ABSTRACTS FROM THE AMERICAN SHOULDER AND ELBOW SURGEONS (ASES) 2012 OPEN MEETING/SPECIALTY DAY

1. PREVALENCE OF ROTATOR CUFF INJURY IN SENIOR ATHLETES AND ITS ASSOCIATION WITH PAIN AND SHOULDER FUNCTION

Patrick J. McMahon, MD, Amit Prasad, MD, Kimberly A. Francisci, MS, James J. Irrgang, PhD, McMahon Orthopaedics and University of Pittsburgh, Pittsburgh, Pennsylvania, USA

Background: Cadaveric and imaging studies have found full thickness rotator cuff tears in about 25% of Americans over 60 years of age. Older individuals with rotator cuff injuries may complain of difficulties not only with activities of daily living but also with athletics. Treating these senior athletes requires knowledge of the prevalence of asymptomatic rotator cuff injuries. Hypothesis/Purpose: We hypothesized that rotator cuff tears would be less common in elite senior athletes than reported prior in similar aged individuals of the general population, as many of those with tears would fail to make it to the Senior Olympics. We also hypothesized that pain and shoulder function would correlate with severity of rotator cuff injury. Methods: We assessed pain with the visual analog scale (VAS), and shoulder function with the ASES and DASH outcome measures in 141 volunteers at the Senior Olympics. All were greater than 60 years of age with no history of fracture, osteoarthritis or shoulder surgery. Ultrasound evaluation was performed by an experienced musculoskeletal radiologist. We compared the prevalence of pain between those with rotator cuff classified as 1) normal, 2) tendinosis, 3) partial-thickness tear or 4) full-thickness tear. We also compared ASES and DASH scores between the painless and painful shoulders. Statistical analysis was performed with t-tests and χ² tests as appropriate, with 0.05 set as the level of significance. Results: There were 20 shoulders with a normal cuff and 5% were painful, 23 with tendinosis and 35% painful, 68 with a partial and 32% painful, and 30 with a full-thickness rotator cuff tear and 25% painful. There was a greater proportion of individuals with pain that had a rotator cuff injury (p = 0.016). But pain was not an indicator of severity of injury as the prevalence of pain was similar in those with tendinosis, partial-thickness cuff tears and full-thickness cuff tears (p > 0.05). Painful shoulders had an ASES score of 69 ± 12 and a DASH score of 17 ± 13, worse than those with painless shoulders. ASES of 95 ± 7 and DASH of 6 ± 6, respectively (p < 0.0001 for each). Neither the ASES nor the DASH were significantly different in comparison of those with tendinosis, partial-thickness cuff tears or full-thickness cuff tears (p > 0.05). Conclusions: The prevalence of full thickness rotator cuff tears is similar in senior athletes to same-aged individuals of the general population. Tendinosis and partial-thickness tears are even more common than full thickness rotator cuff tears. Pain was a good predictor of rotator cuff injury but was a poor predictor of its severity. Athletes with pain had poorer shoulder function but the ASES and DASH were poor predictors of the severity of rotator cuff injury. Clinical Significance: Rotator cuff tears in older individuals do not need to be repaired for successful participation in athletics as some have no symptoms and others are able to cope with their rotator cuff injury.

2. RELATIONSHIP BETWEEN DURATION OF ROTATOR CUFF TEAR SYMPTOMS AND PATIENT PRESENTATION FEATURES

Kenneth P. Unruh, MD, Warren R. Dung, MD, MPH, John E. Jed Kuhn, MD, Rosemary Sanders, BA, Angel Qi AT, MS, Keith M. Baumgartner, MD, Julie Y. Bhatia, MD, Robert H. Brophy, MD, James L. Carey, MD, MPh, G. Brian Holloway, MD, Grant L. Jones, MD, C. Benjamin Ma, MD, Robert G. Marx, MD, MPh, Eric C. McCarty, MD, Sourav K. Podder, MD, Matthew V. Smith, MD, Edwin E. Spencer Jr, MD, Amithender A. Vidal, MD, Brian R. Wolf, MD, Rick W. Wright, MD, MOON Shoulder Group, Vanderbilt University Medical Center, Nashville, Tennessee, USA

Introduction: Patients with full thickness rotator cuff tears present with a variety of complaints and physical exam findings. While some patients present with restrictions in motion, others may present with muscle weakness or atrophy. The purpose of this study was to determine if the duration of symptoms influences the features seen in patients with full thickness rotator cuff tears. Methods: 433 patients with full thickness rotator cuff tears were enrolled in a prospective cohort study to assess the effectiveness and identify predictors of success with nonoperative treatment. Duration of patient symptoms were divided into four groups: <1 month, 1-3 months, 4-6 months, 7-12 months, and >12 months. Data collected included the following things that we hypothesized might be influenced by the duration of symptoms: Activity Scale, ASES score, SANE score, rotator cuff tear size, degree of rotator cuff atrophy, and weakness in external rotation, forward elevation, and abduction. Statistical analysis included a univariate analysis with Kruskal-Wallis test and Pearson tests to identify statistically significant differences in these features for different durations of symptoms. Results: None of the hypothesized features were found to be influenced by the duration of symptoms. Clinical significance: Just as pain does not correlate with rotator cuff tear size, the duration of symptoms does not correlate with patient reported outcome scores, rotator cuff tear severity, or physical examination findings. These data suggest that symptoms generally thought to correlate with rotator cuff disease may be from alternative sources.

3. MEASUREMENT OF ROTATOR CUFF TEAR ATROPHY ON MRI

John G. Miller, MD, Jesse Chandler, MD, Matthew L. Ramsey, MD, Rothman Institute, Thomas Jefferson University, Philadelphia, Pennsylvania, USA

Introduction: Rotator cuff tears are a common source of disability which has the potential to impact functional use of the upper extremity. Current measurements of rotator cuff atrophy are made utilizing sagittal oblique MRI approximately 1 cm medial to the glenoid surface. However, these measurements do not account for the confounding effects of retraction in measuring atrophy and may overestimate the degree of atrophy. This study attempts to define normal morphology of the rotator cuff via MRI and evaluate the effect of rotator cuff tears and the degree of retraction on measurements of atrophy. Methods: Patients who underwent MRI of the shoulder were identified by querying the radiology records at Thomas Jefferson University following institutional review board approval. The MRI reports were reviewed and the MR images were reviewed to confirm the reading. Patients were separated into two groups: 17 patients were identified with a full-thickness rotator cuff tear and 44 patients were identified without a tear. A glenoid reference line (GRL) is created tangential to the glenoid surface on coronal oblique images. Four measurements were obtained on coronal oblique images. First, the perpendicular distance from the GRL to the musculotendinous junction (MT) of the supraspinatus was recorded and its position medial or lateral to the GRL was noted. Second, the supero-inferior width (SI) of the supraspinatus muscle parallel to the GRL was measured 1 cm medial to the GRL. Third, the maximum supe-ro-inferior width of the supraspinatus (MSW) was measured...
parallel to the GRL. Finally, the distance between the GRL and the
MSI was recorded. Measurements were made on sagittal oblique im-
age. A sagittal image was selected 1 cm medial to the glenoid sur-
face or the most lateral image where the scapular spine contacts the
coracoid. Next, the area of the muscle belly was measured, tracing
the muscle belly. Second, the area of the supraspinatus fossa was
measured in a similar manner. Student’s t-test was used to analyze
continuous variables. Linear regression was used to determine rela-
tionship between continuous variables. Results: The location of the
musculotendinous junction in an intact cuff is always lateral to GRL
on coronal MRI, mean=25.3mm, minimum=9.4mm. Patients with
a supraspinatus tear had a MT junction lateral to GRL 45% of the
time with an average MT position of 2.5mm lateral to GRL. The po-
sition of the MT in intact rotator cuffs is significantly more lateral than
those with a tear (p<0.001). On sagittal imaging, the amount of
supraspinatus fossa occupied by supraspinatus muscle is signifi-
cantly greater in patients with intact rotator cuffs, 67% vs. 36%
(p<0.001). This is a combined effect of atrophy and retraction.
The MSI as measured on coronal oblique imaging is significantly
greater in patients with an intact rotator cuff compared to those
with a tear (52.3mm vs. 41.6mm, p<0.001). This is the effect of atro-
phy. The distance from the MSI to the MT is significantly greater in
shoulders with an intact rotator cuff in comparison to those with
a tear (0.79 mm, p<0.001). This is the effect of retraction and
atrophy when analyzing measurements 1 cm medial to the glenoid.
Discussion: An intact MT junction was found no farther medial than 9.4 cm from the glenoid. The dis-


tance from the MT to the PRL is significantly greater in patients with-
out a tear. The location of the MT medial to the PRL is MRI evid-
eence of a rotator cuff tear and signifies retraction of the torn ten-
don. The presence of the MT junction lateral to the PRL can occur in
the presence of an intact or torn rotator cuff. In the face of a tear, the

lateral position of the MT junction signifies less medial retraction of
the torn tendon compared to those cases where the MT junction lies
medial to the PRL. Retraction of the torn rotator cuff tendon effects
two measurements. First, the distance from the MSI to the MT is sig-
nificantly reduced in shoulders with a rotator cuff tear compared to
an intact tendon. Additionally, the amount of supraspinatus fossa oc-
cupied by supraspinatus muscle is significantly less in patients with
a rotator cuff tears. These findings suggest that measurements of
atrophy on sagittal oblique images may overestimate the degree of atro-
phy if there is medial retraction of the torn cuff.

4 TIME TO FAILURE AFTER ROTATOR CUFF REPAIR: A
PROSPECTIVE IMAGING STUDY

Joseph P. Iannotti, MD, PhD, Allen A. Deutsch, MD,
Andrew Green, MD, Sally Rudicel, MD, Jared Christensen, PhD,
Shannon J. Marraffini, Scott A. Rodkey, MD, Department of
Orthopaedic Surgery, Orthopaedic and Rheumatologic Institute,
Cleveland Clinic, Cleveland, Ohio, USA; Pfizer, Inc., Cambridge,
Massachusetts; and Department of Orthopaedic Surgery, Brown
University, Providence, Rhode Island, USA

Background: Failure of tendon healing after rotator cuff repair has been defined by MRI as a fluid filled defect. The frequency and
factors associated with tendon failure after tendon repair have been the focus of many clinical studies. The timing of when these de-
fects occur has not been previously studied in a large prospective de-

dined patient population. This study was designed to determine the timing of failures occur within 12 weeks after surgery. Methods: 113 patients
were enrolled in a multi-institutional prospective study. All patients had a standardized arthroscopic repair of full thickness tears of 1-
4 cm. All patients were sequentially MRI imaged at six intervals from 2 weeks to 52 weeks. MRI images were reviewed at the time

of imaging by the treating surgeon and blindly read by an indepen-
dent musculoskeletal radiologist. Standardized patient oriented clin-
cal data, physical examination and strength measurements were made pre and post operatively. Results: Treating surgeons diag-
nosed 19 of 113 tears (16.8%) with a recurrent tear by MRI within
one year after surgery. The mean time to retear was 19.20 weeks.
There was a linear increase in re-tears over the first 26 weeks after
surgery and one additional tear was diagnosed between 26 and
52 weeks after repair. Conclusions: Re-tears primarily occur between 6 and 26 weeks after surgery and few further tears occurred there-

after. A significant number of tears occur between 12 and 26 weeks after repair and the repair should be protected for at least 6 months.

5 USE OF PLATELET-AND LEUCOCYTE-RICH FIBRIN (L-PRF)
IMPROVES EARLY VASCULARIZATION BUT DOES NOT AFFECT
LATE ROTATOR CUFF TENDON HEALING: A PROSPECTIVE
RANDOMIZED CONTROLLED STUDY

Matthew A. Zumstein, MD, Adam Rumian, MD, Kieran O’Shea, MD,
Charles E. Thélu, MD, Virginie Lebas, MD, Pascal Boileau, MD,
Department of Orthopaedic Sports Medicine, University of Nice, Nice, France

Introduction: Leukocyte platelet-rich plasma (L-PRF’s) and pure
platelet-rich fibrin (PRF) don’t improve the anatomical healing rate
after rotator cuff repair in early healing. In a previous study, we showed that the use of leukocyte platelet-rich fibrin (L-PRF) that has a solid matrix and can store and deliver growth factors up to 28 days. We hypothesized that arthroscopic ro-
tator cuff repair with L-PRF results in better vascularization of the bone tendon unit and a higher watertight healing rate and better
tendon quality at 12 months follow-up than without L-PRF. Methods: Thirty-five prospective randomized patients underwent arthroscopic cuff repair for the treatment of chronic posterosuperior rotator
cuff tears. In seventeen patients, leukocyte platelet-rich fibrin (L-PRF) was added in between the tendon and the bone. All patients were
prospectively followed clinically and radiographically. Vascularization
was measured with Power Doppler ultrasonography at 6 weeks and
3 months, and ana
totic watertight healing, tendon thickness and
tendon quality was measured using MR arthrography. Results: A
double row technique was used in all patients. The mean SSV, SST
and adjusted Constant increased significantly in both groups from
pre- to postoperatively, but with no difference between the groups.
Although early vascularization of the operated tendon-bone inser-
tions was significantly higher in the L-PRF group than in the control
group (10.1 vs. 3.1, p<0.001 at 6 weeks; 7.0 vs. 6.5 at 3 months),
there was no difference in anatomic healing rate (23 in the L-PRF; 17 in the control group). Tendon thickness (5.3 mm vs. 6.0 mm) and tendon quality (Sugaya III) were not differ-
ent in either group at 12 months. Discussion/Conclusions: Arthro-
sopic rotator cuff repair with application of leukocyte platelet-rich
fibrin (L-PRF) yields higher early vascularization response without a beneficial effect in terms of anatomical healing rate, tendon thick-
ness, tendon quality, and the functional results of the shoulder.

6 A PROSPECTIVE MULTICENTER RANDOMIZED CONTROL
TRIAL COMPARING SINGLE ROW WITH DOUBLE ROW
FIXATION IN ARTHROSCOPIC CUFF REPAIR

Peter B. Macdonald, MD, FRCSR, Kimberly Bell, BSc,
Elham Sabri, MSc, Kawan Rastaa, MD, FRCSR,
Sheila McKee, PhD, Jeff Leiter, PhD, Peter L.C. Lapner, MD,
FRCSR, Ottawa Hospital, University of Ottawa, Ottawa, Ontario,
Canada; Pan-Am Clinic, Winnipeg, Manitoba, Canada

Introduction: Controversy exists regarding the optimal technique for arthroscopic rotator cuff repair. The purpose of this multicenter
randomized double-blind controlled study was to compare the func-
tional outcomes and healing rates of double-row suture techniques with single row repair. Methods: Eighty-four patients undergoing ar-
throscopic rotator cuff repair were randomized to receive either
a double row (DR) or single row (SR) repair. The primary objective was to compare the WORC score at 24 months. Secondary objectives included the ASES and Constant scores as well as anatomical rotator cuff repair healing outcomes by MRI or ultrasound. A sample size calculation determined that 84 patients provided 80% power with a 50% effect size to detect a statistical difference between groups. Results: Baseline demographic data did not differ between groups (Table 1). Statistically significant improvements occurred in both groups from baseline to all time points in all clinical outcome scores (p < 0.0001). No statistical differences in WORC scores between groups were detected for any time point (Figure 1). Similarly, secondary outcomes revealed no significant differences between ASES or Constant scores. The difference in healing rates between SR (67% intact) and DR (78% intact) groups was not statistically significant (p = 0.254). The relative risk for re-tear in DR versus SR was 0.65, 95% CI (0.30, 1.38). A multivariable logistic regression analysis revealed that two variables, smaller initial tear size (p = 0.011), and randomization to double row (p = 0.037) correlated with healed cuff status on imaging. Discussion: No statistically significant difference in the primary outcome measure (WORC) was identified between SR and DR techniques. However, analysis by multivariable logistic regression revealed that smaller initial tear size and double row fixation correlated with healed cuff status on imaging. Strengths of this study were the prospective randomized multicenter design, and the use of a single procedure for a single disease entity.

Table 1 Patient demographics by group and overall

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<th>SR</th>
<th>DR</th>
<th>Overall</th>
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<td>31</td>
<td>29</td>
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<td>Males (%)</td>
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<td>69</td>
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<td>18.9</td>
<td>18.9</td>
<td>0.99</td>
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Figure 1 Mean WORC scores (%) by groups (error bars = SD).

8 BIOMECHANICAL EFFECTS OF LATISSIMUS DORSI TENDON TRANSFER IN IRREPARABLE MASSIVE ROTATOR CUFF TEAR

Jee Han Oh, MD, PhD, Michelle H. McGrory, MS, Justin Tilen, MS, Yu-Xen Chen, PhD, Kyung Chil Chung, MD, PhD, Thoy Q. Le, PhD, Orthopaedic Biomechanics Laboratory, VA Healthcare System and UC Irvine, Long Beach, California, USA; Department of Orthopedic Surgery, Seoul National University College of Medicine, Seoul, Korea

Introduction: The treatment of massive rotator cuff tear (RCT) remains a challenge, and latissimus dorsi tendon transfer (LDT), introduced by Gerber et al in 1988 (Clin Orthop Relat Res. 1988;232:51-61), is one of the surgical options available for irreparable massive RCT. While several authors reported favorable outcomes of this salvage procedure, clinical outcomes as a whole remain unpredictable and vary among patients; therefore, the purpose of this study was to determine the biomechanical effects of LDT in a cadaveric model of posterosuperior massive irreparable RCT.

Methods: Eight cadaveric shoulders were used with a custom testing system (Figure 1). Irreparable RCT was created by resection of the entire supraspinatus (SSP) and infraspinatus (ISP) tendons. LDT was performed as described by Gerber et al. The amount of muscle loading was determined based on the physiological muscle cross-sectional area ratios (SSP:10N; subscapularis, ISP:teres minor, pectoralis major, latissimus dorsi (LDT) 24N each; deltoid 48N). An increased load condition for the LAT (LDT2X, 48N) was incorporated to simulate increased muscle tension after LDT due to limited excursion of the LAT. All procedures were performed for the intact cuff, RCT, LDT, and LAT2X conditions in the scapular plane with 0, 30, and 60° shoulder abduction. Resting position of the humeral head and the amount of muscle loading was followed by maximum internal (MaxIR) and external rotation (MaxER) with 2.3 Nm of torque were measured. The position of humeral head apex (HHHA) with respect to the glenoid was calculated using a MicroScribe 3DLX from MaxIR to MaxER in 30° increments. Contact area, force, pressure and peak pressure were measured using TekScan pressure measurement system. Results: The humeral rotation due to muscle loading was 7.1 ± 4.9° internally for the intact cuff, and 42.1 ± 0.3° externally for the RCT group; this increased internal rotation due to muscle loading with massive tear was corrected following LDT. MaxIR and total range of motion (ROM) significantly increased following RCT. LDT and LAT2X significantly decreased Max IR and total ROM compared to RCT at every abduction angle.
(all p<0.05). LDT/LDT2X significantly decreased MaxIR and total ROM in 30° and 60° abduction when compared to intact (p<0.05), and LDT2X showed a significant decrease in both when compared to LDT (p<0.05). At MaxIR, HHA shifted supero-laterally at every abduction angle in the RCT condition compared to intact, and LDT/LDT2X significantly reversed these displacements (p<0.05) [Figure 1]. However, LDT2X over-compensated the correction in HHA kinematics and resulted in significant inter-medial displacement at MaxIR compared to intact cuff, especially at 30° and 60° abduction (p<0.05). Contact area decreased following RCT, but was restored by LDT/LDT2X, especially in 0° and 30° abduction. LDT/LDT2X showed increased contact pressure and peak pressure during the mid-range of rotation, especially in 60° abduction (Figure 2). Conclusions: The findings from this study suggest that the LDT can be beneficial as it reverses the abnormal biomechanics resulting from massive RCT, restores the rotational balance of the humeral head, rotational range of motion, and HHA kinematics and contact characteristics. However, the increased muscle tension due to the possibility of limiting muscle excision after LDT, especially at higher abduction angles can lead to an overcompensation that may further deteriorate normal kinematics of the shoulder, limit MaxIR, cause abnormal displacement of the HHA, and increase GH joint pressure. Therefore, the clinical assessment of LAT tendon length is critical for a successful LDT.

Figure 1: Sth humeral head shift compared to intact.

Figure 2: Glenohumeral contact peak pressure at 60° abduction (♣p<0.05 vs. Intact, *p<0.05 vs. RCT).
anesthesia (ASLEEP). Regional cerebral tissue oxygen saturation (SctO2) was quantified using near-infrared spectroscopy. Baseline heart rate, mean arterial blood pressure, arterial oxygen saturation, and SctO2 were measured before patient positioning and then every 3 minutes for the duration of the surgical procedure. SctO2 values below a critical threshold (<20% decrease from baseline or absolute value <55% for >1.5 seconds) were defined as a CDE and treated using a predetermined protocol. The number of CDEs and types of intervention used to treat low SctO2 values were recorded. The association between intraoperative CDEs and impaired postoperative recovery was also assessed. Results: Baseline mean arterial pressure and SctO2 values did not differ between groups. SctO2 values were lower in the ASLEEP group throughout the intraoperative period (P < .0001). The incidence of CDEs was higher in the ASLEEP group (53.3% vs. 3.4% AWAKE group), as was the mean number of CDEs per subject (2.97 in ASLEEP vs. 0.03 AWAKE, P < .0001). The total number of combined desaturation events were 89 in the ASLEEP vs. 1 in the AWAKE. Conclusions: Patients in the beach chair position treated with regional anesthesia and sedation had almost no cerebral desaturation events, unlike patients who had general anesthe sia. Avoidance of these pre-existing pathologies in the beach chair position may reduce the risk of ischemic neurological injury.

11 ARTHROSCOPY AND MANIPULATION VERSUS A HOME THERAPY PROGRAM IN THE TREATMENT OF ADHESIVE CAPSULITIS OF THE SHOULDER: A PROSPECTIVE RANDOMIZED STUDY

James Adam Smitherman, MD, Thomas W. Wright, MD, Aimee M. Strickland, MD, Mike Crittenden, MD, Ginny Sifita, OTR/L, Ruth B. Dell, OTR/L, University of Florida, Gainesville, Florida, USA

Background: Adhesive capsulitis is a common entity occurring in 2% to 5% of the non-diabetic population, and is responsible for significant morbidity in afflicted patients. The cause of adhesive capsulitis is not known. The natural history of the disease has only been partially elucidated and never in a prospective manner. Most patients with adhesive capsulitis progress through three stages of the disease: pain, stiffness, thawing) over a period of 18 to 36 months, resulting in considerable pain and loss of productivity. At resolution, most patients will have minimal pain and a functional, but not normal, range of motion. Multiple treatment methods have been applied for adhesive capsulitis including: NSAIDS, oral steroids, injections, home therapy, physical therapy (PT), manipulation, and arthroscopic capsular release (ACR). To date, no specific treatment regimen has been clearly shown to shorten the natural history of the disease. Most studies have reported results in a retrospective manner. The purpose of this study is to determine prospectively if arthroscopic shoulder capsular release can decrease the duration of symptoms of adhesive capsulitis when compared to a non-operative home therapy program. Methods: The diagnosis of adhesive capsulitis was made for patients with a painful shoulder and progressive loss of 40 degrees of external rotation of the glenohumeral joint with the arm at the side, or with an external rotation difference of 40 degrees or more when compared to the contralateral shoulder. Patients with a history of shoulder or elbow arthritis, intervertebral disk pathology, or rotator cuff injury were included. All patients with a diagnosis of adhesive capsulitis were initially enrolled in a four month PT program based on passive range of motion (ROM) stretching. Patients who did not improve during this initial period of PT were informed of the current study, and if consented, randomized to either a non-operative group or capsular release and manipulation group. Patients randomized to the operative group underwent examination under anesthesia, arthroscopy of the shoulder, ACR, and manipulation of the shoulder. Patients consistently received a brachial plexus nerve blockade for regional anesthesia at the time of the procedure. A home based stretching program was started immediately after surgery, and consisted of terminal ROM low-grade stretches twice daily for at least 15 minutes per session. Stretching exercises continued for three months after surgery. Patients randomized to the non-operative group began terminal ROM low-grade stretches twice daily for at least 15 minutes per session, and continued for at least three months. Compliance for both groups was monitored with a diary. ROM measurements were obtained for both shoulders upon study enrollment and for the involved shoulder at two weeks, six weeks, 12 weeks, and a final follow-up visit at least one year from the initial visit. Shoulder Pain and Disability Index (SPADI) scores were obtained for the initial, 12 week, and final time points. Internal rotation measurements were recorded as the spinous process level reached by the thumb with the arm actively positioned behind the back of the patient. Results: 44 patients were consented for the study. Only those patients with complete data sets were included in the final data analyses. 10 patients in the operative group met follow-up criteria. 6 patients met follow-up criteria for the non-operative group. There were no statistical differences between the groups regarding gender or age (operative mean age 51.5 +/-11.1 years; non-operative mean age 52.0 +/-6.8 years). No significant differences were noted between the operative and non-operative groups at any time point for active external rotation (AER) or passive external rotation (PER). Both groups demonstrated significant improvement in AER and PER for the points of baseline to two weeks, two weeks to six weeks, and 12 weeks to final follow-up. Neither group demonstrated significant improvement in AER or PER between six weeks and 12 weeks. Mean AER improved from 18.2 +/-14.8 degrees at initial measurement to 41.8 +/-15.1 degrees by 12 weeks, and continued to improve to 57.4 +/-13.4 degrees at final follow-up. Mean PER improved from 22.7 +/-16.2 degrees at initial measurement to 50.3 +/-17.2 degrees by 12 weeks, and continued to improve to 61.4 +/-19.0 degrees at final follow-up. No significant differences were noted between the operative and non-operative groups at any time point for active elevation (AEL) and passive elevation (PEL). Neither group demonstrated significant improvement for all other time point measurements of AEL and PEL. Mean AEL improved from 89.4 +/-26.8 degrees at initial measurement to 124.1 +/-23.5 degrees by 12 weeks, and continued to improve to 144.3 +/-25.8 degrees at final follow-up. Mean PEL improved from 100.6 +/-27.7 degrees at initial measurement to 142.4 +/-20.7 degrees by 12 weeks, and continued to improve to 158.4 +/-16.5 degrees at final follow-up. Internal rotation (IR) measurements did not result in significant differences between the groups. IR was not significantly improved from initial measurement for either group at two weeks, six weeks, or 12 weeks. IR was significantly improved for both groups at the final follow-up measurement (initial IR mean L5 spinous process level +/-3.8 levels, final IR mean T10 level +/-3.2 levels). No significant differences were noted between the groups for SPADI scores. SPADI scores significantly improved for both groups at 12 weeks and final follow-up (Mean initial SPADI 74.7 +/-12.8, 12 week mean 24.0 +/-22.3, final mean 11.0 +/-13.9). Conclusion: In this prospective, randomized study, arthroscopic capsular release and home therapy programs are both shown to be effective treatments for adhesive capsulitis, providing significant improvement of ROM and SPADI scores. Both modalities decrease the duration of pain and motion restriction when compared to other reported outcomes. No significant difference was seen between the operative and non-operative groups regarding rate of improvement or final measurements.

12 EXCELLENT LONG-TERM OUTCOMES OF ARTHROSCOPIC CAPSULAR RELEASE FOR FROZEN SHOULDER

Hugh M.J. Le Lievre, George A.C. Murrell, MD, PhD, Sports Medicine and Shoulder Service, St. George Hospital Campus, University of New South Wales, Sydney, Australia

Background: Arthroscopic capsular release for frozen shoulder has potential complications including iatrogenic chondral injury.
and recurrence of stiffness. Whilst there is long-term data regarding non-operative treatment, and good short-term (two years or less) outcomes following a release for idiopathic frozen shoulder, little is known about the long-term outcomes (five years or more) of arthroscopic capsular release. This study aimed to determine the long-term outcomes of arthroscopic capsular release for idiopathic frozen shoulder. Methods: A cohort of patients with idiopathic frozen shoulder who had a circumferential arthroscopic gleno-humeral joint capsular release for idiopathic frozen shoulder by a single surgeon were assessed using patient-ranked pain and shoulder functional Likert scores and examiner-ranked range of motion preoperatively and at 1, 6, 12, 24, 52 weeks and at 7 years post surgery. Results: At a mean follow-up of seven years, 43 patients (49 shoulders) demonstrated continued significant relief of pain frequency and severity in comparison to initial presentation (p < 0.001) and one year follow-up (p < 0.001). There was significant improvement in shoulder function, stiffness and difficulty completing activities (p < 0.01). Shoulder motion improved (p < 0.001) and was comparable to the contralateral shoulder. There were no complications. Conclusion: Patients with idiopathic frozen shoulder who had an arthroscopic capsular release had early significant improvements in range of motion, pain frequency and severity and function. These improvements were maintained and/or enhanced at seven years. There were no complications in the short or long term. In contrast to that reported for non-operative treatment, shoulder range of motion at seven years was equivalent to the contralateral shoulder.

13 TREATMENT OF SYMPTOMATIC ELBOW OSTEOARTHRITIS WITH ARTHROSCOPIC DEBRIDEMENT AND INTRAARTICULAR HYALURONIC ACID INJECTION

Srinath Kamineni, MD, FRCS, Darren Patten, MD, Juriko Yoshiha, PhD, University of Kentucky, Lexington, Kentucky, USA

Aims of the Study: Middle aged as well as elderly patients are often affected by elbow arthritis, primary degenerative or post-traumatic. This study investigates the efficacy of arthroscopic debridement plus minus intra-articular hyaluronic acid (HA) injection with respect to pain relief, arc of movement, and functional improvement in 30 elbows with osteoarthritis. Material and Methods: 30 elbows were treated for posttraumatic (n=12) or primary degenerative (n=18) osteoarthritis of the elbow by arthroscopic debridement. HA injection protocol was either preoperative (6 cases), postoperative (n=14), combined pre- and post-operative (n=5) intra-articular HA (Synvisc) injections, or without additional Synvisc injections (n=9). A clinical examination and Mayo elbow performance score was conducted at an average of 15 months (range 12-18 months) post-operation. The results were statistically analyzed with the Mann-Whitney and Wilcoxon tests. Results: Intra-articular cartilage changes were observed to be mild fraying (n=7), significant fraying/fibrillation (n=9), and significant fibrillation with areas of bare bone (n=14). The treatment resulted in statistically significant pain reduction for both posttraumatic and primary degenerative OA groups. Pain relief was significantly better in the group with exposed bony areas following debridement alone, compared to the group without visible bone, (p = 0.005). In patients with exposed bone, pain relief was significantly better without additional intra-articular HA (p = 0.039). The Mayo Elbow Performance Score (MEPS) improved significantly by 30 points (p < 0.0001 Wilcoxon test), with p = 0.008 in the post traumatic group and p = 0.0005 in the primary degenerative group. There was a greater improvement in the group with exposed bone without additional HA, and an improved trend in the group with mild cartilage fibrillation with additional HA.

Discussion and Conclusions: Hyaluronic acid (HA) is known to stimulate chondrocyte metabolism and have protective effects on cartilage. We combined this potential beneficial property with elbow debridement, as documented in the literature and corroborated in this study, to treat patients with different stages of elbow osteoarthritis. Our findings reveal a trend toward symptomatic and functional benefit when HA is combined with debridement in osteoarthritic elbow joints without exposed bone. There is a symptomatic detriment associated with HA in osteoarthritic joints with exposed bony areas. Our results support the use of HA in combination with elbow debridement in earlier stages of primary and post-traumatic osteoarthritis, but not in advanced cases with exposed bone.

14 THE CONTRACTED ELBOW: IS ULNAR NERVE RELEASE NECESSARY?

Benjamin G. Williams, MD, Dean G. Soterenas, MD, Mark E. Baratz, MD, Aaron I. Verouziou, MD, Claudius Jarrett, MD, Division of Upper Extremity Surgery, Allegheny General Hospital, Pittsburgh, Pennsylvania, USA

Hypothesis: Prophylactic release of the ulnar nerve in patients undergoing capsular release for significant loss of elbow flexion has been recommended, although there is limited data to support this claim. Our hypothesis was that more severely limited preoperative flexion and extension would be associated with a higher incidence of postoperative ulnar nerve symptoms in patients undergoing capsular release. Methods: A retrospective review of patients undergoing open and arthroscopic elbow capsular release for elbow stiffness between 2003 and 2010 was conducted. The ulnar nerve was decompressed in situ or transposed if the patient had preoperative ulnar nerve symptoms or a positive Tinel’s test. Preoperative and postoperative range of motion was measured using a goniometer. The incidence of preoperative and postoperative ulnar nerve symptoms was noted. Statistical analysis was made using a paired t-test, with a χ² test for non-parametric data. Results: 164 patients underwent elbow capsular release (45 arthroscopic, 110 open, 9 combined). Mean elbow extension improved from 39.2° to 18.5° (p<0.0001), and mean elbow flexion improved from 110.5° to 126.5° (p<0.001), with a mean improvement in the arc of motion of 36.7°. Perioperative complications included one hematoma and one infection, both of which were treated with surgical debridement. One patient undergoing an ulnar nerve decompression (UND) had a partial transection of the nerve that was repaired, and this patient was excluded from the calculations. Of the 101 without preoperative ulnar nerve symptoms, 14 underwent UND. None of these 14 patients developed postoperative ulnar nerve symptoms, whereas 7/87 patients (8.1%) who did not undergo UND developed postoperative ulnar nerve symptoms (p = .027). Five of these patients with persistent symptoms eventually underwent UND (three as part of another procedure on the same elbow). Patients without preoperative symptoms had a higher rate of developing postoperative symptoms if they had preoperative flexion ≤ 100° (15.2%) compared to those with preoperative flexion > 100° (3.6%, p = 0.047). There was no association between preoperative extension and postoperative symptoms. Conclusions: The overall rate of ulnar nerve symptoms following elbow contracture release is low, and only two patients underwent reoperation specifically for UND. Release of the ulnar nerve is indicated in patients with preoperative ulnar nerve symptoms or a positive Tinel’s test. There was a higher rate of ulnar nerve symptoms in patients with more severe contractures (≥ 100 degrees of preoperative flexion), and prophylactic decompression of the ulnar nerve may be indicated in these patients.
15 ACUTE AND CHRONIC RADIAL HEAD FRACTURES TREATED WITH RADIAL HEAD ARTHROPLASTY

Michael M. Kalsiwaart, MD, Mark E. Morrey, MD, Bernard Morrey, MD, Scott P. Steinmann, MD. Department of Orthopaedic Surgery, Mayo Clinic, Rochester, Minnesota, USA

Introduction: Radial head fractures have traditionally been treated with open reduction and internal fixation (ORIF) or radial head excision. Radial head arthroplasty is more commonly being used as an alternative for the treatment of radial head fractures; however, there is little literature concerning the timing of the procedure.

The purpose of this study was to analyze the results of patients initially treated with radial head replacement and patients initially treated with ORIF or radial excision with delayed radial head replacement. Methods: Twenty-eight patients with a radial head fracture were treated with a single radial head arthroplasty – 13 patients underwent radial head replacement within 7 days of the injury (Acute group) and 15 patients were initially treated with ORIF or radial head excision and underwent radial head replacement at an average of 6.5 years following the initial injury as a result of malunion, nonunion, or degenerative joint disease (Delayed group). Twenty-one patients were evaluated 1 year after surgery; 4 patients were evaluated 1 year postoperatively due to attrition (average 4.1 years). Patients were evaluated by measuring range of motion and with the use of the Mayo Elbow Performance Score (MEPS), and radiographs were evaluated for arthritis, periprosthetic radiolucency, and heterotopic ossification.

Results: Range of motion was not significantly different between the Acute and Delayed groups at final follow-up. There was a trend towards better clinical function at final follow-up in the Acute group compared with the Delayed group; patients in the Acute group had a mean MEPS of 94.9, and patients in the Delayed group had a mean MEPS of 89 (p = 0.11). There was also a trend towards less radiographic evidence of arthritis at final follow-up in the Acute group compared with the Delayed group (p = 0.09), but there was no difference in the progression of arthritis between the groups (p = 0.15). There were 3 revisions: 1 in the Acute group (flexion impingement) and 2 in the Delayed group (aseptic loosening). Conclusion: Patients who received an immediate radial head arthroplasty for the treatment of a comminuted radial head fracture did not demonstrate better elbow range of motion, but did tend to have better function and decreased elbow arthritis at final follow-up compared with patients treated with radial head arthroplasty following failed initial treatment with ORIF or radial head excision.

16 SINGLE INCISION CHRONIC DISTAL BICEPS RECONSTRUCTION WITH ALLOGRAFT

Michael B. Cross, MD, Claus C. Egidi, MD, Ray H. Wu, BS, Denis Naveh, MD, Dan C. Osbahr, MD, Joshua S. Dines, MD, Sports Medicine and Shoulder Service, Hospital for Special Surgery, New York, New York, USA

Introduction: Several techniques for chronic distal biceps tendon repair have been reported. Nonetheless, the literature on chronic distal biceps tendon repair is sparse. One of the challenges during chronic distal biceps reconstruction with allograft is achieving the appropriate tension. In this series, we use a technique for chronic biceps tendon reconstruction through a single incision that simplifies tensioning.

Purpose: Given the paucity of outcome data on the treatment of chronic distal biceps reconstructions, the purpose was to increase the amount of reported outcomes of patients treated with this technique. Methods: Seven patients who underwent chronic distal biceps tendon reconstruction were retrospectively evaluated. Patients all had a history, physical exam and MRI consistent with chronic distal biceps rupture. At the time of surgery, all patients had significant retraction necessitating the use of an allograft for reconstruction. The procedure was done through a single incision, using suture anchors and a tibialis anterior allograft. In each case, the graft was first fixed to the radial tuberosity with suture anchors. With the elbow flexed 60°, the allograft was sutured to the remnant of the native biceps tendon. Postoperatively, all patients were splinted for 2 weeks then switched to a hinged elbow brace for the next 6 weeks. Patients were evaluated with the Mayo elbow score and elbow range of motion (flexion, extension, pronation, supination). The intraoperative and postoperative complications were also evaluated. Results: The average time from injury to surgery was 4 months (range: 6 weeks to 14 months). All patients were evaluated a minimum of 1-year postoperatively (average 16 months). Postoperative elbow motion averaged: extension 4° (0°-12°), flexion 134° (130°-140°), pronation 82° (75°-85°), and supination 90° (70°-85°). The average Mayo elbow score was 94.7 (80-100). There was one case of lateral antebrachial cutaneous neuritis postoperatively that resolved by 3 months. Discussion: Though many reported techniques for chronic distal biceps tendon repair achieve satisfactory outcomes with limited complications, we used a technique with theoretical advantages of a single incision approach, the utilization of suture anchors, the use of a tibialis anterior allograft, and tensioning after attachment of the graft to the radial tuberosity. In a complicated series of patients, early-term results are good to excellent, and our series doubles the amount of patients treated with this technique in the literature.

17 PERMANENT OUTPERFORMS BIODEGRADABLE ANCHORS FOR ARTHROSCOPIC STABILIZATION

Kean E. Wei, MD, Kajen H. Pirapakaran, Adrian Pearce, George A.C. Murrell, MD, PhD, Sports Medicine and Shoulder Service, St. George Hospital Campus, University of New South Wales, Sydney, Australia

Introduction: The aim of this study was to determine the clinical outcomes of arthroscopic stabilization of patients with anterior glenohumeral instability using knotless suture anchors made from four different materials with the primary outcome being recurrence rate. Methods: A prospective cohort study was performed. Considered for inclusion were all patients who had an arthroscopic anterior shoulder stabilization for unidirectional anterior instability by a single surgeon using one of four devices: Suretac® resorbable tub make of a resorbable synthetic co-polymer, poly-glucanate-B; PGA (Smith and Nephew), the BioKnollss® resorbable suture anchor made of a slower degrading poly-D-Lactic acid; PLA (DePuy Mitek), the OPUS® Labrafix® knotless anchor (ArthroCare®) made from stainless steel and the Pushlock® knotless anchor made from high density plastic, PEEK, (Arthrex). Standardized patient-determined and examiner-determined outcomes were obtained before operation and 6, 12, 24 weeks after operation and up to 10 year follow-up. Results: One hundred fifty-five patients met the inclusion criteria [41 patients in the Suretac group, 52 in the BioKnolss group, 18 in the Labrafix group and 44 in the Pushlock group].
Kaplan-Meier analysis for re-dislocation showed a fall in survival curves from one year (90% stable) to three years (40% stable) in the Suretac group then a plateau to 10 years; and a fall in stability survivorship for the BioKnotless group from one year (90% stable) to five years (60% stable). Survivorship curves for the two non-resorbable anchors were more encouraging with over 90% stable out to three years (Pushloc) and four years (Labrafix); p < 0.001. Conclusion: These data support the hypothesis that arthroscopic stabilization for traumatic anterior instability leads to excellent outcomes when using non-resorbable knotless devices (6% and 5% recurrence at 3-5 years). However, medium term data on resorbable anchors showed an alarmingly high (40-60%) recurrence rate at 5 years postarthroscopic stabilization.

18 SLAP REPAIR INCIDENCE: A LONGITUDINAL INVESTIGATION OF COMMUNITY AND ACADEMIC DATABASES

Laura A. Vogel, BS, Todd C. Moen, MD, Alec A. Macaulay, MD, Raymond R. Adams, MPH, DrPH, Edwin R. Cadel, MD, Christopher S. Ahmad, MD, William N. Elting, MD, Columbia University, New York, New York, USA

Background: Superior Labrum Anterior to Posterior (SLAP) lesion repair has become controversial with regard to its indications and potential complications due to increases in rate of repair. This study aims to determine the frequency of SLAP repairs and how that frequency has changed over time. Materials and Methods: Three databases were used to determine the frequency of SLAP repair over a 10-year period. In Part A, the New York Statewide Planning and Research Cooperative System (SPARCS) ambulatory surgery database was used to identify all SLAP repairs and all orthopedic surgery ambulatory procedures from 2002 to 2009. In Part B, the California Office of Statewide Health Planning and Development (OSHPD) ambulatory surgery database was used to identify all SLAP repairs and all orthopedic surgery ambulatory procedures from 2005 to 2009. In Part C, the American Board of Orthopaedic Surgery (ABOS) database was used to identify all SLAP repairs and all orthopedic procedures from 2003 to 2010. Results: In Part A, there were 678 SLAP repairs in New York in 2002, representing a population incidence of 3.54 per 100,000. In 2009, there were 2,128 SLAP repairs, representing a population incidence of 10.89 per 100,000. Over these eight years, the volume of SLAP repair increased by 238%, compared to a 22% increase in the volume of all orthopedic surgery ambulatory procedures. For every additional year of study duration, a patient was 6.8% more likely (95% CI, 1.050 to 1.087) to have a SLAP repair compared to all other orthopedic procedures (p < 0.0001). In Part B, there were 4,587 SLAP repairs in California in 2005, representing a population incidence of 12.78 per 100,000. In 2009, there were 5,512 SLAP repairs, representing a population incidence of 14.88 per 100,000. Over these five years, the volume of SLAP repair increased by 20.17%, whereas the volume of all orthopedic surgery ambulatory procedures actually decreased by 13.64%. For every additional year of study duration, a patient was 11.5% more likely (95% CI, 1.094 to 1.137) to have a SLAP repair compared to all other orthopedic procedures (p < 0.001). In Part C, means of 3.2 and 3.4 SLAP repairs per candidate were reported among candidates who performed at least one SLAP repair in 2003 and 2010, respectively. Among candidates performing at least one SLAP repair, there was no statistically significant difference to have performed a SLAP repair (95% CI, 0.973 to 1.003) in 2010 as compared to 2003 (p > 0.10). Conclusion: There has been a substantial increase in the overall volume and population-based incidence of SLAP repairs in recent years in community-based state level databases. No such increases were seen in the cases reported to the ABOS by surgeons who have recently finished academic training. The reasons for these differences are yet to be definitively determined and are likely multifactorial.

Level of Evidence: Cross-sectional study, Level 3

19 THE ROLE OF THE SUPERIOR LABRUM FOLLOWING BICEPS TENODESIS IN GLENOHUMERAL KINEMATICS AND STABILITY

Eric J. Strauss, MD, Michael J. Salata, MD, Robert A. Sershon, BS, Emery C. Thr, BA, Kevin C. McGiff, MD, MPH, Nicholas G. Garbis, MD, Matthew A. Provencher, MD, Vincent M. Wang, PhD, Brandon C. Collins, MD, Anthony A. Rome, MD, Nikhil N. Ladermann, MD, Department of Orthopaedic Surgery, Rush University Medical Center, Chicago, Illinois, USA; Department of Orthopaedic Surgery, Naval Medical Center, San Diego, California, USA

Purpose: The study evaluated the contribution a type II SLAP lesion has on glenohumeral translation in the presence of a biceps tenodesis, asking the question: does a type II SLAP tear need fixation following biceps tenodesis? Methods: Baseline glenohumeral translation data was collected in 15 intact cadaveric shoulders using a custom shoulder testing apparatus. Translation testing was repeated following the creation of an experimental type II SLAP lesion. Two types of SLAP tears were created, the first remaining posterior to the biceps anchor (n = 10) and the second extending anteriorly into the superior glenohumeral ligament (SGHL) insertion (n = 5). Biceps tenodesis was then performed in each specimen, utilizing interference screw fixation with re-evaluation of the translation parameters post-procedure. Finally, anatomic repair of the type II SLAP lesion was performed using a suture anchor construct with re-evaluation of the translation parameters post-procedures. Statistical comparison of glenohumeral translation among the test configurations was performed using a 1-way ANOVA with repeated measures, followed by post-hoc pairwise comparisons using Bonferroni correction. Results: Both experimental anterior and posterior type II SLAP lesions led to significant increases in glenohumeral translation. In posterior SLAP lesions, anterior and posterior translation increased significantly by 85.7% (5.2mm to 9.6mm) and 55.6% (3.4mm to 8.4mm), respectively. Anterior SLAP lesions led to a significant increase in anterior translation of 74.4% (4.3mm to 7.5mm) and a 38.0% non-significant increase in posterior translation (7.1mm to 9.8mm). Biceps tenodesis for both types of SLAP improved translation stability, reducing anterior translation in the presence of a posterior SLAP from 9.6mm to 7.7mm and posterior translation in the presence of an anterior SLAP from 9.8mm to 8.0mm. Arthroscopic repair of experimental anterior SLAP lesions did not significantly improve glenohumeral translation compared to the injured state. However, repair of posterior based SLAP lesions restored near normal glenohumeral translation with no statistical difference compared to the baseline state. Conclusions: Type II SLAP lesions significantly compromised glenohumeral stability. Biceps tenodesis did not restore glenohumeral translation values but did not have a negative effect on glenohumeral stability. Posterior SLAP lesions were effectively treated with arthroscopic repair while persistent increased translation was present following the repair of anterior SLAP lesions in this cadaveric model. The findings of the current study support the concept of capsular pseuodolaxity associated with type II SLAP tears and highlight the importance of addressing the anterior capsule with adjunctive measures during the surgical repair of anterior based lesions. Additionally, as biceps tenodesis had no negative impact on glenohumeral stability, it may have potential use as a revision procedure for cases of persistent pain following SLAP repair. However, based on our data, biceps tenodesis should be considered with caution as the primary treatment method for SLAP lesions in the overhead throwing athlete, secondary to its inability to completely restore normal translational stability.

20 ARTHROSCOPIC BICEPS TENODESIS COMPARED TO REPAIR OF ISOLATED TYPE II SLAP LESIONS IN PATIENTS OVER 35 YEARS OF AGE

Patrick J. Denard, MD, Alexandre Ladermann, MD, Stephen S. Burkart, MD, Southern Oregon Orthopaedics, Medford, Oregon, USA; Department of Orthopaedics & Rehabilitation,
Purpose: The purpose of this study was to compare arthroscopic biceps tenodesis with repair of isolated type II superior labrum anterior and posterior (SLAP) lesions in patients over the age of 35.

Methods: We identified isolated type II SLAP lesions surgically managed over a five-year period. Minimum two-year follow-up was available for 22 patients who underwent repair (Group 1), and for 15 patients who underwent a primary biceps tenodesis (Group 2). The mean age at the time of surgery was 45.2 ± 5.5 years in group 1, and 52.0 ± 8.0 years in group 2. Results: In group 1, functional outcome improved from baseline to final follow-up by American Shoulder and Elbow Surgeons (ASES) (47.5 to 87.4; p < .0001) and University of California, Los Angeles (UCLA) scores (18.5 to 31.2; p < .0001). In group 2, similar findings were observed for ASES (43.4 to 89.9; p < .0001) and UCLA scores (19.0 to 32.7; p < .0001). There was no difference in functional outcome between the groups (ASES, p = .2395; UCLA, p = .6046). Full range of motion recovery was delayed by nearly 3 months in group 1 compared to group 2 (p = .0631). In group 1, 77.3% of patients were both satisfied and returned to normal activity, compared to 100% in group 2 (p = .0673). Two patients in group 1 required a secondary capsular release.

Conclusions: In the current study, individuals over the age of 35 with an isolated type II SLAP lesion had a shorter postoperative recovery, a more predictable functional outcome, and a higher rate of satisfaction and return to activity with a biceps tenodesis compared to a primary repair. Based on our observations, biceps tenodesis is preferable to repair for isolated type II SLAP lesions in non-overhead athletes over the age of 35. Level of Evidence: III
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