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## Upper extremity

Arthroscopy, Volume 35, Issue 7

### **Cyclic and Load-to-Failure Properties of All-Suture Anchors in Human Cadaveric Shoulder Glenoid Bone**

John A. Ruder, M.D., Ephraim Y. Dickinson, M.D., Richard D. Peindl, Ph.D., Nahir A. Habet, M.S., David P. Trofa, M.D., James E. Fleischli, M.D.

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#### **Purpose**

To evaluate the cyclic displacement and ultimate load to failure of 4 all-suture anchors in human cadaveric shoulder glenoid bone.

#### **Methods**

Four all-suture anchors indicated for glenoid labral repair were tested in 14 matched pairs of human cadaveric fresh-frozen glenoids. Anchors were inserted at 4 different locations for a total of 112 tests (12-, 3-, 6-, and 9-o'clock positions for right glenoids). Cyclic loading (10 to 60 N at 1 Hz for 200 cycles) and single pull-to-failure testing (33 mm/s) were performed. A Kruskal-Wallis 1-way analysis of variance with the Dunn multiple-comparison post hoc test was used for statistical analysis.

#### **Results**

One matched pair was excluded because of poor bone quality. Thus, 13 matched pairs were included in the study, and a total of 104 tests were performed. The Q-Fix anchors showed significantly less displacement after 100 cycles (mean  $\pm$  standard deviation,  $1.40 \pm 0.97$  mm;  $P < .001$ ) and 200 cycles ( $1.53 \pm 1.00$  mm,  $P < .001$ ) than all other anchors tested. The Q-Fix ( $191.3 \pm 65.8$  N), Suturefix ( $188.3 \pm 61.4$  N), and JuggerKnot ( $183.6 \pm 63.5$  N) anchors had significantly greater ultimate loads to failure than the Iconix anchors ( $143.5 \pm 54.1$  N) ( $P = .01$ ,  $P = .012$ , and  $P = .021$ , respectively). Displacement greater than 5 mm occurred in 6 Iconix anchors (22.1%), 5 Suturefix anchors (19.2%), 4 JuggerKnot anchors (15.4%), and 0 Q-Fix anchors (0%).

#### **Conclusions**

The Q-Fix anchors showed less displacement with cyclic loading than the Iconix, JuggerKnot, and Suturefix anchors. The Iconix anchors had a lower ultimate load to failure than the Q-Fix, Suturefix, and JuggerKnot anchors. Only the Q-Fix group had no anchors displace greater than 5 mm with cyclic loading.

#### **Clinical Relevance**

All-suture anchors vary in their deployment mechanism, which may alter their strength and performance. Operators must be aware of these anchors' propensity to displace while deploying them.

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## **Nonoperative Management of Posterior Shoulder Instability: An Assessment of Survival and Predictors for Conversion to Surgery at 1 to 10 Years After Diagnosis**

Jarret M. Woodmass, M.D., F.R.C.S.C., Julia Lee, M.D., Nick R. Johnson, M.D., Isabella T. Wu, B.A., Christopher L. Camp, M.D, Diane L. Dahm, M.D., Aaron J. Krych, M.D.

Arthroscopy, Volume 35, Issue 7, Received: August 2, 2018; Accepted: January 31, 2019

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### **Purpose**

To (1) define the rate of delayed surgery, between 1 and 10 years after injury, in a population-based study of patients with posterior shoulder instability (PSI), (2) evaluate predictive factors associated with delayed repair, and (3) identify differences between the nonoperative and operative groups at long-term follow-up.

### **Methods**

A population-based retrospectively reviewed study of all patients with PSI from January 1, 1994, to December 31, 2015, was performed. Inclusion required a clinical diagnosis of PSI combined with supporting imaging. Complete medical records were reviewed for 2,091 potential cases. Kaplan-Meier estimates were used to calculate survival. Landmark survival analysis was performed to identify predictors of conversion to surgery.

### **Results**

The study included 143 patients with PSI, 79 of whom were managed nonoperatively for at least 1 year after diagnosis. After the first year, survival free of surgery was 78.3% at 1 year, 63.1% at 5 years, and 51.5% at 10 years. There was a trend toward increased surgery in patients with a body mass index > 35 ( $P = .10$ ; hazard ratio = 2.32; confidence interval, 0.8-6.8). Nonthrowing athletes (including contact/weight-lifting athletes) showed a trend toward an increased risk for surgery ( $P = .07$ ). Patients who underwent surgery were significantly more likely to have progression in arthritis ( $P = .02$ ; hazard ratio = 4.0; confidence interval, 1.2-13.2).

### **Conclusions**

Nonoperative management was performed for at least 1 year in over half of patients diagnosed with PSI. Overall, long-term follow-up demonstrates that 46% of these patients converted to surgery between 1 and 10 years after initial diagnosis. Ultimately, 70% of patients diagnosed with PSI go on to surgical intervention. Patients who underwent surgery at any time point were at an increased risk of radiographic progression of arthritis at a minimum of 5 years of follow-up.

### **Level of Evidence**

Level III, cohort study.

## **Clinical Outcomes and Tendon Integrity in Patients With Chronic Retracted Subscapularis Tear After Arthroscopic Single-Row Oblique Mattress Suture Repair Technique**

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### **Purpose**

To evaluate clinical outcomes and tendon integrity in patients with chronic retracted subscapularis tears using an arthroscopic single-row oblique mattress suture repair technique.

### **Methods**

Patients with full-thickness subscapularis tears retracted to the glenoid level and with at least 2 years of follow-up were included. Tendon retraction level was measured on preoperative axial magnetic resonance images and confirmed during arthroscopic surgery. The subscapularis tendon was repaired arthroscopically using the single-row oblique mattress suture technique on the medial margin of the lesser tuberosity. Two double-loaded suture anchors were used to obtain firm fixation between the tendon and the footprint. Clinical outcomes were assessed for all patients preoperatively and postoperatively using active range of motion, a visual analog scale score for pain, and American Shoulder and Elbow Surgeons and Constant scores. To evaluate structural integrity of the repaired tendon, all patients underwent magnetic resonance imaging at 6 months and ultrasonography at 1 year after surgery.

### **Results**

The shoulder function of the 33 patients analyzed was improved significantly after a mean follow-up period of  $26.3 \pm 3.5$  months compared with preoperative values (American Shoulder and Elbow Surgeons score of  $52.0 \pm 7.9$  preoperatively vs  $79.6 \pm 7.0$  at last follow-up,  $P < .001$ , and Constant score of  $43.0 \pm 13.4$  preoperatively vs  $76.7 \pm 9.2$  at last follow-up,  $P < .001$ ). Postoperative active range of motion improved significantly in forward flexion, external rotation, and internal rotation ( $P < .001$ ). The mean visual analog scale pain score decreased by 3.42 ( $5.2 \pm 1.6$  preoperatively vs  $1.9 \pm 1.4$  at last follow-up,  $P < .001$ ). In 4 patients (12.1%), subscapularis retears were confirmed on postoperative magnetic resonance imaging.

### **Conclusions**

Despite significant retraction, arthroscopic repair using a single-row oblique mattress suture technique in patients who had chronic subscapularis tears with retraction to the glenoid level yielded satisfactory clinical outcomes and reliable tendon healing.

### **Level of Evidence**

Level IV, therapeutic case series.

## **Surgical Treatment of Septic Shoulders: A Comparison Between Arthrotomy and Arthroscopy**

Patawut Bovonratwet, B.S., Michael C. Fu, M.D., M.H.S.b, Neil Pathak, B.S., Nathaniel T. Ondeck, M.D., M.H.S., Daniel D. Bohl, M.D., M.P.H., Shane J. Nho, M.D., M.S., Jonathan N. Grauer, M.D.

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### **Purpose**

To compare the efficacy, as measured through the rate of reoperation, and rates of other 30-day perioperative complications between arthrotomy and arthroscopy for the treatment of septic native shoulders in a national patient population.

### **Methods**

Patients who were diagnosed with septic arthritis in a native shoulder and underwent irrigation and debridement through arthrotomy or arthroscopy were identified in the 2005-2016 National Surgical Quality Improvement Program database. Patient preoperative characteristics were characterized. Rate of reoperation, a proxy used to measure treatment efficacy, and other perioperative complications were compared between the 2 procedures.

### **Results**

In total, 100 patients undergoing shoulder arthrotomy and 155 patients undergoing shoulder arthroscopy for septic shoulder were identified. On univariate analysis, there were no statistically significant differences in patient preoperative characteristics, operative time (60 vs. 48 minutes,  $P = .290$ ), length of stay (7.5 vs. 6.6 days,  $P = .267$ ), or time to reoperation (8.9 vs. 7.2 days,  $P = .594$ ) between the 2 surgical groups. On multivariate analysis controlling for patient characteristics, there were no statistically significant differences in risk of reoperation (relative risk [RR] = 1.914, 99% confidence interval [CI] = 0.730-5.016,  $P = .083$ ), any adverse events (RR = 1.254, 99% CI = 0.860-1.831,  $P = .122$ ), minor adverse events (RR = 1.304, 99% CI = 0.558-3.047,  $P = .421$ ), serious adverse events (RR = 1.306, 99% CI = 0.842-2.025,  $P = .118$ ), or readmission (RR = 0.999, 99% CI = 0.441-2.261,  $P = .998$ ) comparing arthrotomy with arthroscopy.

### **Conclusions**

By demonstrating similar rates of reoperation, other postoperative complications, and 30-day readmissions, the current study suggests that arthrotomy and arthroscopic surgery have similar efficacy in treating septic shoulders. However, owing to the small sample size, there is still the possibility of a type II error.

### **Level of Evidence**

Level III, therapeutic retrospective comparative study.

## **Clinical Outcomes After Biceps Tenodesis or Tenotomy Using Subpectoral Pain to Guide Management in Patients With Rotator Cuff Tears**

Corey Dwyer, M.D., Cameron Kia, M.D., John M. Apostolakos, M.D., Jessica DiVenere, B.S., Felix Dyrna, M.D., Mark Cote, P.T., D.P.T., Robert A. Arciero, M.D., Augustus D. Mazzocca, M.D.

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### **Purpose**

To assess whether preoperative subpectoral tenderness in patients with rotator cuff tears was associated with arthroscopic findings of tendinopathy of the long head of the biceps, as well as whether they had resolution of their subpectoral tenderness postoperatively after tenodesis or tenotomy.

### **Methods**

Patients presenting between 2011 and 2016 undergoing arthroscopic rotator cuff repair were evaluated preoperatively with the subpectoral biceps test (SBT). This test is performed with the arm adducted and internally rotated to allow palpation of the biceps as it courses under the pectoralis major tendon. Preoperative SBT findings determined operative management with either tenodesis or tenotomy during rotator cuff repair. Patients were followed up postoperatively to assess resolution of subpectoral tenderness with a repeated SBT. Preoperative and postoperative Single Assessment Numeric Evaluation (SANE), American Shoulder and Elbow Surgeons, and Constant-Murley scores were recorded in all patients.

### **Results**

A total of 128 patients were enrolled in the study, with a mean age of 58 years (range, 33-82 years). Patients with a positive preoperative SBT ( $n = 68$ ) had significantly lower SANE and Constant-Murley scores preoperatively ( $P < .01$ ) than patients with a negative SBT ( $n = 60$ ). All patients with a positive preoperative SBT underwent either tenodesis or tenotomy, with 94% of patients ( $n = 64$ ) having resolution of subpectoral pain and tenderness at final follow-up. Intraoperatively, 93% of patients with a positive SBT showed gross pathologic changes in the tendon (fraying, erythema, tears, or subluxation) compared with only 65% of patients with negative preoperative examination findings ( $P < .01$ ). American Shoulder and Elbow Surgeons, Constant-Murley, and SANE scores were significantly increased postoperatively in all patients ( $P = .02$ ).

### **Conclusions**

In this group of patients with rotator cuff tears surgically treated with concomitant biceps tenodesis or tenotomy, 94% had resolution of their subpectoral tenderness. A positive SBT was associated with gross pathologic changes of the biceps in 93% of patients.

### **Level of Evidence**

Level III, prospective comparative study.



## **Arthroscopic Rotator Cuff Repair With a Knotless Suture Bridge Technique: Functional and Radiological Outcomes After a Minimum Follow-Up of 5 Years**

Ruben Dukan, M.D, Pauline Ledinot, M.D., Julia Donadio, M.D., Patrick Boyer, M.D., Ph.D.

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### **Purpose**

To evaluate clinical and radiological outcomes of knotless suture bridge repair after a minimum of 5 years of follow-up.

### **Methods**

A prospective consecutive series of full-thickness supraspinatus atraumatic chronic tears was evaluated in the study. Tears were medium or large. Further inclusion criteria were minimum clinical follow-up of 5 years with magnetic resonance imaging (MRI) at 24 months and fatty infiltration <2. Patients with shoulder stiffness, arthritis, or rotator cuff tear involving the subscapularis tendon were excluded. An arthroscopic cuff repair was performed using a knotless double-row suture bridge technique with braided suture tapes. Clinical outcomes were evaluated using the Constant score, the American Shoulder and Elbow Surgeons score, strength score, and a visual analog scale. Tendon healing was analyzed according to Sugaya MRI classification at 24 months. A Sugaya score of 1 or 2 was considered as tendon healing. Statistical analysis was performed with the Student's t-test.  $P = .05$  were considered statistically significant.

### **Results**

Sixty-eight patients were included in this series. Mean follow-up was equal to  $68.8 \pm 7$  months. At last follow-up, the mean visual analog scale, American Shoulder and Elbow Surgeons score, and Constant scores improved significantly from  $5.5 \pm 1.6$ ,  $48.2 \pm 13.1$ ,  $37.8 \pm 8.3$ , to  $2.1 \pm 2.1$  ( $P = 5.43 \text{ E-}14$ ),  $87.4 \pm 15.8$  ( $P = 7.15 \text{ E-}27$ ), and  $82.8 \pm 14.7$  ( $P = 1.01 \text{ E-}33$ ), respectively. Anteflexion improved from  $99.3^\circ \pm 13.4^\circ$  preoperatively to  $136.6^\circ \pm 15.9^\circ$  at last follow-up ( $P = 3.08 \text{ E-}21$ ). Strength score was significantly higher postoperatively ( $18.4 \pm 6.7$  vs  $8.3 \pm 3.5$ ). MRI showed 88% ( $n = 57$ ) of Sugaya 1-2 repairs. Patients with unhealed rotator cuffs showed significantly lower functional results than the Sugaya 1-2 group. No correlation between degree of retraction and rate of healing was observed. Four symptomatic patients (6%) required revision for failed rotator cuff repair.

### **Conclusions**

Despite potential confounding factors, arthroscopic knotless suture bridge repair of rotator cuff tears with acromioplasty demonstrated excellent long-term results of tendon healing, pain relief, and improvement of shoulder function.

### **Level of Evidence**

Level IV, therapeutic case series.

## **Factors Influencing Surgeon's Choice of Procedure for Anterior Shoulder Instability: A Multicenter Prospective Cohort Study**

Julie Y. Bishop, M.D., Krystin A. Hidden, M.D., Grant L. Jones, M.D., Carolyn M. Hettrich, M.D., M.P.H., Brian R. Wolf, M.D., M.S.

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### **Purpose**

To investigate preoperative factors associated with selection of surgical treatment for anterior shoulder instability.

### **Methods**

Patient demographics, initial physical examinations, and patient-oriented outcome questionnaires were collected prospectively from 26 shoulder surgeons at 10 sites. Symptom duration, number of dislocations, sport, history of prior stabilization procedure, Hill-Sachs/glenoid bone loss, pain level, and failure of conservative treatment were recorded. Statistical analysis was performed with Fisher's exact test and logistic regression analysis.

### **Results**

A total of 564 patients who underwent surgical treatment for anterior shoulder instability from November 2012 to June 2017 were enrolled. Of these, 426 shoulders underwent arthroscopic stabilization alone, 38 underwent arthroscopic stabilization with remplissage, 28 underwent open Bankart repair, and 72 underwent a Latarjet procedure. Predictors for undergoing Latarjet ( $P < .003$ ) were symptom duration (75% had symptoms for  $>1$  year), number of dislocations (47% had  $>5$  dislocations), revision surgery (69%), Hill-Sachs lesion size (45% had a lesion between 11% and 20% of the humeral head), and glenoid bone loss (75% of Latarjet patients had 11% to 30% loss). Predictors for undergoing open Bankart repair ( $P < .001$ ) were number of dislocations (32% had  $>5$  dislocations), revision surgeries (54%), and glenoid bone loss (11% of open Bankart patients had 11% to 20% loss). History of prior shoulder surgery was the only significant predictor of open versus arthroscopic Bankart procedure. Prediction models showed athletes involved in high-risk sports were 2.61 times more likely to have a Latarjet ( $P < .01$ ).

### **Conclusions**

Indications for the Latarjet were: humeral and glenoid bone loss, duration of symptoms, number of dislocations, and revision stabilizations. Athletes involved in high-risk sports were more likely to undergo the Latarjet procedure, even if other predictive factors were not present. The open Bankart procedure was the least common procedure performed, with a history of prior shoulder surgery being the only predictor for use when treating recurrent instability.

### **Level of Evidence**

Level II, prospective prognostic cohort investigation.

## **The Effect of Humeral and Ulnar Bone Tunnel Placement on Achieving Ulnar Collateral Ligament Graft Isometry: A Cadaveric Study**

Ajay C. Lall, M.D., David P. Beason, M.S, Jeffrey R. Dugas, M.D., E. Lyle Cain Jr., M.D.

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### **Purpose**

To assess simulated ulnar collateral ligament (UCL) graft length change, using surgically dissected anatomic landmarks, between multiple combinations of humeral and ulnar bone tunnels.

### **Methods**

Three equidistant humeral and ulnar tunnels were created at each UCL footprint of 10 cadaveric elbows. Suture was passed between 9 possible tunnel combinations for each elbow and affixed to an isometry gauge. Each elbow was moved through an arc of 0, 30, 60, 90, and 120° for each tunnel combination. Changes in isometry gauge spring displacement (and, in effect, tension) were recorded.

### **Results**

There was an overall significant effect ( $P < .0001$ ) of tunnel placement at all degrees of flexion. Pairwise comparisons revealed increases in displacement between the central and posterior tunnel positions of the medial epicondyle, with significant differences ( $P = .0009$ ) occurring when paired with both the central and posterior aspect of the sublime tubercle. Significant differences ( $P < .0001$ ) were noted between the anterior and posterior humeral tunnel positions.

### **Conclusions**

Simulated UCL graft isometry is dependent upon optimal bone tunnel placement. No significant differences were noted between ulnar tunnel locations when paired with any given humeral tunnel. Conversely, deviation anterior or posterior from the centroid of the UCL footprint on the medial epicondyle significantly affected isometry at all degrees of flexion recorded with the greatest amount of displacement occurring with pairing of posterior tunnels on both the humeral and ulnar footprints.

### **Clinical Relevance**

This anatomic study highlights the importance of medial elbow bone tunnel placement and its effect on simulated UCL graft isometry.

## **Safety of Anteromedial Portals in Elbow Arthroscopy: A Systematic Review of Cadaveric Studies**

Tucker Cushing, B.A., Zachary Finley, M.D., Michael J. O'Brien, M.D., Felix H. Savoie III, M.D., Leann Myers, Ph.D., Gleb Medvedev, M.D.

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### **Purpose**

To systematically review available literature comparing location and safety of 2 common anteromedial portals with nearby neurovascular structures in cadaveric models and to determine the correct positioning and preparation of the joint before elbow arthroscopy.

### **Methods**

The review was devised in accordance with Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines. Inclusion criteria consisted of original, cadaveric studies performed by experienced surgeons on male or female elbows evaluating anteromedial portal placement with regard to proximity of the arthroscope to neurovascular structures. Exclusion criteria consisted of case reports, clinical series, non-English language studies, and noncadaveric studies. Statistical analysis was done to measure reviewer reliability after scoring of each study.

### **Results**

During screening, 2,596 studies were identified, and 10 studies met final inclusion as original, cadaveric investigations of anteromedial portal proximity to neurovascular structures. The difference in distance between proximal and distal portals was <1 mm for the brachial artery and <1.5 mm for the medial antebrachial cutaneous nerve, whereas the ulnar nerve was 4.17 mm further from the distal portal and the median nerve was 5.07 mm further from the proximal portal. Joint distension increased the distances of neurovascular structures to portal sites, with the exception of the ulnar nerve in distal portals. Elbow flexion to 90° increased distances of all neurovascular structures to portal sites.

### **Conclusion**

The results show that the proximal anteromedial portal puts fewer structures at risk compared with the distal portal. Elbows in 90° flexion with joint distension carry a lower risk for neurovascular injury during portal placement. These findings suggest the proximal anteromedial portal to be the safer technique in anteromedial arthroscopy of the elbow.

### **Clinical Relevance**

Discrepancies in placement of portals have existed in the literature, indicating differing safety margins regarding surrounding neurovascular anatomy. The present study aims to link together the literature-based evidence to describe the safest anteromedial portal variation.

**Validity and efficiency of a smartphone-based electronic data collection tool for operative data in rotator cuff repair**

Sambit Sahoo, Jill Mohr, Gregory J. Strnad, Jose Vega, Morgan Jones, Mark S. Schickendantz, Lutul Farrow, Kurt P. Spindler, Joseph P. Iannotti, Eric T. Ricchetti, Kathleen A. Derwin

DOI: <https://doi.org/10.1016/j.jse.2018.12.009>

**Background**

This study tested validity and efficiency of Orthopaedic Minimal Data Set (OrthoMiDaS) Episode of Care (OME).

**Methods**

We analyzed 100 isolated rotator cuff repair cases in the OME database. Surgeons completed a traditional operative note and OME report. A blinded reviewer extracted data from operative notes and implant logs in electronic medical records by manual chart review. OME and electronic medical record data were compared with data counts and agreement between 40 variables of rotator cuff disease and repair procedures. Data counts were assessed using raw percentages and McNemar test (with continuity correction). Agreement of categorical variables was analyzed using Cohen  $\kappa$  (unweighted) and of numerical variables using the concordance correlation coefficient (CCC). Efficiency was assessed by median time to complete.

**Results**

OME database had significantly higher data counts for 25% (10/40) of variables. A high level of proportional and statistical agreement was demonstrated between the data. Among 35 categorical variables, proportional agreement was perfect for 17%, almost perfect ( $0.81 \leq \kappa \leq 1.00$ ) for 37%, substantial ( $0.61 \leq \kappa \leq 0.80$ ) for 20%, moderate ( $0.41 \leq \kappa \leq 0.60$ ) for 14%, fair ( $0.21 \leq \kappa \leq 0.40$ ) for 6%, and slight ( $0.0 \leq \kappa \leq 0.20$ ) for 6%. Of 5 numerical variables, agreement was almost perfect (CCC > 0.99) for 20% and poor (CCC < 0.90) for 80%. Median OME completion time was 161.5 seconds (interquartile range, 116-224.5).

**Conclusion**

OME is an efficient, valid tool for collecting comprehensive, standardized data on rotator cuff repair.

**Level of evidence:**

Basic Science Study, Development or Validation of Outcomes Data Collection Tool

## **Neer Award 2019: Latarjet procedure vs. iliac crest bone graft transfer for treatment of anterior shoulder instability with glenoid bone loss: a prospective randomized trial**

Philipp Moroder, Philipp Moroder, Eva Schulz, Guido Wierer, Alexander Auffarth, Peter Habermeyer, Herbert Resch, Mark Tauber

DOI: <https://doi.org/10.1016/j.jse.2019.03.035>

### **Background**

The Latarjet and iliac crest bone graft transfer (ICBGT) procedures are competing treatment options for anterior shoulder instability with glenoid bone loss.

### **Methods**

In this bicentric prospective randomized study, 60 patients with anterior shoulder instability and glenoid bone loss were included and randomized to either an open Latarjet or open ICBGT (J-bone graft) procedure. Clinical evaluation was completed before surgery and 6, 12, and 24 months after surgery, including the Western Ontario Shoulder Instability index, Rowe score, Subjective Shoulder Value, pain level, satisfaction level, and work and sports impairment, as well as assessment of instability, range of motion, and strength. Adverse events were prospectively recorded. Radiographic evaluation included preoperative, postoperative, and follow-up computed tomography analysis.

### **Results**

None of the clinical scores showed a significant difference between the 2 groups ( $P > .05$ ). Strength and range of motion showed no significant differences except for diminished internal rotation capacity in the Latarjet group at every follow-up time point ( $P < .05$ ). A single postoperative traumatic subluxation event occurred in 2 ICBGT patients and 1 Latarjet patient. The type and severity of other adverse events were heterogeneous. Donor-site sensory disturbances were observed in 27% of the ICBGT patients. Computed tomography scans revealed a larger glenoid augmentation effect of the ICBGTs; this, however, was attenuated at follow-up.

### **Conclusion**

The Latarjet and ICBGT procedures for the treatment of anterior shoulder instability with glenoid bone loss showed no difference in clinical and radiologic outcomes except for significantly worse internal rotation capacity in the Latarjet group and frequently noted donor-site sensory disturbances in the ICBGT group.

### **Level of evidence**

Level I, Randomized Controlled Trial, Treatment Study

## **Long-term results after arthroscopic treatment of symptomatic Ellman grade 2 PASTA lesions**

Fabian Plachel, Korn, Andreas Traweger, Reinhold Ortmaier, Herbert Resch, Philipp Moroder

DOI: <https://doi.org/10.1016/j.jise.2018.12.002>

### **Background**

The purpose of this retrospective study was to evaluate the clinical and radiologic long-term results of medium-sized (Ellman grade 2) partial-thickness articular-sided supraspinatus tendon avulsion (PASTA) lesions treated arthroscopically.

### **Methods**

Of 22 patients, 18 (82%) were available for follow-up evaluation after a mean of  $15 \pm 2$  years (range, 12-17 years). The mean age at time of surgery was  $55 \pm 9$  years (range, 35-66 years). The Constant score was used as the primary outcome instrument to evaluate shoulder function. Furthermore, the University of California–Los Angeles shoulder score, the American Shoulder and Elbow Surgeons score, and the Subjective Shoulder Value were collected. The patients' satisfaction with the outcome was investigated. Tendon integrity of the affected shoulder at final follow-up was assessed with magnetic resonance imaging or ultrasound in 89% of the cohort.

### **Results**

Overall, 94% of the patients were very satisfied or satisfied with the outcome. The average Constant score of the affected shoulder was  $78 \pm 21$  points; the University of California–Los Angeles score,  $31 \pm 7$  points; the American Shoulder and Elbow Surgeons score,  $85 \pm 24$  points; and the Subjective Shoulder Value,  $83\% \pm 21\%$ . Radiologic evaluation showed progression to a full-thickness rotator cuff tear in 6% (1/16), and 60% of the patients (6/10) showed persistent signs of partial tearing evaluated by magnetic resonance imaging.

### **Conclusion**

At long-term follow-up, arthroscopic treatment of medium-sized PASTA lesions resulted in good clinical results together with a high satisfaction level of the patients.

### **Level of evidence:**

Level IV, Case Series, Treatment Study

## **Bone healing potential of fascia lata autografts to the humeral head footprint in rotator cuff reconstruction based on magnetic resonance imaging and histologic evaluations**

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### **Background**

The purpose of the study was to evaluate the bone healing potential of fascia lata autograft (FLA) by magnetic resonance imaging (MRI) and histologic analysis.

### **Methods**

The study included 69 patients assessed by MRI after an FLA patch procedure. Three of the 69 patients underwent a revision procedure after the primary FLA procedure; 1 underwent a second-look arthroscopy and 2 underwent reverse shoulder arthroplasties (RSAs). In the 2 RSA patients, we histologically evaluated greater tuberosities with the repaired graft. Moreover, as a control, we harvested the greater tuberosity with the cuff tendon at the time of RSA for failed open reduction–internal fixation of 4-part proximal humeral fracture. Based on MRI, retear cases were divided into type 1 (the graft did not remain on the greater tuberosity) and type 2 (the graft remained on the greater tuberosity). Histologic sections were evaluated to examine fascia-bone or rotator cuff–bone interfaces.

### **Results**

There were 35 intact repairs: 7 type 1 and 27 type 2 shoulders (type 1 vs. type 2,  $P < .001$ ). Second-look arthroscopic findings confirmed that the graft was securely attached to the greater tuberosity. Histologic analysis of greater tuberosities in RSA patients showed solid continuity of the graft to the bone, with cells with nuclei in the collagen matrix oriented in parallel. The FLA to bone junction consisted of the FLA, fibrocartilage, and bone, which is similar to the normal cuff tendon to bone junction.

### **Conclusions**

These results indicate that a fresh cellular FLA has good to excellent bone healing potential.

### **Level of evidence:**

Level IV, Case Series, Treatment Study



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## Lower Extremity

Arthroscopy, Volume 35, Issue 7

### **Do Larger Acetabular Chondral Defects Portend Inferior Outcomes in Patients Undergoing Arthroscopic Acetabular Microfracture? A Matched-Controlled Study**

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#### **Purpose**

To elucidate the effect, if any, of acetabular chondral defect size on surgical outcomes after arthroscopic microfracture was performed with concomitant treatment for labral tears and femoroacetabular impingement (FAI) syndrome.

#### **Methods**

The study period was between February 2008 and November 2014. Data were collected on patients who underwent hip arthroscopy. The inclusion criteria were acetabular microfracture; concomitant treatment for labral tears and FAI syndrome; and preoperative modified Harris Hip Score, Nonarthritic Hip Score, Hip Outcome Score–Sports Specific Subscale, and visual analog scale. Exclusion criteria were Workers' Compensation, preoperative Tönnis grade >1, or previous ipsilateral hip surgeries or conditions. Patients were grouped based on smaller chondral defects (SCDs) or larger chondral defects (LCDs), then matched 1:1 by age at surgery  $\pm 10$  years, sex, body mass index  $\pm 5$ , labral treatment, capsular treatment, acetabuloplasty, and femoroplasty. Outcomes, secondary arthroscopies, and conversions to total hip arthroplasty (THA) were documented.

#### **Results**

Of 131 eligible cases, 107 (81.7%) had minimum 2-year follow-up. Before matching, the conversion rate to THA was higher for LCDs (24.6%) than for SCDs (12.0%). Thirty-five patients were matched for each group. Mean follow-up time was 47.9 months (range, 24.0, 84.1) for the matched LCD group and 46.1 months (range, 24.0, 88.1) for the matched SCD group. Ligamentum teres debridement ( $P = .03$ ) was performed more frequently in the LCD group. No other differences were found regarding demographics, intraoperative findings, procedures, traction time, preoperative scores, or follow-up scores. Both groups demonstrated significant improvements in all scores. Rates of revision or conversion to THA were similar between groups. The relative risk for conversion to THA was 2.33 for patients with defects  $\geq 300$  mm<sup>2</sup> compared with patients with defects  $\leq 250$  mm<sup>2</sup> ( $P = .13$ ). Deep vein thrombosis occurred in 3 (5.3%) patients with LCDs.

#### **Conclusions**

Matched patients with either SCDs or LCDs undergoing arthroscopic acetabular microfracture with concomitant treatment for labral tears and FAI syndrome demonstrated similar improvements at minimum 2-year follow-up. Patients with chondral defects approaching 300 mm<sup>2</sup> or greater may have a higher propensity toward conversion to THA.

#### **Level of Evidence**

Level III, retrospective comparative therapeutic trial.

[BACK](#)

## **Predicting Severe Cartilage Damage in the Hip: A Model Using Patient-Specific Data From 2,396 Hip Arthroscopies**

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### **Purpose**

To determine patient-specific factors that can be used to predict the presence of severe articular cartilage damage in the hip in patients without osteoarthritis.

### **Methods**

The prevalence of severe (Outerbridge grade III or IV) cartilage damage to the acetabulum and femoral head was prospectively recorded at hip arthroscopy. Patients who underwent primary hip arthroscopic surgery between 2006 and 2016 performed by a single surgeon were included. Patients were excluded if they underwent previous hip surgery, had poor-quality radiographs, were younger than 16 years at the time of surgery, or had a minimal joint space of 2 mm or less. The relation between severe cartilage damage and preoperative patient characteristics was examined using multivariable logistic regression analysis with restricted cubic splines.

### **Results**

Of the 2,396 hips presenting for hip arthroscopy, 995 (41%) had severe cartilage damage to the acetabulum and 257 (11%) had severe cartilage damage to the femoral head. Older age was a significant risk factor for severe cartilage damage both to the acetabulum ( $\chi^2 = 69.5$ ,  $P < .001$ ) and to the femoral head ( $\chi^2 = 53.9$ ,  $P < .001$ ). An age of 45 years was associated with a 1.96 (95% confidence interval, 1.54-2.49) increase in the odds of severe acetabular cartilage damage and a 3.94 (95% confidence interval, 2.61-5.94) increase in the odds of severe femoral head cartilage damage relative to an age of 20 years. Male sex was associated with severe cartilage damage to the acetabulum ( $\chi^2 = 66.7$ ,  $P < .001$ ), and a lower center-edge angle was a significant risk factor for severe cartilage damage to the femoral head ( $\chi^2 = 78.5$ ,  $P < .001$ ). Predictive nomograms were established for severe cartilage lesions.

### **Conclusions**

The primary risk factors for severe hip cartilage damage were older age for both the femoral head and acetabulum; a lower center-edge angle and larger Tönnis angle for the femoral head; and male sex, body mass index, alpha angle, and joint space for the acetabulum. The likelihood of cartilage damage to the hip can be estimated clinically using a prediction nomogram.

### **Level of Evidence**

Level III, cross-sectional study.

## **Minimal Clinically Important Difference and Substantial Clinical Benefit Values for a Pain Visual Analog Scale After Hip Arthroscopy**

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### **Purpose**

To define minimal clinically important difference (MCID) and substantial clinical benefit (SCB) values for a pain visual analog scale (VAS) in patients undergoing hip arthroscopy for femoroacetabular impingement or chondrolabral pathology.

### **Methods**

This was a retrospective review of prospective collected data on patients having hip arthroscopy for femoroacetabular impingement and/or chondrolabral pathology. On initial assessment and follow-up between 335 and 395 days postsurgery, subjects completed a pain VAS and categorical self-rating of function. MCID was calculated using one-half the standard deviation (SD) of the change in 1-year pain VAS values. Receiver operator characteristic analysis was performed to determine SCB values. A change in SCB value was determined based on change in categorical self-rating of function to create “improved” and “not improved” groups. Absolute postoperative SCB scores were calculated to determine scores that would be associated with “normal” or “abnormal” function ratings.

### **Results**

Of 1,034 eligible patients, 733 (71%) met the inclusion criteria, with 537 (73%) women and 196 (27%) men having a mean age of 35.3 years (SD 13). At a mean of 352 (SD 21) days postsurgery, 536 (73%) were in the improved group and 197 (27%) in the not improved group. MCID was  $-15.0$  mm. A change of  $-22.7$  mm on the pain VAS was able to identify those that improved with high sensitivity (0.74) and specificity (0.63). Values of  $\leq 10.4$  mm and  $\geq 29.0$  mm were cutoffs identifying subjects that rated their function as normal or abnormal, respectively, with high sensitivity (0.79 and 0.76) and specificity (0.88 and 0.76).

### **Conclusions**

This study provides surgeons with information to help interpret pain VAS values at a follow-up period ranging from 335 to 395 days with MCID and SCB values of  $-15.0$  mm and  $-22.7$  mm, respectively. Additionally, a patient who assesses a pain level at  $\leq 10.4$  mm is likely to have a normal rating of function, whereas a patient who assesses a pain level at  $\geq 29.0$  mm is likely to have an abnormal rating of function.

### **Level of Evidence**

III, retrospective comparative study.

## **Increases in Joint Laxity After Anterior Cruciate Ligament Reconstruction Are Associated With Sagittal Biomechanical Asymmetry**

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### **Purpose**

To investigate the longitudinal changes in landing mechanics and knee kinematics for patients both before and 3 years after anterior cruciate ligament reconstruction (ACLR) and to investigate the association between changes in landing mechanics and magnetic resonance knee kinematics.

### **Methods**

Thirty-one ACLR patients were included in the study. All patients underwent magnetic resonance imaging and biomechanical analysis of a drop-landing task using the injured knee and contralateral knee preoperatively and at 6 months and 3 years after ACLR. For evaluations of knee joint anteroposterior laxity, tibial position was calculated using quantitative loaded magnetic resonance methods.

### **Results**

The ACLR knee exhibited a significantly lower peak vertical ground reaction force and peak external knee flexion moment and angle at 6 months compared with the contralateral knee; however, the differences were resolved at 3 years. Tibial position was significantly more anterior on the injured side, and the side-to-side difference (SSD) in tibial position exhibited a significant increase from 6 months to 3 years. Among ACLR knees, a greater SSD in peak knee flexion moment at 6 months was associated with an increase in the SSD in anterior tibial translation from 6 months to 3 years.

### **Conclusions**

Although landing mechanics and clinical outcomes recovered in patients with ACLR in this study, anteroposterior translation failed to be restored at 3 years after surgery. In addition, patients who have low knee flexion moments in early stages could have greater anteroposterior laxity.

### **Clinical Relevance**

Because of the adverse consequences of abnormal knee kinetics on anterior laxity after ACLR, efforts to improve knee movement patterns should be initiated.

## **Opioid Prescription Refills After Osteochondral Procedures of the Knee**

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### **Purpose**

(1) To assess the incidence of postoperative opioid prescription refills in patients undergoing osteochondral autograft transplant (OAT) and osteochondral allograft transplant (OCA) procedures of the knee; (2) to evaluate the effect of filling preoperative opioid prescriptions on the incidence of postoperative filling; and (3) to assess the impact of age, sex, and diagnosis of low-back pain on postoperative opioid prescription filling.

### **Methods**

The Humana administrative claims database was queried for patients undergoing knee OAT and OCA procedures between 2007 and 2017 by use of Current Procedural Terminology codes. Patients were stratified by age, diagnosis of low-back pain, preoperative opioid use, autograft and allograft procedures, and open and arthroscopic procedures. Preoperative opioid users were defined as those having filled an opioid prescription within 3 months before surgery. The relative risk (risk ratio) for opioid prescription refills was calculated monthly for 12 months. Multivariate logistic regression analysis was performed to determine odds ratios (ORs) at 3, 6, and 12 months.

### **Results**

We identified 300 patients: 133 (44%) underwent OAT and 167 (56%) underwent OCA procedures. Of the patients, 236 (79%) were aged 49 years or younger, and 31% of patients filled opioid prescriptions preoperatively. Of those who filled preoperative opioid prescriptions, 28% were still filling prescriptions 12 months after surgery. Multivariate analysis showed an increased risk of opioid prescription filling at 3 months (OR, 7.46 [95% confidence interval (CI), 3.26-17.38]), 6 months (OR, 15.41 [95% CI, 5.52-41.99]), and 12 months (OR, 13.45 [95% CI, 5.41-33.75]) postoperatively in preoperative opioid users.

### **Conclusions**

Filling opioid prescriptions preoperatively increased the risk of postoperative filling of opioid prescriptions after cartilage restoration procedures of the knee. Over 30% of patients were found to have filled an opioid prescription preoperatively. Univariate analysis showed that age of 50 years or older and low-back pain increased the risk of postoperative prescription refilling, but only age of 50 years or older provided a significantly increased risk at 3 months postoperatively using a multivariate analysis.

### **Level of Evidence**

Level III, retrospective case-control study.

## **Operative Time as an Independent and Modifiable Risk Factor for Short-Term Complications After Knee Arthroscopy**

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### **Purpose**

To determine whether operative time is an independent risk factor for 30-day complications after arthroscopic surgical procedures on the knee.

### **Methods**

The American College of Surgeons National Surgical Quality Improvement Program database was queried between 2005 and 2016 for all arthroscopic knee procedures including lateral release, loose body removal, synovectomy, chondroplasty, microfracture, and meniscectomy. Cases with concomitant procedures were excluded. Correlations between operative time and adverse events were controlled for variables such as age, sex, body mass index, patient comorbidities, and procedure using a multivariate Poisson regression with robust error variance.

### **Results**

A total of 78,864 procedures met our inclusion and exclusion criteria. The mean age of patients was  $51.0 \pm 14.3$  years; mean operative time,  $31.2 \pm 18.1$  minutes; and mean body mass index,  $31.0 \pm 7.8$ . Arthroscopic lateral release (coefficient, 5.8; 95% confidence interval [CI], 4.8-6.8;  $P < .001$ ), removal of loose bodies (coefficient, 4.2; 95% CI, 3.2-5.3;  $P < .001$ ), synovectomy (coefficient, 1.8; 95% CI, 1.2-2.3;  $P < .001$ ), and microfracture (coefficient, 6.5; 95% CI, 5.8-7.2;  $P < .001$ ) had significantly greater durations of surgery in comparison with meniscectomy. The overall rate of adverse events was 1.24%. After we adjusted for demographic characteristics and the procedure, a 15-minute increase in operative duration was associated with an increased risk of transfusion (relative risk [RR], 1.5; 95% CI, 1.3-1.8;  $P < .001$ ), death (RR, 1.6; 95% CI, 1.2-2.1;  $P = .005$ ), dehiscence (RR, 1.6; 95% CI, 1.2-2.2;  $P = .002$ ), surgical-site infection (RR, 1.3; 95% CI, 1.2-1.3;  $P = .001$ ), sepsis (RR, 1.3; 95% CI, 1.2-1.4;  $P < .001$ ), readmission (RR, 1.1; 95% CI, 1.1-1.2;  $P < .001$ ), and extended length of stay (RR, 1.4; 95% CI, 1.3-1.4;  $P < .001$ ).

### **Conclusions**

Marginal increases in operative time are associated with an increased risk of adverse events such as surgical-site infection, sepsis, extended length of stay, and readmission. Efforts should be made to maximize surgical efficiency.

### **Level of Evidence**

Level IV, retrospective database study.

## **The Role of Fibers Within the Tibial Attachment of the Anterior Cruciate Ligament in Restraining Tibial Displacement**

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### **Purpose**

To evaluate the load-bearing functions of the fibers of the anterior cruciate ligament (ACL) tibial attachment in restraining tibial anterior translation, internal rotation, and combined anterior and internal rotation laxities in a simulated pivot-shift test.

### **Methods**

Twelve knees were tested using a robot. Laxities tested were: anterior tibial translation (ATT), internal rotation (IR), and coupled translations and rotations during a simulated pivot-shift. The kinematics of the intact knee was replayed after sequentially transecting 9 segments of the ACL attachment and fibers entering the lateral gutter, measuring their contributions to restraining laxity. The center of effort (COE) of the ACL force transmitted to the tibia was calculated. A blinded anatomic analysis identified the densest fiber area in the attachment of the ACL and thus its centroid (center of area). This centroid was compared with the biomechanical COE.

### **Results**

The anteromedial tibial fibers were the primary restraint of ATT (84% across 0° to 90° flexion) and IR (61%) during isolated and coupled displacements, except for the pivot-shift and ATT in extension. The lateral gutter resisted 28% of IR at 90° flexion. The anteromedial fibers showed significantly greater restraint of simulated pivot-shift rotations than the central and posterior fibers ( $P < .05$ ). No significant differences (all  $< 2$  mm) were found between the anatomic centroid of the C-shaped attachment and the COE under most loadings.

### **Conclusions**

The peripheral anteromedial fibers were the most important area of the ACL tibial attachment in the restraint of tibial anterior translation and internal rotation during isolated and coupled displacements. These mechanical results matched the C-shaped anteromedial attachment of the dense collagen fibers of the ACL.

### **Clinical Relevance**

The most important fibers in restraining tibial displacements attach to the C-shaped anteromedial area of the native ACL tibial attachment. This finding provides an objective rationale for ACL graft position to enable it to reproduce the physiological path of load transmission for tibial restraint.



## **Suture Augmented Versus Standard Anterior Cruciate Ligament Reconstruction: A Matched Comparative Analysis**

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### **Purpose**

To compare outcomes between standard anterior cruciate ligament reconstruction (ACLR) using hamstring grafts with and without suture augmentation (SA).

### **Methods**

Patients who underwent ACLR with hamstring autografts or allografts with minimum 2-year follow-up were retrospectively reviewed. Patients undergoing ACLR with SA were matched 1:1 by age, gender, body mass index, graft type, and revision status to standard ACLR. Range of motion, pain, postoperative activity, patient-reported outcome measures (PROMs), and complications were collected. Paired 2-tailed Student's t-tests and Pearson's  $\chi^2$ -tests were used for continuous and categorical variables, respectively. A multivariate analysis of variance was conducted. Return to preinjury activity level was assessed using Spearman's rho and Pearson's  $\chi^2$ -tests.

### **Results**

Sixty patients at a mean age of  $29.50 \pm 6.60$  years, 43.4% male, body mass index  $26.27 \pm 3.37$ , and follow-up of  $29.54 \pm 5.37$  months were included. Preoperative PROMs were not significantly different ( $P > .05$ ). Postoperative range of motion was similar between groups ( $P = .457$ ). Postoperative average daily ( $0.60 \pm 1.25$  vs  $1.66 \pm 1.90$ ) and maximum daily pain ( $1.57 \pm 1.83$  vs  $3.35 \pm 2.28$ ) were significantly lower for SA ( $P < .014$ ). SA predicted improvement in PROMs ( $P < .05$ ) and maximum pain scores ( $P = .001$ ). SA was significantly correlated with improved time to return to preinjury activity level ( $9.17 \pm 2.06$  vs  $12.88 \pm 3.94$  months;  $P = .002$ ) and percentage of preinjury activity level ( $93.33\% \pm 13.22\%$  vs  $83.17\% \pm 17.69\%$ ;  $P = .010$ ). There was a trend toward improved rate of return to preinjury activity level for SA ( $76.7\%$  vs  $56.7\%$ ;  $P = .100$ ).

### **Conclusions**

Our study demonstrates that SA hamstring ACLRs were associated with improved PROMs, less pain, and a higher percentage of and earlier return to preinjury activity level when compared with standard hamstring ACLRs without evidence of overconstraint.

### **Level of Evidence**

Level III, retrospective comparative study.



## **Intra-articular Injection of Tranexamic Acid Reduced Postoperative Hemarthrosis in Arthroscopic Anterior Cruciate Ligament Reconstruction: A Prospective Randomized Study**

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### **Purpose**

To evaluate the effect of intra-articular injection of tranexamic acid (TXA) in patients receiving arthroscopic anterior cruciate ligament reconstruction (ACLR).

### **Methods**

A total of 304 patients were included in this study, which was performed between August 2017 and April 2018. Single-bundle reconstructions using autologous hamstring tendon grafts were performed in all patients. Patients were randomized into 2 groups: Group 1 patients (TXA group) received the index procedure with a 10-mL intra-articular injection of TXA (100 mg/mL). Group 2 patients (control group) received the index procedure without TXA injections. An intra-articular suction drain was placed in the joint and clamped for 2 hours after the procedure. The volume of drainage was recorded 24 hours after surgery. Clinical evaluations using the International Knee Documentation Committee functional score, range of motion, and a visual analog scale pain score were performed on day 3 and at week 4 postoperatively.

### **Results**

Twenty-four hours after surgery, a significant decrease in the amount of drainage was observed in patients receiving intra-articular injections (TXA group,  $56.1 \pm 34.1$  mL; control group,  $80.1 \pm 48$  mL;  $P < .05$ ). On day 3 and at week 4, significantly reduced pain scores were reported in the TXA group. However, at week 4, clinical function scores did not show significant differences between the 2 groups.

### **Conclusions**

Intra-articular injection of TXA could significantly reduce postoperative intra-articular bleeding in the first 24 hours in patients receiving arthroscopic ACLR. TXA injection may also decrease pain and the grade of hemarthrosis in the early postoperative period. No systemic side effects or need for aspiration was noted during the follow-up period. Therefore, intra-articular injection of TXA could be considered an effective and relatively safe solution to reduce postoperative bleeding and pain in ACLR patients.

### **Level of Evidence**

Level II, prospective comparative study.

## **Magnetic Resonance Imaging Evaluation of the Anterolateral Ligament in Acute Anterior Cruciate Ligament Injuries in an Adolescent Population**

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### **Purpose**

To evaluate the frequency of anterolateral ligament (ALL) injuries in acute anterior cruciate ligament (ACL) injuries in adolescent patients using magnetic resonance imaging (MRI) and characterize other potential intra- and extra-articular knee injuries that are associated with ALL injuries.

### **Methods**

Patients between 14 and 17 years of age with acute ACL injuries (trauma for <3 weeks before examination) were retrospectively evaluated with MRI over 24 months (January 2016-December 2017). Among this population, ALL was classified as not visible, normal, or injured. Injuries were separated into strains (partial injuries), complete injuries, or Segond fractures. Possible abnormalities of the menisci, collateral ligaments, popliteal tendon, posterior cruciate ligament (PCL), iliotibial tract (ITT), and bone injuries were evaluated. Associations were calculated between ALL injuries and injuries of these other knee structures, as well as age and gender.

### **Results**

ALL was visible in 171 of the 184 MRI-evaluated knees (92.9%). ALL was considered normal in 68 (39.8%) and damaged in 103 (60.2%) patients. ALL injuries were considered partial in 56 (54.4%) and total in 44 (42.7%) cases. Only 3 (2.9%) cases were Segond fractures. ALL injuries were associated with ITT ( $P < .0001$ ), lateral meniscus ( $P = .04$ ), lateral collateral ligament ( $P = .01$ ), popliteal tendon ( $P = .001$ ), and medial collateral ligament ( $P = .009$ ) injuries, in addition to bone contusions in the lateral compartment of the knee ( $P < .0001$ ). There was no correlation between ALL injuries and medial meniscus ( $P = .054$ ) or PCL ( $P = .16$ ) injuries.

### **Conclusions**

MRI evaluation showed ALL injuries are present in 60.2% of acute ACL injuries in adolescent patients. These injuries are associated with the medial and lateral collateral ligaments, ITT, lateral meniscus injuries, and bone contusions, but they are not associated with medial meniscus or PCL injuries.

### **Level of Evidence**

Level IV, case series.

## **Fifteen-Year Minimum Follow-Up of Anteromedial Tibial Tubercle Transfer for Lateral and/or Distal Patellofemoral Arthrosis**

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### **Purpose**

To evaluate a minimum 15-year clinical and radiographic follow-up after anteromedial tibial tubercle transfer (anteromedialization [AMZ]) for lateral and/or distal patellar facet arthrosis.

### **Methods**

Patients treated from 1996 to 2000 were contacted. The inclusion criteria were a minimum of 15 years' follow-up after AMZ for isolated persistent retropatellar pain related to lateral and/or distal patellar chondrosis. The exclusion criteria were clinical patellar instability, revision, and significant medial patellar facet or adjacent compartment chondrosis. The anatomic location(s) and severity of arthrosis, as well as the degree of lateral maltracking, were documented. Follow-up data included pain, activity level, and satisfaction.

### **Results**

Of 23 patients, 15 met the inclusion criteria. All were women (17 knees) followed up for a mean of 17.1 years (range, 15.4-18.8 years). The mean age at surgery was 29.5 years. Satisfactory results were reported in 94% of knees (16 of 17), based simply on patients' subjective evaluation of the degree of success perceived. An important criterion of satisfaction was that these patients stated they would opt to undergo surgery again under the same circumstances. For 35% of knees, patients reported engaging in recreational activities, whereas for 18%, patients were minimally active. The average pain score (range, 0-10) for 75% was 2.1, and most of these patients showed grade I or II arthrosis. Post-AMZ symptomatic medial patellar subluxation was corrected successfully in 2 patients. Removal of hardware was performed in 59% of knees, and additional procedures were required in 41%. No cases of postoperative lateral patellar instability or conversion to knee arthroplasty occurred.

### **Conclusions**

Anteromedial tibial tubercle transfer without articular cartilage implantation is effective in patellofemoral joint preservation, ameliorating symptoms and facilitating active lifestyles for a minimum of 15 years to nearly 20 years in patients with lateral and/or distal patellofemoral arthrosis. For 94% of knees, patients would choose to undergo the procedure again under the same circumstances. Fifty-nine percent underwent screw removal, and 41% required additional procedures, mostly arthroscopic. No patients in this therapeutic case series underwent an arthroplasty procedure.

### **Level of Evidence**

Level IV, therapeutic cases series.

## **Elongation Patterns of the Anterior and Posterior Borders of the Anterolateral Ligament of the Knee**

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### **Purpose**

To compare the elongation patterns of the anterior and posterior borders of the anterolateral ligament (ALL) at varying knee flexion angles with the knee in a neutral position without any external forces and with external forces applied, including anterior-posterior translation, internal-external rotation, and varus-valgus angulation.

### **Methods**

Eight cadaveric knees were tested in a custom knee testing system. Elongation of the anterior and posterior borders of the ALL was measured using a MicroScribe 3DLX system at knee flexion angles of 0°, 30°, 60°, and 90° and after the application of internal-external rotation, anterior-posterior translation, and varus-valgus angulation.

### **Results**

The anterior border showed a slight noncontinuous increase in percentage elongation ( $0.8\% \pm 2.2\%$ ) whereas the posterior border showed a continuous decrease in percentage elongation ( $-12.0\% \pm 2.8\%$ ) as knee flexion increased ( $P < .001$ ). Apart from the elongation of the posterior border at 90° of knee flexion, internal rotation, varus angulation, and anterior translation resulted in a significant increase in the percentage elongation of the anterior and posterior borders at each flexion angle compared with external rotation, valgus angulation, and posterior translation, respectively.

### **Conclusions**

The ALL shows different elongation patterns between the anterior and posterior borders, with a continuous decrease in the percentage elongation of the posterior border as knee flexion increases.

### **Clinical Relevance**

This study presents useful evidence to resolve the uncertainty regarding the change in length of the ALL at various degrees of knee flexion. This information may be helpful for deciding the optimal knee flexion angle during ALL graft fixation. The findings from this study suggest that graft fixation during ALL reconstructions should be performed at close to full extension of the knee.

## **Indications and Outcomes of Arthroscopic Labral Reconstruction of the Hip: A Systematic Review**

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### **Purpose**

The primary purpose of this investigation was to systematically evaluate the literature for the current indications and outcomes of arthroscopic labral reconstruction of the hip. Our secondary purpose was to evaluate the role of arthroscopic labral reconstruction in the management of reparable labral tears.

### **Methods**

A systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines using a PRISMA checklist. Studies published between June 2009 and June 2018 that evaluated outcomes after arthroscopic labral reconstruction with a minimum of 1 year of follow-up were included.

### **Results**

Eleven studies met the inclusion and exclusion criteria. A total of 373 patients were identified. Of the 11 studies, 9 reported that an irreparable labrum was their indication for reconstruction, with 8 reporting that this was ultimately determined intraoperatively. Substantial variability in surgical technique, graft choice, and concurrent pathology was found. All 11 studies used at least 1 validated functional outcome metric to evaluate surgical outcomes, with all studies reporting improvement greater than the minimal clinically important difference. Donor-site pain was the most common complication, although it was reported in only 2 studies. Reported rates of revision surgery and conversion to arthroplasty were low (range, 0%-9.1% for both).

### **Conclusions**

All 11 studies included in this systematic review reported clinically significant functional improvements after arthroscopic labral reconstruction and low rates of complications, revision surgery, and progression of arthritis, although graft types and concomitant procedures confound the results. The most common indication for reconstruction was a deficient labrum on intraoperative evaluation. The 6 studies that evaluated patient satisfaction reported favorable results, with a range of 6.73 to 8.7.

### **Level of Evidence**

Level IV, systematic review of Level III and IV studies.

## **Biomechanical Properties of Posterior Meniscal Root Repairs: A Systematic Review**

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### **Purpose**

To systematically review the literature regarding the biomechanical properties of various meniscal root repair techniques.

### **Methods**

A systematic review of multiple databases was performed. The inclusion criteria included English language, studies relevant to meniscal root repairs, studies comparing 2 or more different discrete techniques, posterior root repairs, controlled laboratory studies, and human cadaveric or animal studies. Abstracts, case reports, cohort studies, case-control studies, systematic reviews and meta-analyses, and studies of meniscal body repairs were excluded.

### **Results**

Seventeen controlled laboratory studies were included for final analysis. There is no consensus on biomechanical superiority between transtibial pullout repair (TPR) and suture anchor repair. For TPR, there is no significant difference between 1 and 2 tibial tunnels. Nonanatomic repairs result in significantly lower joint surface contact areas and higher contact pressures, but suture placement farther from the root results in higher maximum load to failure. Two-suture repair has a greater maximum load to failure than 1-suture repair. Use of more than 2 sutures has diminishing returns. The modified Mason-Allen suture configuration is superior to a simple suture configuration, but there is no consensus regarding the superiority or feasibility of more complex sutures. There is no consensus on the superiority of a single suture material or shape.

### **Conclusions**

Anatomic meniscal root repairs with either TPR or suture anchor repair have better joint surface contact pressures and contact surface areas than nonanatomic repairs. The use of 2 sutures results in better fixation than 1 suture. There is evidence that the modified Mason-Allen suture configuration is superior to a simple suture configuration in a TPR, although the benefits of more complicated configurations are unclear.

### **Clinical Relevance**

This study suggests that, in general, more complex sutures exhibit higher maximum loads. Increasing the number of sutures to up to 2 of the same configuration also increases the maximum load.

## **Autologous Interleukin 1 Receptor Antagonist Blood-Derived Products for Knee Osteoarthritis: A Systematic Review**

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### **Purpose**

To systematically review the available clinical data regarding the use of autologous IL-1 receptor antagonist blood products (AILBPs) and their validity as an alternative intra-articular (IA) therapy for symptomatic knee osteoarthritis (OA).

### **Methods**

The PubMed, MEDLINE, Embase, and Cochrane Library databases were searched from inception to June 2018. All randomized controlled trials (RCTs) and noncomparative studies that evaluated the clinical efficacy of AILBPs (i.e., autologous protein solution and autologous conditioned serum) for knee OA were included. The primary outcome measure was the Western Ontario and McMaster Universities Osteoarthritis Index. The secondary outcomes measured were the Knee Injury and Osteoarthritis Outcome Score, visual analog scale score, Short Form 36 (SF-36) score, radiographic scores, and adverse events, which were qualitatively analyzed.

### **Results**

We included 8 studies, comprising 3 RCTs (Level II) and 5 noncomparative studies (Level IV), with a total of 592 patients (mean age, 56.4 years; 49.7% male patients). The RCTs represented high methodologic quality, whereas the noncomparative studies represented moderate to good quality. With AILBPs, 2 of 4 studies (50%) showed improvements in the Knee Injury and Osteoarthritis Outcome Score symptom and sport subscales, 5 of 7 studies (71%) achieved improvements in the Western Ontario and McMaster Universities Osteoarthritis Index score, and 4 of 5 studies (80%) attained improvements in the visual analog scale pain score from baseline to final follow-up. Most adverse events associated with AILBPs were mild to moderate in severity and were primarily localized to the injection site.

### **Conclusions**

Limited evidence substantiates that AILBPs are a safe and tolerable IA injection therapy that may improve pain parameters and functionality for mild to moderate knee OA patients and may be an effective adjunct for those unresponsive to traditional IA therapies.

### **Level of Evidence**

Level IV, systematic review of Level II through IV studies.

## **Return to Sport Following Revision Anterior Cruciate Ligament Reconstruction in Athletes: A Systematic Review**

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### **Purpose**

To report the rate of return to sport following revision anterior cruciate ligament (ACL) reconstruction in athletes.

### **Methods**

A systematic review of the literature following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines was conducted for athletes undergoing revision ACL reconstruction at a minimum 1-year follow-up. The primary outcome measure was return to sport following revision ACL reconstruction. Secondary outcomes were International Knee Documentation Committee score, Knee Injury and Osteoarthritis Outcome Score, Tegner and Lysholm scores, KT-1000 arthrometer measurements, and rates of ACL rerupture. A subjective analysis was performed, and data were summarized using forest plots, ranges, and tables.

### **Results**

Thirteen studies met the inclusion criteria. The rate of return to sport at any level ranged from 56% to 100%. The rate of return to sport at preinjury level ranged from 13% to 69%. The average time to return to sport ranged from 6.7 to 12 months. The average patient-reported outcome scores ranged from 43% to 86% (International Knee Documentation Committee score), 45% to 95% (Knee Injury and Osteoarthritis Outcome Score), 4.3 to 9 (Tegner), and 84% to 91% (Lysholm). KT-1000 arthrometer measurements ranged from 1.2 to 3.1 mm. Rates of ACL rerupture ranged from 0% to 20%.

### **Conclusions**

This systematic review demonstrated a relatively high rate of return to sport at any level in patients who underwent revision ACL reconstruction, but a relatively low rate of return to sport at preinjury level of play. Patient-reported outcomes were favorable, showing improvement at follow-up from preoperative scores. Rates of ACL rerupture were high relative to those reported for primary ACL reconstruction. This study suggests that athletes may have difficulty resuming their previous level of sport following revision ACL reconstruction but have a good chance of returning to a lower level of play.

### **Level of Evidence**

Level IV, systematic review of Level II-IV studies.



## **Anterior Cruciate Ligament Repair Outcomes: An Updated Systematic Review of Recent Literature**

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### **Purpose**

To critically review recent literature on outcomes following primary surgical repair of the anterior cruciate ligament (ACL).

### **Methods**

In December 2018, a search of the MEDLINE database was conducted for English language articles reporting clinical outcomes of ACL repair from 2003 to 2018. Included studies were evaluated for patient demographics, patient-reported outcome measures, return to sports/work, patient satisfaction, and postoperative complications. Subgroup analysis was conducted for studies that included patients with only type 1/proximal ACL ruptures.

### **Results**

Twenty-eight studies satisfied the inclusion criteria, comprising 2,401 patients (52.3% male, 35.7% female, 12.0% unspecified gender) with mean age ranging from 6.0 to 43.3 years. Most studies were conducted in Europe (82.1%), were level of evidence IV (60.7%), and were designed as case series (57.1%). Fourteen investigations (50.0%) used primary suture repair and 14 (50.0%) used dynamic intraligamentary stabilization. Preoperative ranges for Lysholm, International Knee Documentation Committee Score subjective, and Tegner scores were 28 to 100, 94.1 to 100, and 2 to 9, respectively. Postoperative ranges for the same measures were 80 to 100, 54.3 to 98, and 3.67 to 7, respectively. Time to return to sport/work ranged from  $3.1 \pm 3.3$  to  $17.4 \pm 1.5$  weeks. Frequency of rerupture, revision ACL surgery, and overall reoperations were as high as 23.1%, 33.3%, and 51.5%, respectively. Overall ACL repair survivorship ranged from 60.0% to 100.0%. In subgroup analysis for proximal ruptures treated with repair, the rates of revision ACL reconstruction (ACLR) and total reoperations were as high as 12.9% and 18.2%, respectively.

### **Conclusions**

Based on our cumulative findings across 2,401 patients from the 28 included studies, it appears that ACLR results in better survivorship and patient-perceived postoperative improvement when compared with ACL repair. At present, ACLR appears to remain the superior treatment strategy in the vast majority of cases.

### **Level of Evidence**

Level IV, systematic review of Level II to IV studies.

**Low-Molecular-Weight Heparin for the Prevention of Venous Thromboembolism in Patients Undergoing Knee Arthroscopic Surgery and Anterior Cruciate Ligament Reconstruction: A Meta-analysis of Randomized Controlled Trials**

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**Background** Low-molecular-weight heparin (LMWH) thromboprophylaxis is widely used for reducing the risk of thrombosis after major orthopaedic surgery. However, the effect and safety on knee arthroscopic surgery are still controversial.

**Purpose** To assess the efficacy and safety of LMWH for the prevention of symptomatic venous thromboembolism (VTE) after knee arthroscopic surgery and anterior cruciate ligament reconstruction (ACLR) by conducting a meta-analysis of randomized controlled trials (RCTs).

**Study Design** Meta-analysis.

**Methods** The authors searched the electronic databases of MEDLINE, Embase, Cochrane Central Register of Controlled Trials (CENTRAL), ClinicalTrials.gov, and Web of Science for all studies from inception to June 30, 2017. All selected studies were categorized into 2 subgroups: simple knee arthroscopic surgery and ACLR. The primary effect and safety endpoint were the incidence of major VTE and major bleeding events (BEs), respectively. The secondary effect and safety endpoint were the incidence of all VTE and all BEs, respectively. Relative risks (RRs) with 95% CIs were calculated using Review Manager 5.3.

**Results** Eight RCTs with 4113 patients were included. For patients undergoing simple knee arthroscopic surgery, LMWH prophylaxis did not bring a significant reduction in the risk of major VTE (RR, 1.00 [95% CI, 0.37-2.67];  $P > .99$ ) and all VTE (RR, 0.63 [95% CI, 0.31-1.29];  $P = .21$ ) and did not increase the risk of major BEs (RR, 0.98 [95% CI, 0.06-15.72];  $P = .99$ ) but did have a higher risk of all BEs (RR, 1.64 [95% CI, 1.18-2.28];  $P = .003$ ) in comparison with non-LMWH prophylaxis. For patients undergoing ACLR, LMWH prophylaxis was associated with a significantly lower rate of major VTE (RR, 0.23 [95% CI, 0.12-0.43];  $P < .001$ ) and all VTE (RR, 0.22 [95% CI, 0.06-0.73];  $P = .01$ ) but no increase in major BEs (RR, 1.80 [95% CI, 0.19-17.25];  $P = .61$ ) and all BEs (RR, 1.12 [95% CI, 0.72-1.74];  $P = .61$ ) in comparison with non-LMWH prophylaxis.

**Conclusion** Compared with non-LMWH treatment, LMWH had no significant efficacy in preventing VTE in patients undergoing simple knee arthroscopic surgery but increased the risk of BEs. However, LMWH had significant efficacy in preventing VTE for patients mainly undergoing ACLR and did not increase the risk of BEs.