**FM18** Cerebral activation related to shoulder apprehension in patients with glenohumeral instability and in healthy volunteers

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**Introduction:** Apprehension is the most frequent complaint of patients after traumatic anterior glenohumeral dislocations. Also, some patients have persisting apprehension even after successful open or arthroscopic stabilization. It is not always clear whether the origin of apprehension is true instability or whether it stems from a cerebral pattern linking a certain motion or position to a subjectively unpleasant sensation. Failure to recognize and adequately address this issue of persisting apprehension due to cerebral patterning may result in poor outcomes and even lead to unnecessary revision surgery. Furthermore, identifying this condition may allow establishing adequately targeted rehabilitation protocols.

Functional magnetic resonance imaging (fMRI) is a powerful tool to assess neuronal activations during numerous situations. To date, no investigation has assessed the neuronal correlates of shoulder apprehension.

**Hypothesis:** Apprehension is consecutive to brain activation and cerebral remodeling. Shoulder instability could lead to cerebral reorganization and thus, apprehension could persist even in the case of a mechanically stable glenohumeral joint. Therefore, in some cases, the sensation of apprehension could be linked to abnormal cerebral conditioning and not necessarily to persisting instability.

**Purpose of the study:** The purpose of the study was to localize the zones of cerebral activation and to investigate neuronal activation patterns using event-related fMRI while the subjects are visualizing provocative videos depicting situations stimulating apprehensive reactions.

**Materials and methods:** Multimodal neuroimaging including functional connectivity, grey matter (GM) and white matter (WM) morphometry was used to assess the unexplored neuronal mechanism mediating shoulder apprehension. This prospective study included 7 consecutive right-handed male patients with right-sided shoulder apprehension (30.1 ± 8.1 years) and 11 healthy male right-handed control participants.

**MR protocol:** A video projector was used to project the stimuli onto a translucent screen mounted to the table of the MR imager. Stimuli were seen via mirrors on the head coil. Each run consisted of twelve movies evoking shoulder instability and twelve control movies. Multimodal analyses include functional connectivity tensorial independent component analysis during visual stimulation of movies showing typical apprehension movements versus control videos, voxel-based morphometry analysis of GM and tract-based spatial statistics analysis of WM.
Results: Patients with shoulder apprehension had cerebral remodeling with significant (p<0.05 corrected) increase in functional connectivity notably in the ipsilateral motor area (Smode +151%, component 16) and less pronounced in anterior (Smode + 131%, component 19) and posterior (Smode + 41%, component 10) parts of the default mode network despite the absence of potentially confounding structural changes in GM or WM.

Discussion: Shoulder instability is often associated with peripheral nerve injury. This is the first study that demonstrates that a peripheral orthopaedic pathology could also lead to a central neurological impairment. Shoulder apprehension induces functional reorganization of the brain with notably up-regulation of ipsilateral motor areas as well as alteration of the default mode network. This premier observation offers novel insights into the neuronal effects of shoulder instability which could, with future studies, be generalized to other joints. These original findings may open new horizons leading to improved management regimens for articular instability.

References:
FM19  Suture Anchor Fixation of Bony Bankart Fractures: A Comparison of Single Row versus Suture Bridge Techniques

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Introduction: Multiple techniques exist for arthroscopic suture anchor fixation of small bony bankart fragments; however, there is little evidence supporting a preference for one technique. As an alternative to the standard single row suture anchor technique, a suture bridge technique has been described. While the standard technique a single loop passes around the bone fragment, the suture bridge technique places an anchor at the articular margin of the defect and second medial to the fragment on the anterior glenoid vault with sutures passing from the medial anchor over the bone fragment to the lateral anchor. The objective of this study was to compare the fixation stability, strength and load transfer of these techniques.

Methods: Sixteen shoulders (8 pairs) were tested with an intact glenoid, after creating a 15% bony bankart lesion and after fragment fixation using a single row or suture bridge technique. Paired specimens were randomly assigned to each technique. Cyclic loading was applied to the glenoid concentrically and then eccentrically according to a 7 step staircase protocol. Fragment displacements, failure strength, glenoid strain load transfer and contact area were quantified.

Results: Centralized loading produced significant differences in fragment displacement at 5, 150, and 200N (p≤0.045) and approached a difference at 50 and 100 N (p≤0.061). In all cases the single row technique permitted greater translation, ranging from 0.06-0.28±0.07-0.32 mm. Eccentric loading caused significantly greater fragment displacement in the single row group for all loads above 25N as compared to the suture bridge (mean range, 0.38-0.63±0.23-0.28 vs. 0.14-0.19±0.11-0.27 mm, respectively (0.009≤p≤0.048)). Load transfer measurements did not differ between techniques (p≥0.318), nor between the suture bridge technique and the intact glenoid (p≥0.181); however, single row strain results approached a difference to intact at 5, 10 and 25N (p≤0.072). No significant differences in failure strength were found between the two techniques (mean strength, single row: 74±28N versus suture bridge: 77±56N, p=0.91).

Conclusion: Interface displacement results demonstrate that the suture bridge technique provides significantly greater fracture fragment stability; however, it does not increase failure strength. Thus, the suture bridge technique provides improved initial fragment stability; however, its overall strength is comparable to the single row repair.
In anterior shoulder dislocations the degree of displacement of the humeral head correlates with rotator cuff tears

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Introduction: Rotator cuff tears (RCT) are a well-known complication of anterior shoulder dislocations. Several studies have shown that the incidence increases with increasing age. We hypothesized that the risk of a tear also increases with the degree of dislocation of the humeral head.

Methods: Three independent observers retrospectively reviewed the charts and initial x-ray pictures of 155 consecutive patients with a traumatic first time anterior shoulder dislocation. The severity of dislocation was graded according to the position of the humeral head relative to the glenoid plane on standard anteroposterior x-ray pictures: grade I) the geometric center of rotation (CR) of the humeral head is lateral to the glenoid plane; grade II) the CR is in the plane of the glenoid; grade III) the CR is medial to the plane of the glenoid; grade IV) the entire humeral head is medial to the plane of the glenoid. The reliability of the classification system was assessed using an intra-class correlation ICC(2,k). A multivariate logistic regression model was used to reveal relevant predictors for RCT. The analyzed co-variates were age (</≥45y), gender(m/f), side(r/l), greater tuberosity fractures(y/n), glenoid fractures(y/n), neurologic lesions(y/n), and the grade of dislocation.

Results: The ICC showed a high reliability (0.93). The proportions of RCT for grades I-IV were 8%, 19.3%, 36.7% and 62.5%, respectively. The adjusted regression analysis showed that patients with a grade III dislocation had an 8.5-time (K195% 1.5-47.3) and patients with a grade IV dislocation a 19.9-time (K195% 2.9-135.2) higher likelihood for a RCT compared with patients with a grade I dislocation. Additionally, patients older than 45 years had a 2.9-time (K195% 1.2-7.4) higher likelihood and patients with a greater tuberosity fracture a 0.16-time (K195% 0.05-0.47) lower likelihood for a RCT than younger patients and patients without a fracture, respectively.

Conclusion: The proposed classification system is reliable and helps to identify patients at risk for a rotator cuff tear after a first time anterior shoulder dislocation.
FM21 Clinical and radiological results following arthroscopically assisted stabilization of acute grade III and IV AC joint separations

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Introduction: Persistent horizontal instability after an acute acromioclavicular (AC) joint separation may provoke unsatisfactory results of conservative treatment.

Hypothesis: The arthroscopically assisted double flip button stabilization of an acute grade III and IV AC joint disruption results in full functional restoration and stable radiological reposition.

Method: 21 patients who were treated for an acute grade III or IV AC joint separation were enrolled in this study and clinically evaluated using the Constant Score (CS) and the Simple Shoulder Test (SST). Functional outcome was tested for correlation with radiographic results.

Results: 19 individuals with a mean age of 37 years (17 men, 2 women) were available for clinical and radiological examination after a minimum follow-up of 24 months (range 24-51 months). From injury to surgery, the mean time interval was 12.5 days (range 4-21 days). According to Rockwood’s classification 3 type III and 16 type IV injuries were treated. There was no statistically significant difference between the Constant Score of the study group and the age adjusted normative values. The mean Constant Score was 90.2 points (SD 3.4) and the mean Simple Shoulder Test scored 11.5 points (range 8-12). The overall satisfaction was 8.2 on the visual analogue scale. 16 patients would undergo the intervention again. The functional outcome of these patients was not affected by the radiographic findings. Complications occurred in 4 cases and were treated surgically in 2 patients.

Conclusion: Patient satisfaction after arthroscopically assisted double flip button stabilization for acute grade III and IV AC joint separation is high. Clinical outcome shows similar results to age adjusted normative values. Loss of reduction is a radiographic finding in approximately one third of patients but not affecting clinical outcome.
FM22 Immobilization in internal or external rotation does not change recurrence rates after traumatic anterior shoulder dislocation.

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Introduction: A major complication of anterior dislocation, and the main reason for subsequent shoulder instability, is damage to the anterior tissues of the shoulder, specifically the anterior-inferior labrum and/or glenoid rim, better known as a Bankart Lesion. If this lesion heals, as it does in 50% to 80% of all patients, recurrent dislocations are less likely. In 1999 Itoiet al. made an argument that immobilization in external rotation would reduce damaged anterior-inferior tissues to the glenoid via ligamentotaxis, improve the healing rates of Bankart-type lesions, and thus result in a reduction of recurrence rates. A number of randomized, controlled trials have tested this theory, but have reached conflicting results. It is the objective of this study to systematically review and quantitatively synthesize the data on recurrence rates after shoulder immobilization in internal versus external rotation in first time, traumatic dislocators.

Methods: We performed a systematic search of the keywords "(((external rotation) OR internal rotation) AND immobilization) AND shoulder)" in the online databases PubMed, EMBASE, CINAHL, and the Cochrane Library.

Internal validity was assessed using a modified Jadad scale, which ranges from 0 points (poorest result) to 3 points (best result), attributing 1 point for each randomization, blinding, and attrition.

Publication bias among the included studies was assessed graphically using Egger’s regression.

The presence of between-study heterogeneity was qualified by Cochrane’s Q test.

Random effect models were used to calculate the cumulatively pooled risk ratios (RR) of recurrent shoulder dislocations. All analyses were also stratified by age.

Results: Our search strategy generated 254 studies online and by citation tracking. After exclusion of duplicates, studies not focusing on clinical treatment or outcome, animal studies, studies without any intervention and one study with unacceptable high attrition, five studies including 471 patients (n=230 in internal rotation and n=241 in external rotation) remained for analysis. The included studies were published between 2001 and 2011 in English.

The mean Jadad score for the included trials was 1.6 points (95% confidence interval 0.6 to 2.6 points).

There was no evidence for publication bias (p=0.252) in Egger’s regression.
Between studies heterogeneity was borderline significant (p=0.055) with an $I^2$ index of 56.7%.

The pooled, cumulative, DerSimonian-Laird random effects risk ratio (RR) for recurrence of shoulder dislocations at all ages was 0.74 (95%CI 0.44 to 1.27), not consistent with a statistically significant difference (p=0.278) (Figure 2). The post hoc power for this inference test was 94.5%.

In the meta-regression we found a significant influence of age on the risk ratio (p=0.003).

The pooled, cumulative, DerSimonian-Laird random effects risk ratio (RR) for recurrence of shoulder dislocations for patients aged 30 years or younger ages was 0.70 (95%CI 0.38 to 1.29) (Figure 3). Again this risk ratio was not significant (p=0.250) with a power of 99.8%.

The pooled, cumulative, DerSimonian-Laird random effects risk ratio (RR) for recurrence of shoulder dislocations for ages 30 and higher was 0.78 (95%CI 0.32 to 1.88) at a p-value of 0.579, but with a power of only 12.2% (Figure 4).

**Conclusion:** The currently available best evidence does not support a relative effectiveness of immobilization in external rotation compared to internal rotation in reducing recurrent shoulder dislocations in patients with traumatic anterior shoulder dislocations. However, after reviewing the current clinical data and the available basic science it is our opinion, that yet to be determined subgroup of patients could benefit from such treatment. Future investigations are needed to test this hypothesis.
Use of autologous segmental bone graft for large humeral head defects after posterior shoulder dislocation

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Introduction: During posterior dislocation an osteochondral impression fracture of the anteromedial humeral head is produced. Engaging defects predispose for recurrent instability and require reconstruction of the humeral head contour. The McLaughlin procedure or the transfer of the lesser tuberosity is recommended for defects between 25 and 40%. These procedures may limit internal rotation and impair humeral head circulation. For larger defects, the use of allograft has been advocated. However, there are concerns about availability and transmission of viral infections. In this case series, clinical and radiological results with the use of autologous segmental cortico-cancellous bone from the iliac crest were assessed.

Methods: Three patients (age 43, 57, 63) with locked traumatic posterior shoulder dislocations were retrospectively reviewed. The osteochondral lesions measured on axial CT involved more than 40% of the joint surface (45, 50, 55%). They were treated by open reduction and reconstruction of the anteromedial head lesion by two segments of cortico-cancellous bone from the iliac crest. The grafts were fixed with screws. Congruency of the humeral head was achieved in all cases. One patient needed ORIF of a concomitant humeral head fracture. There were no complications from the donor site.

Results: At a mean follow-up of 23 months (10, 11, 50) no redislocations occurred. There were no radiological signs of osteoarthritis (according to Samilson and Prieto) or osteonecrosis. Mean absolute Constant score was 86 (76, 88, 96), mean relative Constant score 94 (86, 95, 100), mean subjective shoulder value 83% (80, 80, 90). Maximal abduction was 140-170°, flexion 145-160°, external rotation 35-45°, internal rotation ranged from lumbar 3 to thoracic 12. One patient (age 63) was free of symptoms after bursectomy and removal of two screws one year after reconstruction. The other two patients returned to work within two months and had no limitations in their daily life.

Conclusion: Large bony defects of the humeral head after posterior dislocation require reconstruction. In the literature several surgical procedures are described. This small case series presents mid-term results of anteromedial humeral head reconstruction with the use of autologous cortico-cancellous bone graft. The clinical and radiological outcome is comparable to the results achieved by allograft in terms of subjective satisfaction, range of motion and resumption of daily life.
Introduction: The rate of severe degenerative changes of the supraspinatus varies between 30 and 45%. No other tendon in the human body has such a rate of degenerative tear. Many authors demonstrated that most of the lesions appear at the deep surface of the supraspinatus. An anatomical and biomechanical research has been undertaken to try to explain the cause of the supraspinatus lesion.

Material and methods: 20 shoulders from fresh human cadavers were dissected. The patterns of insertion, the course of the tendon and the variations of the orientation of the fibers at the level of their bony attaches were studied during the movements of scapulohumeral joint.

Results: In most of movements studied the humeral head worked as a pulley for the subscapularis and infraspinatus tendons. As a consequence there was very little change at the level of the tendon’s attaches. Study of the supraspinatus tendon evidenced absence of pulley effect leading to huge plication and torsion of the fibers.

Ninety degrees abduction of the arm with neutral rotation led to a 90° plication of the supraspinatus tendon. In the same way 90° internal rotation didn’t change anything to subscapularis and infraspinatus tendons whereas the same amount of rotation was measured for the supraspinatus.

Discussion: These results strongly suggest that the attach of the supraspinatus sustains a huge range of plication and/or torsion by comparison with to the other cuff muscles that may explains the high rate of degenerative lesions.

Furthermore a more general anatomic study demonstrated that most of the tendons (with the noticeable exception of the brachial triceps and the Achille’s tendons) in the human body are protected by pulley phenomenons that limits the range of plication at the attach.

Therefore, the anatomy of the supraspinatus attach is very peculiar regarding not only the cuffs tendon but also the whole body and may be an important part of the explanation of the high range of degenerative lesions.
FM25  The humeral head surface is not spherical

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Introduction: Anatomic shoulder prostheses with spherical heads very often do not perfectly cover the osteotomy surface of the anatomical neck. This may result in a prosthetic overhang anteroposteriorly with the risk of damaging the rotator cuff or an insufficient coverage of the metaphysis inferiorly with the risk of glenohumeral impingement, resulting in asymmetric loading and potential loosening of the glenoid component. The purpose of the present study was therefore to assess the geometry of the humeral head in order to improve the design of shoulder prostheses.

Material and Methods: Thirty-seven dry cadaver humeri without macroscopic lesions were included in this study. The bones were fixed in a custom made frame, with the humeral head surface pointing upwards and the anatomical neck in a horizontal plane. The anatomical neck, as well as the craniocaudal and anteroposterior meridians were marked with two cross line lasers and scanned with use of a hand held Microscribe 3D digitizer. The data were stocked and analyzed in Excel files.

Results: In all except one specimen the anteroposterior diameter was smaller than the craniocaudal diameter. The average difference between these two diameters was 2.7mm (range: -0.3mm to 6.1mm, SD: 1.4mm). This difference was statistically significant. The anteroposterior meridian had a smaller radius of curvature posteriorly than anteriorly, indicating an asymmetry of the humeral head in the transverse plane. Such a difference could not be found in the craniocaudal plane.

Conclusions: The humeral head surface is not spherical. Therefore, currently used shoulder prostheses do not perfectly restore the normal anatomy and biomechanics of the shoulder joint. Malpositioning of a prosthetic head could lead to an unsatisfactory result.
FM26 Fair to good correlation of goutallier rating of supraspinatus fatty changes on axial and parasagittal reformatted computed tomography images

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Purpose: To compare the assessment of fatty infiltration of the supraspinatus muscle on parasagittal views with the standard Goutallier grading on axial computer tomographic images.

Methods: Three independent readers rated fatty changes of the supraspinatus muscle on CT scans of 91 shoulders. Goutallier grades were assessed on axial and parasagittal-reformatted CT images in two different reading sessions. Paired-t-test was used to find differences between grading results on axial and parasagittal-reformatted images. Pearson correlation coefficient (PCC) and weighted kappa statistics were employed to quantify linear correlation, intrareader and interreader agreement.

Results: Average Goutallier grading on axial images among all readers was 0.80 (range, 0 – 4; standard deviation 1.16) and 0.89 (range, 0 – 4; standard deviation 1.08) on parasagittal reconstructions. There was a trend to a slightly higher Goutallier grading on parasagittal reconstructions, however not significant (paired-t-test: p = 0.07). PCC was 0.702 (p<0.001). Weighted kappa statistics indicated a moderate to good intrareader (range of weighted kappa 0.53 – 0.62) and interreader (weighted kappa: axial images 0.55; parasagittal-reformatted images 0.65) agreement.

Conclusion: Grading of fatty infiltration of the supraspinatus muscle on parasagittal CT images is comparable with the standard Goutallier grading on axial images and is characterized by a moderate to good intrareader and interreader agreement. Parasagittal assessment is characterized by a slightly higher interreader agreement and may therefore indeed be preferable.
FM27 The balloon, a new revolutionary technique for massive irreparable rotator cuff tears: Preliminary results at 1 year follow-up, after balloon degradation.

Leslie Naggar

**Introduction:** Patients having massive irreparable rotator cuff tears with painful functional impairment represent a therapeutic challenge when conservative treatment has failed. The objective of this study is to introduce a new revolutionary mini-invasive technique for the treatment of massive irreparable rotator cuff tears, consisting of an inflatable "balloon" introduced arthroscopically in the subacromial space. The initial results of this new technique will be presented.

**Methods:** This is a prospective and on-going series of the first 35 balloons implanted. This report concerns the first 22 cases, counting 13 females and 8 males (1 case operated on both shoulders), with a mean age of 69.3 years (range 50-83), and a follow-up greater than 1 year (mean 24 months). The biodegradable balloon, consists of a copolymer of poly-L-lactide-co-epsilon-caprolactone membrane. The balloon will restore shoulder kinematics, by acting as a subacromial spacer and by repositioning the center of rotation of the humeral head. The surgical technique is arthroscopic. After having checked the non-reparability of the cuff, a minimal bursectomy is performed. An acromial roughening, but not a normal acromioplasty, is then done, taking care not to section the coracoacromial ligament. Before implantation, the size is measured, and the balloon is introduced folded, inside an insertion sheath, then it will be inflated with a saline solution. Mobilizing the humeral head then checks stability of the balloon. The balloon can also be used in partial cuff repairs. The long head of the biceps is also addressed through tenotomy or tenodesis.

**Results:** The results are good and excellent in 86% of the cases, with complete pain relief and a very rapid recovery (often after 6 weeks) of active and painless range of motion. The mean Constant score is improved and almost doubled postoperatively. The progress in power can continue up to 18 months postop, which is way beyond the period that is usually noted for balloon degradation (10 to 12 months maximum).

**Conclusion:** The ideal indication for the balloon is an irreparable massive rotator cuff tear, particularly in patients aged less than 70 years of age, in which a reverse shoulder prosthesis should not be implanted, as well as in older patients. The balloon implantation is ideal for massive irreparable rotator cuff tears, as it is a simple, low risk and less invasive operation than conventional techniques.
FM28 Correlation Between ASES and SANE Scores After Rotator Cuff and SLAP Repair

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Background: Over 44 scores have been proposed to measure the shoulder function. Among the most popular are the American Shoulder and Elbow Surgeons (ASES) and Single Assessment Numeric Evaluation (SANE) scores. However, the ASES score contains overall 41 items based on objective and subjective measures and can hence be time-consuming compared to the SANE score, which only consists in one question. Simple subjective scores have become more popular in the last decades because they are easily administered and accepted, timesaving and avoid the bias of inter-observer variability. A high degree of correlation between ASES and SANE score has already been found for shoulder instability, but nothing had yet been demonstrated for other shoulder pathologies.

Purpose: The purpose of this study was thus to compare the ASES and SANE scores after rotator cuff and superior labral tear from anterior to posterior (SLAP) repairs.

Methods: This study was a retrospective review of a prospective recorded database of patients operated arthroscopically by the same shoulder surgeon in a single institution. The patient database included prospectively recorded preoperative and outcome measures, notably ASES and SANE scores. Pearson coefficient was used to establish correlation between both scores. Those scores were compared in the three groups separately and altogether.

Results: 262 patients were included in our analysis. The mean age was 56.8 years old (+/- 13.6) with 177 male (68%). Three patients groups were identified: primary cuff repair (N=135), SLAP repair (N=54) and cuff revision (N=73). The overall mean ASES score and SANE score after surgery were 82.7 (+/- 20.2) and 83.3 (+/-19.6) respectively. The Pearson’s correlation coefficient (r) between both scores was 0.8, (p=<0.001) demonstrating a very good (high) correlation. In subgroup analysis, the correlation was was highest in the cuff revision group (r=0.88, p=<0.001), followed by the SLAP group (r=0.78, p=<0.001) and primary cuff group (r=0.75, p=<0.001).

Conclusion: SANE score is rapidly administered, simple, comprehensible and cost-effective compared to the ASES score. This study reports a high correlation between SANE and ASES scores in rotator cuff and SLAP repairs. We thus recommend the SANE score as a reliable outcome indicator for iterative follow-ups, which can be wisely combined with the ASES for preoperative and final assessment.
Secondary Latissimus Dorsi Transfer for Residual Dysfunction after Reverse Total Shoulder Arthroplasty

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Introduction: Reverse Total Shoulder Arthroplasty (RTSA) allows restoration of overhead elevation in patients with pseudoparalysis for elevation due to irreparable rotator cuff tear. However, loss of external rotation can often not sufficiently be addressed. RTSA and Latissimus dorsi Transfer (LDT) as a single stage procedure has been described for combined pseudoparalysis of elevation and external rotation. Secondary LDT in patients with functional loss of external rotation, which persisted or decreased after previous RTSA has not yet been studied. The aim of this retrospective study was to evaluate the clinical results of secondary LDT in such a patient group.

Methods: Between February 2006 and October 2010, ten patients were treated with LDT at a mean of 27(±13) months after RTSA. In 6 patients the teres major was additionally transferred according to the technique of l’Episcopo. All patients had preoperative and postoperative clinical evaluation including a structured interview and the assessment of the Constant score (CS) and the Subjective Shoulder Value (SSV).

Results: With the RTSA the preoperative relative CS increased from 26%(11-67) to 51%(20-100) (p=0.05). However, patients were dissatisfied mainly because of loss of active external rotation.

At a mean of 49(23-67) months after LDT relative Constant score increased to 58%(34-100). This further increase did not reach statistical significance (p=0.14) but remained significantly increased compared to pre RTSA (p=0.021).

The SSV was 15%(0-30) before and 44%(20-70) after RTSA (p=0.27) and 50%(0-90) after LDT (p=0.92), which was a significant improvement compared to pre RTSA (p=0.042).

Flexion increased from 36°(0°-130°) to 86°(10-140) after RTSA (p=0.024) and further increased to 109°(70-140) after LDT (p=0.017). Similarly abduction increased from 31°(0-85) to 80°(40-130) (p=0.011) and 92°(50-130) (p=0.039).

Active external rotation decreased from 0°(-80-50) to -18°(-50-10) after RTSA (p=0.079) and was improved to 2°(-40-40) after LDT (p=0.024).

Discussion and Conclusion: The clinical results for these patients are inferior to the results of single stage RTSA and LDT for combined pseudoparalysis of elevation and external rotation. Secondary LDT after RTSA improved active mobility significantly, CS and SSV were improved but not significantly.
Influence of fatty supraspinatus muscle degeneration on rehabilitation after arthroscopic rotator cuff repair: A prospective case series.

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Introduction: Fatty muscle degeneration has been known to diminish function after rotator cuff reconstruction and contributes to failure of surgical repair. It, however, is yet unknown to what extent fatty degeneration influences speed of postoperative recovery. This prospective case series aims to identify how fatty supraspinatus degeneration (graded according to Goutallier) affects early rehabilitation after cuff repair.

Methods: 69 patients undergoing arthroscopic supraspinatus tendon double row suture anchor repair were followed prospectively for one year after surgery. Clinical analysis and scoring was acquired by an independent examiner unrelated to the performing surgeon. Quick-DASH and SPADI scores, as well as range of motion and abduction starting strength were measured preoperatively and at 3, 6 and 12 months after surgery. 8 patients were lost to follow-up due to incomplete independent clinical analysis. For the remaining 61 patients, radiographic analysis was performed by an MRI-experienced radiologist in order to determine fatty degeneration equivalents in preoperative arthro-MRI scans. Group 1 (Goutallier 0) included 31 patients (50.8%), group 2 (Goutallier 1) 21 (34.4%) and group 3 (Goutallier 2) 9 patients (14.8%). No patients with higher graded fatty degeneration had qualified for arthroscopic repair. T-Test and Spearman-correlation were used for statistical analysis, significance was defined at p<.05.

Results: At 3 months, group 1 displayed significantly faster improvement in SPADI ($\Delta_1=-15.4\pm19.9$; $\Delta_2=-1.2\pm27.1$; $\Delta_3=-5.7\pm13.1$) and Quick-DASH ($\Delta_1=-23.1\pm23.7$; $\Delta_2=-11.5\pm20.0$; $\Delta_3=-12.0\pm16.1$). The amount of improvement had leveled with groups 2 and 3 at 6 months after surgery. Range of motion displayed similar recovery profiles in all groups. Recovery of endpoint strength at 12 months was significantly better in group 1 ($\Delta_1=+3.2\text{kg}\pm2.9$; $\Delta_2=+1.3\text{kg}\pm2.2$; $\Delta_3=+1.8\text{kg}\pm2.0$) with no differences in terms of rehabilitation speed. Tendon retraction (Patte) and rupture size (Bateman) had no significant influence on the examined early rehabilitation parameters.

Conclusion: Patients with supraspinatus degeneration Goutallier grade 0 display quicker improvement in SPADI and Quick-DASH scores during the first 3 months. Faster short-term recovery after arthroscopic repair can be expected in this group. At 6 months, however, Goutallier 1 and 2 had caught up in terms of functional improvement. Goutallier 0 implies higher potential of restoring abduction strength postoperatively.
The ventral Latissimus dorsi transfer for irreparable subscapularis tears. A cadaveric study with anatomical aspects

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Background: Chronic, irreparable tears of the subscapularis tendon often result in weakness and disabling pain of the affected shoulder. If there is a combination with an irreparable superior rotator cuff tear, results of pectoralis major tendon transfers are poor and there are currently no treatment options except for total shoulder arthroplasty. We hypothesized that due to a potentially more favourable direction of pull, a ventral proximal transfer of the latissimus dorsi tendon insertion may be a new option to restore shoulder function in such patients. This anatomical cadaveric study was therefore designed to explore this new surgical option and the associated technical details and risks.

Methods: We performed a study of five human cadavers (three left and two right shoulders) fixed in Thiels solution. One shoulder was affected by a partial subscapularis tear with a consecutive medial subluxation of the long biceps tendon. Through a deltopectoral approach the pectoralis major tendon was released from its insertion at the humeral shaft. Following the exposition of the insertion of the latissimus dorsi tendon, measurements of anatomical references including the axillary nerve, the radial nerve and the musculocutaneus nerve were taken. The latissimus dorsi tendon was shifted proximally along the posterior surface of the conjoined tendon and fixed with transosseus sutures to the minor tuberosity where the subcapularis had been previously released.

Results: In all five cadavers the mobilization of the latissimus dorsi tendon was performed without difficulty. The distance of the proximal insertion of the latissimus tendon was 28 mm (+/-5mm) to the axillary nerve and 27 mm (+/-5mm) to the radial nerve, which is crossing the latissimus dorsi muscle directly on its ventral surface and must be protected together with the musculocutaneous nerve by lifting the conjoined tendon ventrally using a retractor. The mean distance of transfer was 43.2mm (+/- 7.66mm).

Discussion: This new surgical technique could be reliably performed in the tested cadavers and appears to be reasonably safe concerning neurovascular structures. As hypothesized, the latissimus dorsi tendon can be transferred to the lesser tuberosity and does anatomically insert in a favourable angle, according to its line of action simultaneously performing both internal rotation and depression of the humeral head.
**FM32 Neuropathy of the Suprascapular Nerve and Massive Rotator Cuff Tears. A prospective Electromyography Study.**

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**Introduction:** An association between massive rotator cuff tears (RCT) and suprascapular nerve neuropathy (SSNN) have been previously suggested. The anatomical course of the suprascapular nerve is relatively fixed along its passage. Injury to the nerve by trauma, compression and iatrogenic reasons is well documented. But as a reason for pain and weakness in massive RCT due to muscle retraction and nerve impingement remains unclear. We aimed to prospectively evaluate the suprascapular nerve for preoperative electromyography (EMG) abnormalities in shoulders with massive RCT.

**Methods & Materials:** A prospective study was performed in two centers. Fifty patients with retracted tears of both supraspinatus and infraspinatus were evaluated. This was confirmed with preoperative computed tomography (CT) arthrograms, and the fatty infiltration of the affected muscles was graded. Forty-nine preoperative EMGs were performed in a standardized fashion and the results analyzed twice.

**Results:** Six of 49 (12%) shoulders had neurologic lesions noted on EMG; one SSNN, one radicular lesion of the C5 root, one affected EMG in the context of a previous stroke, three cases of partial axillary nerve palsy with a history of shoulder dislocation. No difference or diminution of the latency or amplitude of the EMG curve were found in the cases that presented significant fatty infiltration.

**Conclusion:** An EMG study did not detect a suprascapular lesion in the majority of cases of massive RCT. With a low association of neuropathy with massive RCT, there is no support for the routine suprascapular nerve release when performing a RCT repair.
Fluoroscopic, MRI and Electrophysiologic Assessment of Shoulders with Massive Tears of the Rotator Cuff.

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Background: It remains unknown why some patients preserve their shoulder function despite a massive rotator cuff tear while others develop pseudoparalysis. The purpose of this study was therefore to analyse anatomical, biomechanical and/or electrophysiological factors possibly determining shoulder function in patients with massive cuff tear.

Methods: 19 patients (20 shoulders) with a painless, massive (>2 tendons) rotator cuff tear were prospectively assessed from the November 2011 until the December 2012 and divided into group PP (pseudoparalytic group with 9 shoulders and average flexion of 42 (range 20 to 85) degrees) and group NP (not pseudoparalytic with 11 shoulders and average flexion of 145 (range 130 to 165) degrees). All patients underwent an evaluation protocol including Constant score, shoulder MRI, fluoroscopic motion scan in ap and Neer projection while attempting shoulder elevation to evaluate the pattern of the glenohumeral and scapulothoracic motion and surface and needle electromyographic evaluation of the deltoid muscle to explore a possible muscular coordination problem on the three deltoid portions during shoulder elevation.

Results: The average Constant score reached 30 (range 11 to 47) points in group PP and 68 (range 55 to 87; p<0.001) in group NP. The mean Goutallier stages of SSP and ISP were 4 in both groups, of the SSC we found significant differences with a mean stage 3 in group PP and stage 1 in group NP. The anterior center-cuff angle, defined as how far the tear extends caudally towards the SSC, was significantly lower with a mean of -11 (range -31 to 9) degrees in group PP compared to 24 (range 0 to 47; p<0.001) degrees in group NP. Significant differences were seen in the fluoroscopy results regarding the Hamada classification, the acromiohumeral distance (ACHD) and the pattern of the glenohumeral and scapulothoracal movement. There were no axillary nerve lesions and no significant differences among the groups regarding the coordination of the three deltoid parts.

Conclusion: There seems to be a relevant association between pseudoparalysis and the cuff tear configuration when analyzing the anterior cuff angle. Interestingly however, the innervation pattern of the deltoid muscle appears normal also in case of pseudoparalysis. Our findings support the concept of a functional antero-posterior force couple, necessary to stabilize the humeral head to perform an elevation over 90 degrees.