and hypertonic after reverse shoulder arthroplasty (RSA), which is thought to increase muscle stiffness. Lower tonus of deltoid muscle might induce shoulder instability or elevation difficulty, higher tonus of deltoid muscle might induce muscle pain or acromion fracture. Proper deltoid muscle tonus is important for postoperative good shoulder function after RSA. We can evaluate muscle tonus by measuring muscle stiffness with Shear Wave Elastography (SWE). Muscle tonus is regulated by upper arm extension after RSA. The purpose of this study was to examine the effect of upper arm extension rate after RSA on deltoid muscle stiffness and postoperative shoulder function.

Methods: Twenty-one patients (76.1 ± 4.6 years) after RSA were involved in this study. The upper arm length was measured by pre- and postoperative radiographic images; upper arm extension ratio was calculated. Muscle stiffness was measured with SWE at the middle portion of the deltoid muscle. Shoulder function was evaluated with active ROM of flexion and abduction at pre-operation and 3 months postoperatively. Relations among deltoid muscle stiffness, upper arm extension rate and shoulder function were statistically analyzed.

Results: A significant correlation between upper arm extension rate and change amount of SWE was observed ($r=0.58$). A significant correlation between postoperative change amount of SWE and ROM of active abduction was also found ($r=0.44$).

Conclusions: We should pay attention to the deltoid muscle stiffness determined by upper arm extension rate to improve postoperative shoulder function after RSA.

IEP.01.13

THE COVID-19 LOCKDOWN AS A MODEL OF DETRAINING IN DIVISION 1 COLLEGE SOFTBALL PLAYERS

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Background: The COVID-19 pandemic interrupted the organized training of softball players, causing them to isolate, similar to the abrupt cessation of sports participation that can happen after an injury. Thus, the COVID-19 pandemic offers a unique model to study how sudden detraining influences softball players.

Methods: 15 NCAA division 1 softball players participated in three data collections: pre-lockdown (Jan 2020, T1), post-lockdown (Sept 2020, T2), and before the 2021 season (Jan 2021, T3). Between T1-T2, players received an at-home conditioning and throwing program, but compliance was not strictly monitored. Between T2-T3, players resumed formal fall training (team-organized workouts and on-field practice, and within-team scrimmage games). At each time point, we collected bilaterally: 1) shoulder internal rotation (IR) and external rotation (ER) range of motion (ROM); 2) shoulder IR and ER strength; 3) hip IR and ER ROM; and 4) hip abduction and extension strength. We used four independent (2 Sides x 3 Timepoints) MANOVA with repeated measures; we followed up significant MANOVA main effect of time with Sidak posthoc tests for pairwise comparisons between time points.

Results: We found a significant MANOVA main effect of time for shoulder and hip ROM ($p < 0.01$). Between T1-T2, dominant shoulder ER ROM decreased 6.5° , dominant shoulder IR ROM increased 4.3° , and lead hip IR ROM increased 4.4° . Between T2-T3, dominant shoulder ER ROM increased 6.3° and trail hip ER ROM increased 5.9° . We found a significant MANOVA main effect of time for shoulder strength ($p = 0.03$) but not for hip strength ($p = 0.18$). Between T2-T3, non-dominant shoulder IR and ER increased 1.8kg and 1.5kg, respectively.

Conclusions: A sudden and prolonged cessation of organized training induced changes in shoulder and hip ROM but affected strength to a lesser extent. The loss of shoulder ER and increased lead hip IR are maladaptive as they are associated with injury in overhead athletes. Resuming team-organized training and scrimmage reversed some (shoulder ER), but not all of these changes. Practitioners should monitor clinical variables regularly and be aware of potential changes due to unexpected and prolonged interruptions in training, such as when players suffer sports-related injuries.

IEP.01.14

VISUAL MEASUREMENT OF THE RANGE OF MOTION OF THE SHOULDER: ARE WE DOING IT CORRECTLY? - INTRA AND INTEROBSERVER VARIABILITY OF THE SHOULDER MOTION

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Background: Accurate measurement of the shoulder joint range of motion (ROM) is imperative when evaluating pre and postoperative clinical results. This study aims to identify the variability of clinical evaluation of the shoulder by physicians at different times of their orthopedic training, from their first year of residency until shoulder surgeons.

Methods: An online survey containing 7 video files showing shoulder elevation in the frontal and sagittal planes for approximately 10 seconds was sent to orthopedic residents of all levels, shoulder fellows, and attending shoulder. Each surgeon was asked to review the videos and indicate the amount of flexion they considered correct. Finally, we obtained the intra- and inter-observer reliability by using the intraclass correlation index and kappa Fleiss (KF) index.

Results: 47 physicians answered the questionnaire. Our research presented that inter-observer agreement is low at 0.168 (IC 95%, $p=0.228$) at 160 and 115 degrees, and moderate or good at 0.670 (IC 95%, $p=0.000$) when evaluating 90 degrees. The intra-observer agreement presented a weak positive correlation of 0.491 (kF 95%, $p=0.216$) among shoulder surgeons and a very low negative among fellows and residents 0.072 (kF 95%, $p=0.532$). The general percentage of error was 72% (N 47).

Conclusions: The variability in both inter- and intra-observer in the clinical evaluation of the shoulder demonstrates a strong negative correlation in general but decreases considerably when more experience the observer has.

IEP.01.15

EFFECTIVENESS OF MANUAL THERAPY ON SHOULDER PAIN, RANGE OF MOTION, AND FUNCTION IN PATIENTS WITH FROZEN SHOULDER – A SYSTEMATIC REVIEW OF SYSTEMATIC REVIEWS

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Background: Frozen shoulder is a common condition that can cause persistent shoulder pain, restricted range of motion (ROM), and functional impairment. Despite current physical therapy guidelines recommending exercise therapy that includes lifestyle guidance and stretching, along with manual therapy, several unknown aspects regarding the evidence for manual therapy still exist. As research on the efficacy of the manual therapy continues to grow, there is a need to update the evidence for its use in managing patients with frozen shoulder. This systematic review (SR) of SRs aims to evaluate the current evidence for the manual therapy in the management of patients with frozen shoulder.

Methods: Full-text SRs published through October 2022 were searched in PubMed and Cochrane Library. Papers targeting frozen shoulder patients were included, and those targeting secondary stiff shoulder with a known etiology were excluded. Papers that mentioned the effects of all manual therapies were incorporated, and all outcomes, including pain, joint range of motion, and functional scores, were considered. SRs that did not include randomized controlled trials were excluded. Out of 189 citations retrieved, 17 SRs were included.

Results: Out of the 17 SRs, five studies conducted meta-analyses. These five studies yielded three main themes: the effect of joint mobilization, the effect of mobilization with movement (MWM), and the combined effect of manual therapy and exercise therapy. The joint mobilization was found to provide pain relief and improve shoulder ROM when compared to other treatments that did not involve joint mobilization. The MWM was found to be more effective than conservative therapy, including manual therapy and exercise therapy, in terms of pain relief, shoulder ROM improvement, and shoulder joint functional improvement.

Conclusions: The findings of the SR and meta-analysis suggest that the MWM and joint mobilization are effective in reducing pain and improving shoulder ROM in patients with frozen shoulder. However, the optimal frequency and duration of the manual therapy, the potential effects when combined with exercise therapy remain uncertain and could be potential areas for future research.

IEP.01.16

SHOULDER ROTATIONAL RANGE OF MOTION DURING SHOULDER FLEXION, ABDUCTION AND HORIZONTAL ADDUCTION IN HEALTHY MEN AND WOMEN: A COMPARISON BETWEEN MEN AND WOMEN

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Background: Sex differences on the change in shoulder rotational range of motion (ROM) while the shoulder is in motion are not well known. The aim of this study was to investigate the rotational ROM during flexion, abduction, and horizontal adduction of shoulder and its sex differences.

Methods: 160 shoulders in 80 healthy participants (40 men, 40 women) were included in the study. The maximum range of internal rotation (IR) and external rotation (ER) at 0°, 30°, 60°, 90°, 120°, and 150° of shoulder flexion and abduction, and up to 120° of shoulder horizontal adduction were passively measured in the supine position using a goniometer. The change in IR, ER, total arc of rotation (TA) and midrange of rotation (MR) were calculated at each successive angle of flexion, abduction, and horizontal adduction. In addition, IR, ER, TA, and MR were compared between men and women. MR was used as an index of changes in rotational ROM. Statistical analysis was performed using Bonferroni's multiple comparison test and Student t-test.

Results: As participants performed flexion, IR significantly increased up to 90° and decreased after 120°, while ER and TA significantly decreased at all angles. MR showed change in the direction of internal rotation in both sexes. For abduction, IR significantly decreased and ER significantly increased at all angles, and TA significantly decreased after 60°. MR showed change in the direction of external rotation in both sexes. For horizontal adduction, IR significantly decreased between 0° to 90°, ER significantly decreased between 30° to 60° and 90° to 120°, and TA significantly decreased at all angles. MR showed change in the direction of external rotation up to 90° and in the direction of internal rotation after 90° in both sexes. Women had significantly greater IR, ER, and TA of flexion, abduction, and horizontal adduction than men. But there were no significant sex differences in MR of all motions.

Conclusions: This study revealed characteristics and sex differences of rotational ROM during shoulder motion. The results of this study may be useful to do the assessment of patients with shoulder motion abnormalities and planning for rehabilitation programs.

IEP.01.17

ELECTROMYOGRAPHIC ANALYSIS OF SCAPULAR MUSCLES DURING FOUR CLOSED KINETIC CHAIN EXERCISES: WHAT IS THE EFFECT OF GLENOHUMERAL JOINT ELEVATION STATUS ON MUSCLE ACTIVITY?

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Background: In shoulder rehabilitation the kinetic chain approach incorporates segments in shoulder exercises. Closed kinetic chain exercises have been widely used for neuromuscular control to stimulate mechanoreceptors, which contribute to shoulder joint stabilization. However, there are limited data on the influence of exercise design variations on muscle activity. Therefore, the aim of this study is to determine the activation of the upper trapezius (UT) and the exercises that middle trapezius (MT), lower trapezius (LT), serratus anterior (SA) muscle activation in four closed kinetic chain exercises using various glenohumeral joint elevation status.

Methods: Nine healthy physically active individuals were included in this single group repeated-measures design study. Participants performed a standard Low Plank and three variations (Low Plank Plus, Dolphin Plank, and Saw) in random order. Superficial electromyographic (EMG) activity of UT, MT, LT, SA, and UT/LT activation ratios were collected. Repeated measures analysis of variance (ANOVA) was used for statistical analysis.

Results: Scapular muscle activation levels seen during the tested exercises were low to moderate ($< 40\%$ maximal voluntary isometric contraction, MVIC). There was no difference found in UT and MT muscle activation levels when all tested exercises compared ($p > 0.05$) LT activity was higher during Saw (concentric-phase) when compared to Low Plank Plus ($P = 0.002$) and Dolphin Press ($p = 0.01$). SA muscular activity was moderate during Low Plank Plus and Saw (concentric-phase) exercises ($20\% - 40\%$ MVIC). SA muscle activation was found to be higher in Low Plank Plus exercise among other variations ($F_{1,71}, 13.7 = 13.625, p = 0.001$). UT/LT activity ratio were found to be low (< 1) in Low Plank and Saw exercises ($F_{2,04}, 16.3 = 3.857, p = 0.04$).

Conclusions: Findings of this study showed that low plank variations created low to moderate scapular muscular activity, and the activity levels and ratios were affected by glenohumeral joint elevation status. These findings support the use of low plank and its variations in shoulder rehabilitation.

IEP.01.18

ASSESSMENT OF CROSS-CULTURAL ADAPTATIONS AND PATIENT-REPORTED OUTCOME MEASURES RELEVANT TO SHOULDER DISORDERS IN TURKISH: A SYSTEMATIC REVIEW USING THE COSMIN METHODOLOGY

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Background: There are many Patient-Reported Outcome Measures (PROMs) are widely used in shoulder rehabilitation. To identify the valid and reliable Turkish scales used to evaluate shoulder pain and disability, to reveal how compatible these scales are with the methodological quality of studies on (COSMIN) criteria list.

Methods: A systematic search was performed in the following electronic databases: MED-LINE, Web of Science (WOS), EMBASE, SCOPUS, and ULAKBIM. The electronic search was tailored to each database based on the protocol suggested by the COSMIN group and the PRISMA guidelines were followed. Five databases were searched from inception to January 2022.

Results: A total of 2890 articles were found in the databases. Additionally, two articles were included with a hand-search. Then, after eliminating the duplicates, 2229 articles were included based on the and abstract search. After removing the articles meeting the exclusion criteria, 61 articles were included in full-text review. After the full-text review, according to our criterias 27 articles were included in the systematic review. According to the assessment by the COSMIN checklist, 26 articles received the final classification of "inadequate". Only 1 article received the final classification of "adequate".

Conclusions: There is a wide variety of Turkish patient reported outcome measures (PROMs) for the shoulder, and only one specific scale was demonstrated to fit all of the parameters defined according to the COSMIN methodology.

IEP.01.19

EXERCISE INTO PAIN IN SUBACROMIAL PAIN SYNDROME: A FEASIBILITY STUDY

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Background: Exercise therapy is strongly recommended in the conservative management of subacromial pain syndrome (SAPS). Loaded exercises are suggested but it is not clear what is the best type of exercise and whether pain should be provoked or avoided during exercise. Temporary reproduction of symptoms in the context of "hurt not equalling harm" could help to address fear avoidance and catastrophising beliefs. Considering that different exercises are beneficial in SAPS, we hypothesised that exercising at high range of pain (4-7 on verbal Numeric Pain Rating Scale) could strengthen the deconditioned shoulder muscles and lead to beneficial results. This feasibility study aimed to test: the adherence to exercise into pain, the process of data collection, the feedback from physiotherapists and patients, and changes in patient-reported outcome measures (PROMs).

Methods: Participants: 12 patients with unilateral SAPS for minimum 3 months, aged 18-65 years, were enrolled. Design: unblinded non-randomised single-group study. Setting: private physiotherapy clinic in Belgium. Intervention: 12 weeks with 4 individualized exercises, with 9 physiotherapy (PT) sessions with pain ratings on average 4-7 out of 10 on a verbal NPRS for 9 weeks and then pain ratings 0-2 for 3 weeks. Non-supervised exercises were 2x/week in the weeks with PT and 3x/week in the weeks without PT. Outcomes: patients were considered adherent to PT if they attended 7/9 (78%) sessions and adherent to non-supervised exercises if they completed 22/27 (81%) sessions. PROMs, e.g. Shoulder Pain and Disability Index (SPADI), were registered. Physical (strength, range of motion and scapular dyskinesis) and ultrasound outcomes were measured as part of the study protocol.

Results: Adherence was analysed when patients could attend at least 7 PT sessions (n=8): 88% of patients adhered to the PT sessions and 50% to non-supervised exercises; none of these patients withdrew from the study. Three of these patients obtained individual clinically important improvements in SPADI score above 20 points. The process of data collection for ultrasound and physical outcomes took around 60 minutes (n=12).

Conclusions: The adherence to supervised sessions was satisfactory, whereas the adherence to non-supervised exercises should be improved. The process of data collection was feasible but some changes are suggested.

IEP.01.20

REHABILITATION FOLLOWING SHOULDER ARTHROPLASTY: A SURVEY OF CURRENT CLINICAL PRACTICE PATTERNS OF ITALIAN PHYSIOTHERAPISTS

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Background: The incidence of Total Shoulder Arthroplasty (TSA) and Reverse Total Shoulder Arthroplasty (RTSA) is constantly increasing. Likewise, interest has grown in post-surgical rehabilitation which is crucial to achieve full recovery and successful outcomes. The aim of this study is to investigate the Italian physiotherapists (PTs) clinical practice for the management of patients with TSA and RTSA and to compare it with the best evidence available in the literature.

Methods: This cross-sectional observation study was designed following the CHERRIES checklist and the STROBE guidelines. The study solely involved PTs who were working in Italy at the time of the survey and who spontaneously participated in the study filling out the survey. A 4-sections survey with a total of 30 questions was developed and sent to Italian PTs from December 2020 until February 2021.

Results: Results. A total of 607 PTs completed the survey; 43.5% of participants (n=264/607) stated that TSA is more likely to dislocate into abduction and external rotation, while 53.5% (n=325/607) affirmed RTSA is more likely to dislocate into internal rotation, adduction and extension. Moreover, 65.7% of the sample (n=399/607) declared that during the rehabilitation of patients with TSA, they tend to strengthen the scapular and rotator cuff muscles, deltoid, biceps and triceps. Conversely, 68.0% (n=413/607) of participants stated that they preferably focus the rehabilitation of patients with RTSA on strengthening the periscapular and deltoid muscles. Finally, 33.1% (n=201/607) of the participants indicated the instability of the glenoid prosthetic component as the most frequent complication in patients with TSA, while 42.5% (n=258/607) of PTs identified scapular neck erosion as the most frequent post- RTSA surgery complication.

Conclusions: Conclusions. The clinical practice of Italian PTs reflects the actual indications of the literature on strengthening the main muscle groups and on the precautions on dislocation movements. Regarding the restoration of active and passive movement, the time of introduction and progression of muscle strengthening and the return to sport, differences arose in the clinical practice of Italian PTs. These contrasts represent the lack of methodologically robust studies that can address clinical rehabilitation principles.

IEP.01.21

THE INTRA-RATER AND INTER-RATER RELIABILITY OF HAND-HELD DYNAMOMETRY FOR SHOULDER STRENGTH ASSESSMENT IN CIRCUS ARTS STUDENTS

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Background: Circus is a physically demanding performing arts discipline that requires high levels of stability, strength, and repetitive force attenuation in positions of large shoulder joint range of motion. This study aimed to establish the intra-rater and inter-rater reliability of isometric shoulder strength assessment, using a hand-held dynamometer, in functional joint positions, in student circus artists with symptomatic atraumatic shoulder instability.

Methods: Over two testing sessions, two experienced physiotherapists assessed the shoulder strength of 24 student circus artists, with clinically diagnosed atraumatic shoulder instability. Both the symptomatic and asymptomatic shoulder was assessed using a hand-held dynamometer, in 10 functional positions. A 'make test' protocol was used to mitigate any potential risks associated with the testing procedure in a clinically unstable shoulder population. Intra-class correlation coefficients (ICCs) were calculated to determine reliability of strength measurements.

Results: All examined positions showed moderate-high intra-rater and inter-rater reliability for both raters with ICC_{3,1} values ranging from 0.84-0.96 for absolute peak force, and 0.83-0.94 for the average peak force. External rotation at 0° and internal rotation in horizontal flexion at 45° revealed the most reliable results, and the shrug position the least reliable. Inter-rater and intra-rater reliability was high and demonstrated similar results in symptomatic and asymptomatic shoulders by both raters.

Conclusions: This study demonstrated clinical applicability in reliably measuring functional strength in symptomatic atraumatic instability and asymptomatic shoulders, when assessed by experienced therapists using a hand-held dynamometer.

IEP.01.22

FORZEN SHOULDER DURING COVID-19 PANDEMIC. TREATMENT WITH CPM AND EXERCISES PROTOCOL

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Background: Significant increase in the incidence of frozen shoulders (FS) happened during Covid19-pandemic. Patients infected with Covid-19 hypothesizes that both direct and indirect effects of the viral disease may contribute to the pathogenesis of FS

OBJECTIVE

To compare the use of CPM with traditional treatment to improve the clinical condition of shoulder joint

Methods:

We have included 48 patients, 32 females (55.8 ±5.7 years old) and 16 males(48.9±12.9 years old). The stiffness time were 115.9±12.9 days. All the patients have performed different treatments during 4-5 months without any improvement. We modified the treatment using CPM 1-2hours every days (Monday to Friday), manual techniques and a simple exercises protocols. We have increased the ROM of CPM taking into account the level of pain. To always avoid a new inflammation reaction. An independent evaluator used VAS for pain and goniometry each 15 days.

Results:

The time of treatment with our protocol were 47.2±35.9 days.

The pain decreased between day 0 and day 15 $P<0.0001$, Between day 0 and days30-45 $p<0.001$ and between day 0 and day 60 $p<0.01$

Flexión anterior, abducción and rotation improved with statistically significant differences ($p<0.001$) between day 0 and days 30-45-60

We excluded patients with rotator cuff tears and instability.

Conclusions: The use of CPM improve the clinical condition in patients with frozen shoulder after Covid 19 pandemic. We found statistically significant differences in the level of pain and the ROM in the affected shoulder after our treatment . We didn't find papers using CPM in patients with FS after Covid-19

We didn't find collateral effects with this treatment. 77% of the patients recover the ROM when they finished the treatment

IEP.01.23

SEVEN POSTOPERATIVE CONTROLLED HOME REHABILITATION PROTOCOLS BASED ON PATHOLOGY AFTER ARTHROSCOPIC ROTATOR CUFF SURGERY

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Background: The concept of rehabilitation after arthroscopic rotator cuff repair is described many times in the literature. Although there are many different types and degrees of rotator cuff tear no sophisticated protocol is presented in the literature as far as our knowledge. In this study we present seven protocols based on the different types of the rotator cuff pathologies. The program is done with coordination of the patient, the physiotherapist and the surgeon. The details of the seven protocols will be presented.

Methods: Seven protocols for the different rotator cuff tear pathologies will be described. It is mainly in general a home exercises done by the patient 3 to 5 times a day with a clinic visit to the physiotherapist twice a week and the surgeon once every two weeks for 4 months. The program is in 3 phases, the passive assisted exercises phase, the active assisted phase and the strengthening and stretching phase. The seven pathology classifications are partial insertion supraspinatus (ssp) tear, partial medial ssp tear, small complete ssp tear, medium size ssp tear, large ssp tear, massive and recurrent tear, subscapularis tear, infraspinatus tear and the biceps tear. Consideration has to be made to the type of surgery if it was an Anchor suture fixation or transosseous suture fixation.

Results: The results of this program are widely more effective than other programs as reported by ten physiotherapists involved in the study of 100 cases of outlet impingement rotator cuff tears. No financial problems as the rehabilitation cost were inclusive in the surgery cost which increases the commitment level of the patients.

Conclusions: In the last 10 years the senior author has been using these rehabilitation protocols with distinguished results so that we recommend this segmentation of rehabilitation of rotator cuff repair according to the pathology and type of repair.

IEP.02.01

A SYSTEMATIC REVIEW OF RANDOMIZED CONTROL TRIALS TO ASSESS EXERCISE PRESCRIPTION PRACTICE IN TENNIS ELBOW

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Background: Aims:

To systematically review the exercise prescription practices in the management of Tennis Elbow.

Methods: A comprehensive literature search was conducted using recommended methods using Boolean logic with the following terms: physiotherapy; physical therapy; rehabilitation; exercise; tennis elbow; lateral epicondylitis and lateral elbow tendinopathy. The study was registered under PROSPERO registration number: CRD42021281976. PICO and PRISMA was used to guide the search and report the process of synthesizing the search results. The quality of the RCTs was assessed using The Physiotherapy Evidence Database (PEDro) scale.

Inclusion Criteria - Control trials with randomization

Patients with acute or chronic TE participating in any exercise interventions

Exercise interventions with a focus of improving function, strength, endurance, quality of life (QoL).

Intervention outcome report

Patient reported pain: pain physical function, QoL, activities of daily living (ADL), work and social life

Objective: physical performance, range of motion, strength, and, endurance.

Duration: 2015 to 2021

English language text only.

Exclusion Criteria - Case reports, preclinical studies, studies reported as abstracts only, systematic review

Population, Intervention, Comparator, Outcome

Population, Male and female patients diagnosed with TE

Intervention, Any intervention involving exercise and stretching

Comparison. Comparison of various exercise models and their outcomes.

Outcomes, Physical function, ADL, muscle strength, QoL

Results: Out of the total of 848 articles that were identified from the initial search 22 RCT's were shortlisted for the current systematic review. On the PEDro scale, of the 22 RCT's only 2 scored as excellent, 12 as good, 7 fair and 1 poor. Majority of the studies failed to outline their scientific rationale for choosing exercises and have also not provided science behind exercise progression aimed at achieving optimal benefits.

Conclusions: There is clearly a paucity of high-quality evidence available to guide physiotherapists in designing and progressing exercise programs for patients with TE. Further research in the field of exercise prescription and related progression and dosage is required to provide more robust evidence in prescribing exercise for the management of TE in clinical practice. We also involved patient and public in this systematic review.

IEP.02.02

RETURN-TO-PLAY OUTCOMES IN BASEBALL PLAYERS FOR ULNAR COLLATERAL LIGAMENT INJURIES: CONTRIBUTIONS OF DYNAMIC STABILIZERS

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Background: Ulnar collateral ligament (UCL) injuries are common in baseball pitchers. Past our study found that stress ultrasound with FDS muscle contraction can help predict the potential for return to the same level of play or higher (RTSP). But it had not compared with the other forearm flexors muscles function. The purpose of this study was to evaluate changes to medial elbow joint laxity under valgus stress, as well as under valgus stress with forearm flexor muscles contraction including flexors digitorum superficialis (FDS), Flexor carpi ulnaris (FCU), and pronator teres (PT). And its ability to predict rehabilitation outcomes was also investigated.

Methods: Sixty-one UCL injuries were diagnosed UCL by MRI. All patients were high school students who initially received rehabilitation treatment. The intra-articular ring-down artifact (RDA) of medial elbow joint space was assessed at elbow gravity valgus stress and elbow gravity valgus stress with maximum flexors contraction: superficial layers of FDS; deep layers of FDS; FCU; PT. A throwing rehabilitation program was provided for a minimum of 3 months. Players who were able to return to the same level of play or higher were categorized into the RTSP group and rates of return to the same level of play or higher (RTSP) were calculated. Univariate analyses were performed using Fisher exact tests to investigate the predictive factors for nonoperative treatment success.

Results: The overall RTSP rate in patients receiving nonoperative treatment was 83.6% (51 of 61 patients). There were significant differences in the RDA under gravity valgus stress conditions with superficial and deep layers of FDS contraction between the 2 groups ($P = .0001$).

Conclusions: UCL injuries in high school baseball players can be successfully treated nonoperatively in most cases. Stress ultrasound with FDS muscle contraction can help predict the potential for RTSP and FDS function as the dynamic stabilizer might be important for rehabilitation of UCL injuries in high school baseball players.

IEP.02.03

CHANGES BALL SPEED WITH STATIC THORACIC SPINE ALIGNMENT

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Background: Large thoracic kyphosis angle (TKA) in baseball players at a static standing and a maximum elevation of the upper limbs is a risk factor in pitching elbow injuries. On ball speed, it has been reported that an intervention program including exercises to decrease TKA improved ball speed. However, whether ball speed is altered by differences in static spinal alignment is unclear. The purpose of this study was to investigate the relationship between static thoracic spinal alignment and ball speed.

Methods: Fourteen healthy male university students with over 5 years of baseball experience and over 1 year of pitching experience participated. The TKA (sum of Th1-2 to Th12-L1) was measured three times using the spinal mouse (Index Co., Ltd) in a static standing position and a maximum elevation of the upper limbs. The participants performed a maximum-effort pitching throw to the catcher 18.44 m away. Ball speed was measured using a speed gun (Bushnell Co., Ltd), and the highest speed of the five pitches was selected. In the statistical analysis, Pearson's product-moment correlation was used to investigate the correlation between TKA at a static standing position and at a maximal elevation of the upper limbs and ball speed. Statistical significance was set at $p < 0.05$.

Results: The mean TKA at a static standing was $34.4 \pm 5.4^\circ$ and at a maximum elevation of the upper limbs was $21.5 \pm 5.6^\circ$. The mean ball speed was 108.7 ± 6.4 km/h. A significant negative correlation was found between TKA at a static standing and at a maximal elevation of the upper limbs and ball speed ($r = -0.77, p < 0.01$; $r = -0.53, p < 0.05$, respectively).

Conclusions: This study suggests that static thoracic spinal alignment may affect ball speed. It may be necessary to decrease TKA in the static standing position to increase ball speed as well as prevent pitching elbow injuries. In addition, the TKA in static standing, which is easier to measure than that of dynamic thoracic spinal alignment, may be useful as a screening tool to improve pitching performance in the field.

IEP.02.04

EFFECT OF ARM PATH ON PITCH METRICS AND INJURY RISK

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Background: A pitcher's arm path is a strong predictor of both performance capabilities as well as injury risk. Developing a smooth and efficient arm path can affect elbow torque and may impact pitch performance metrics such as ball velocity, spin rate, and extension at release. These metrics greatly impact movement profiles and aid in the execution, deception, and probable success of specific pitches. The purpose is to determine how arm path can influence pitch performance metrics and injury risk factors. The goal is to determine the potential mechanical changes from training with the PocketPath device, and the subsequent effect of a shortened arm path on pitch performance metrics and injury risk.

Methods: Collected pitching and physical measures data on 7 collegiate pitchers before and after a six-week performance training program. Trackman data collected pitch performance metrics. A Driveline Pulse sensor collected elbow torque and arm speed data. The PocketPath was used as an intervention to create a short and repeatable arm path. Data was collected during each session under three conditions: throws at 75% intensity, 100%, and 100% with the PocketPath.

Results: A slight decrease in elbow torque was observed when using the PocketPath compared to regular 100% intensity throws. While falling short in statistical significance, four of the seven pitchers exhibited lower torques, suggesting the PocketPath can create meaningful change in shortening a pitcher's arm path. The six-week training program showed improvement in ball velocity, extension at release, and spin rate in both the 100% and PocketPath conditions across all pitchers. With respect to pitch performance metrics across the seven pitchers, 21/28 possible variables improved in the 75%, 19/28 variables improved in the 100%, and 23/28 variables improved when using the PocketPath.

Conclusions: Changes in a pitcher's arm path can influence the performance capabilities of specific pitches to generate more success, as well as create mechanics with less variability and result in less stress and torque placed on the elbow. Finding their ideal arm path has the capability to give pitchers more control of their perceived intensity when throwing which is an incredibly valuable skill when monitoring a pitcher's workload long-term.

IEP.02.05

POST SURGICAL 'CAPITELLAR WRIST' AND SHOULDER STIFFNESS AFTER ELBOW TERRIBLE TRIAD

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Background: In the realm of orthopaedics, the terrible triad of the elbow is infamous, not only because the prognosis is often poor, but also, maybe to a greater extent, because the unique name of this malady attracts considerable attention and interest in both physicians and patients. The adjective terrible is bestowed on an elbow triad that comprises three coexisting traumas: namely radial head and ulnar coronoid fractures and posterior dislocation of the elbow joint, plus, in some cases, collateral ligaments injuries.

Methods: In our experience, in a group of patients who underwent elbow surgery from 2019 to 2023 (9 women 48 - 62 yo, mean age 54), we noticed, in the immediate post-op, remarkable loss of motion of wrist radial deviation and palmar flexion (we called it ' capitellar wrist') and shoulder stiffness. It is well known that some biochemical factors (transforming growth factor beta and alfa SMA protein) are involved in tissue repair, and sometimes their sustained production underlies the development of tissue fibrosis. In adjunct, inadequate sizing of radial head prostheses (oversizing and overstuffing) may lead to inadvertent change in radial length, with potential adverse effects on elbow, forearm and wrist mechanics . Other factors, such as subjective aspects , type and length of post surgical immobilization as well as improper rehab strategies may lead to poor outcome and important delay in return to ADL and sport activities.

Results: in this presentation we discuss the correct assessment , biomechanical aspects as well as the correct rehab strategies to propose in respect of the biology of surgery, timing , comorbidities and functional requests of the single patient in order to better tailor the rehabilitation program.

Conclusions: Elbow terrible triad represent a hard challenge for the surgeon and for the rehabilitation team. A thorough patient examination, a correct pharmacological approach as well as proper and tailored rehab strategies are the keys of a satisfactory outcome.

IEP.02.06

OUTPATIENT OCCUPATIONAL THERAPY WITH HOME EXERCISE AMELIORATED THE ULNAR NEUROPATHY AFTER OLECRANON FRACTURE WITH OSTEOSYNTHESIS: A SINGLE CASE STUDY

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Background: Home exercise is one of the promising interventions as outpatient occupational therapy for patients with orthopedic injuries. This study aimed to report the outcome of outpatient occupational therapy with home exercise for a case with ulnar neuropathy after the osteosynthesis of the olecranon fracture.

Methods: The case was a 53-year-old woman who worked at her own bedding store and underwent the osteosynthesis due to the olecranon fracture in her dominant arm. On 47 days after surgery, she was aware of numbness and difficulty in using her little finger. On 58 days after surgery, the nerve conduction test suggested the cubital tunnel syndrome. However, muscle weakness was mild. On 74 days after surgery, she had obvious muscle weakness (McGowan's classification grade 2). Thus, outpatient occupational therapy was started with 20 minutes once a week from the 86 days after surgery. Occupational therapist instructed her ulnar nerve gliding exercise and muscle strengthening of the intrinsic muscle innervated by the ulnar nerve as home exercise. This home exercise took about ten minutes. She noted how many times she implemented home exercises in calendar. The outcome was measured before and after outpatient rehabilitation with the two-point discrimination test (2PD; mm), grip strength (kg and %; affected/unaffected), the Hand 20, and the Canadian occupational performance measure (COPM; performance and satisfaction).

Results: She visited our outpatient occupational therapy eight times and implemented the home exercise three times every day. She mentioned that the home exercise was easy to accomplish in my spare time. Static and moving 2PD were 11 and 4 mm before outpatient occupational therapy, respectively. Subsequently, those were 7 and 3 mm at final follow-up. Grip strength increased from 16.5kg (61.1%) to 26.5kg (98.1%). The Hand 20 score improved from 40.5 to 5. The COPM for housework also ameliorated 1/1 to 9/9.

Conclusions: We have experienced a case with ulnar neuropathy complicated after the osteosynthesis of the olecranon fracture, which was improved by outpatient occupational therapy with home exercises. Our home exercise was easy to accomplish within 10 minutes. We believe that the home exercises that can be easily implemented are effective for patients with ulnar neuropathy.

IEP.02.07

FUNCTIONALITY AFTER TRICEPS BRACHII MUSCLE TENDON RUPTURE OF OF A YOUNG BUILDER -A CASE STUDY

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Background: building involves weight training to develop a visual muscle distinction. The tendon rupture of triceps brachii is an extremely rare type of rupture and is caused either by injury or fall when the limb is extended. According to studies, builders that have been taking anabolic-androgenic steroids for years are threatened by tendon ruptures to a greater extent than builders that have never taken such substances. AIM: The paper aims to present a clinical case which focuses on a complete tendon rupture of triceps brachii muscle of a young builder and its rehabilitation

Methods: It is presenting the case of a 28 years-old athlete, surgically treated with a functional technique for high-level athletes. The synthetic allograft unit material is formed from a bundle of polyester fibers which are constrained by a partial braid of polyester, forming a "criss-cross" configuration. The rupture strength was 3300 Nt. The attachment of the graft was performed initially via a transverse drill hole at the olecranon close to the anatomical footprint of triceps tendon insertion. Then the free ends of the graft were sutured in a "criss-cross" fashion to the distal third of the muscle up to the level of the musculotendinous junction. REHABPROGRAMME: The early postoperative physiotherapy included a high protection stage of mobility, from passive to active treatment progressively. The elbow was protected with a functional splint. ROM exercises applied, passive flexion limitation to 90°. From the 4th to 7th w, active exercises entered, while up to the end of the 8th w resistance exercises have been introduced. From the 9th to 12th w, functional rehabilitation has been taken place. The physiotherapy secondly involved weight-lifting and compound difficult exercises aiming the athletic reintegration the isokinetic assessment included elbow measurements at various velocities, involved elbow extension-flexion of 30-45-90-180/s and pronation-supination of 90/s and 180/s.

Results: Eighteen months postoperatively, the operated limb was 13% stronger than the healthy extended in extension and 20% in flexion.

Conclusions: The assessment indicates that the athlete was capable of returning to his sport without any sort of pain or other symptoms.