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#### CORR

- None

#### BJJ

– None

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## Upper extremity

### Arthroscopy

#### **Morphologic Risk Factors in Predicting Symptomatic Structural Failure of Arthroscopic Rotator Cuff Repairs: Tear Size, Location, and Atrophy**

Gregory Gasbarro, Jason Ye, Hillary Newsome, Volker Musahl  
October 2016, volume 32, issue 10, pages 1947 - 1952  
<http://dx.doi.org/10.1016/j.arthro.2016.01.067>

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#### **Purpose**

To evaluate whether morphologic characteristics of rotator cuff tear have prognostic value in determining symptomatic structural failure of arthroscopic rotator cuff repair independent of age or gender.

#### **Methods**

Arthroscopic rotator cuff repair cases performed by five fellowship-trained surgeons at our institution from 2006 to 2013 were retrospectively reviewed. Data extraction included demographics, comorbidities, repair technique, clinical examination, and radiographic findings. Failure in symptomatic patients was defined as structural defect on postoperative magnetic resonance imaging or pseudoparalysis on examination. Failures were age and gender matched with successful repairs in a 1:2 ratio.

#### **Results**

A total of 30 failures and 60 controls were identified. Supraspinatus atrophy ( $P = .03$ ) and tear size (18.3 mm failures  $\nu$  13.9 mm controls;  $P = .02$ ) were significant risk factors for failure, as was the presence of an infraspinatus tear greater than 10 mm (62%  $\nu$  17%,  $P < .01$ ). Single-row repair ( $P = .06$ ) and simple suture configuration ( $P = .17$ ) were more common but similar between groups. Diabetes mellitus and active tobacco use were not significantly associated with increased failure risk but psychiatric medication use was more frequent in the failure group.

#### **Conclusions**

This study confirms previous suspicions that tear size and fatty infiltration are associated with failure of arthroscopic rotator cuff repair but independent of age or gender in symptomatic patients. There is also a quantitative cutoff on magnetic resonance imaging for the size of infraspinatus involvement that can be used clinically as a predicting factor. Although reported in the literature, smoking and diabetes were not associated with failure.

#### **Level of Evidence**

Level III, retrospective case control.

[BACK](#)

## Subsequent Shoulder Surgery After Isolated Arthroscopic SLAP Repair

Brent Mollon, Siddharth A. Mahure,, Andrew S. Rokito  
October 2016, volume 32, issue 10, pages 1954 - 1962

<http://dx.doi.org/10.1016/j.arthro.2016.01.053>

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### Purpose

To quantify the incidence of and identify the risk factors for subsequent shoulder procedures after isolated SLAP repair.

### Methods

New York's Statewide Planning and Research Cooperative System database was searched between 2003 and 2014 to identify individuals with the sole diagnosis of a SLAP lesion who underwent isolated arthroscopic SLAP repair. Patients were longitudinally followed up for a minimum of 3 years to analyze for subsequent ipsilateral shoulder procedures.

### Results

Between 2003 and 2014, 2,524 patients met our inclusion criteria. After 3 to 11 years of follow-up, 10.1% of patients (254 of 2,524) underwent repeat surgical intervention on the same shoulder as the initial SLAP repair. The mean time to repeat shoulder surgery was  $2.3 \pm 2.1$  years. Subsequent procedures included subacromial decompression (35%), debridement (26.7%), repeat SLAP repair (19.7%), and biceps tenodesis or tenotomy (13.0%). After isolated SLAP repair, patients aged 20 years or younger were more likely to undergo arthroscopic Bankart repair (odds ratio [OR], 2.91; 95% confidence interval [CI], 1.36-6.21;  $P = .005$ ), whereas age older than 30 years was an independent risk factor for subsequent acromioplasty (OR, 2.3; 95% CI, 1.4-3.7;  $P < .001$ ) and distal clavicle resection (OR, 2.5; 95% CI, 1.1-5.5;  $P = .030$ ). The need for a subsequent procedure was significantly associated with Workers' Compensation cases (OR, 2.4; 95% CI, 1.7-3.2;  $P < .001$ ).

### Conclusions

We identified a 10.1% incidence of subsequent surgery after isolated SLAP repair, often related to an additional diagnosis, suggesting that clinicians should consider other potential causes of shoulder pain when considering surgery for patients with SLAP lesions. In addition, the number of isolated SLAP repairs performed has decreased over time, and management of failed SLAP repair has shifted toward biceps tenodesis or tenotomy over revision SLAP repair in more recent years.

### Level of Evidence

Level III, case-control study.

[BACK](#)

## Short-term Complications of the Arthroscopic Latarjet Procedure: A North American Experience

George S. Athwal, October 2016, Volume 32, issue 10, pages 1965-1970

<http://dx.doi.org/10.1016/j.arthro.2016.02.022>



### **Purpose**

To report on the intraoperative and early postoperative (<3 months) problems and complications encountered with the arthroscopic Latarjet procedure in patients with complex anterior shoulder instability.

### **Methods**

Between 2010 and 2014, 83 patients underwent an arthroscopic Latarjet procedure for recurrent post-traumatic anterior instability. The group's mean age was  $28 \pm 10$  years and consisted of 76 (92%) male patients. A "problem" was defined as an unanticipated perioperative event that was not likely to affect the patient's final outcome. A "complication" was defined as an event that was likely to negatively affect outcome.

### **Results**

At a mean follow-up of 17 months (range, 3 to 43 months), 20 (24%) patients sustained either a problem and/or a complication. The problem rate was 18% and the complication rate was 10%. The most commonly encountered adverse event was intraoperative fracture of the coracoid graft, which occurred in 6 patients (7%). In addition, 1 arthroscopic case was intraoperatively converted to open and 1 patient sustained a transient axillary nerve injury. A total of 7 cases underwent secondary operative procedures. The rate of problems and/or complications in primary cases was not significantly different than revision cases ( $P = .335$ ).

### **Conclusions**

The rate of adverse events reported in this arthroscopic series is not insignificant and is similar to that reported with the traditional open Latarjet. With appropriate training, the arthroscopic Latarjet procedure can be effective for the management of patients with complex shoulder instability.

### **Level of Evidence**

Level IV, therapeutic case series.

[BACK](#)

## **Comparison of Passive Stiffness Changes in the Supraspinatus Muscle After Double-Row and Knotless Transosseous-Equivalent Rotator Cuff Repair Techniques: A Cadaveric Study**

Taku Hatta, Hugo Giambini, Chunfeng Zhao, John W. Sperling, Kai-Nan An.  
October 2016 Volume 32, Issue 10, Pages 1973–1981

<http://dx.doi.org/10.1016/j.arthro.2016.02.024>

### **Purpose**

To investigate the alteration of passive stiffness in the supraspinatus muscle after double-row (DR) and knotless transosseous-equivalent (KL-TOE) repair techniques, using shear wave elastography (SWE) in cadavers with rotator cuff tears. We also aimed to compare altered muscular stiffness after these repairs to that obtained from shoulders with intact rotator cuff tendon.

## Methods

Twelve fresh-frozen cadaveric shoulders with rotator cuff tear (tear size: small [6], medium-large [6]) were used. Passive stiffness of 4 anatomic regions in the supraspinatus muscle was measured based on an established SWE method. Each specimen underwent DR and KL-TOE footprint repairs at 30° glenohumeral abduction. SWE values, obtained at 0°, 10°, 20°, 30°, 60°, and 90° abduction, were assessed in 3 different conditions: preoperative (torn) and postoperative conditions with the 2 techniques. The increased ratio of SWE values after repair was compared among the 4 regions to assess stiffness distribution. In addition, SWE values were obtained on 12 shoulders with intact rotator cuff tendons as control.

## Results

In shoulders with medium-large-sized tears, supraspinatus muscles showed an increased passive stiffness after rotator cuff repairs, and this was significantly observed at adducted positions. KL-TOE repair showed uniform stiffness changes among the 4 regions of the supraspinatus muscle (mean, 189% to 218% increase after repair), whereas DR repair caused a significantly heterogeneous stiffness distribution within the muscle (mean, 187% to 319% after repair,  $P = .002$ ). Although a repair-induced increase in muscle stiffness was observed also in small-sized tears, there were no significant differences in repaired stiffness changes between DR and KL-TOE (mean, 127% to 138% and 127% to 130% after repairs, respectively). Shoulders with intact rotator cuff tendon showed uniform SWE values among the 4 regions of the supraspinatus muscle (mean, 38.2 to 43.0 kPa).

## Conclusions

Passive stiffness of the supraspinatus muscle increases after rotator cuff repairs for medium-large-sized tears. KL-TOE technique for the medium-large-sized tear provided a more uniform stiffness distribution across the repaired supraspinatus muscles compared with the DR technique.

## Clinical Relevance

Based on this insight, investigating rotator cuff muscle stiffness changes, further studies using SWE may determine the optimal repair technique for various sizes of rotator cuff tears.

[BACK](#)

## Mechanical Effects of Heat Exposure From a Bipolar Radiofrequency Probe on Suture Under Simulated Arthroscopic Conditions

Sebastian Valet, Bernhard Weisse, Dominik C. Meyer October 2016 Volume 32, Issue 10, Pages 1985–1992

<http://dx.doi.org/10.1016/j.arthro.2016.03.006>

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## Purpose

To determine conditions for the safe use of radiofrequency (RF) tissue ablation probes that avoid damaging suture material.

## Methods

Four sutures made of 3 different materials commonly used in arthroscopic procedures were analyzed in a saline bath related to effects of RF-produced heat by proximity, duration, and intensity settings measuring burn-through time and ultimate load to failure. The parameters tested

were electrode-to-suture distance, power setting, and the presence of tendon tissue or metallic anchor eyelets. Outcome variables were the burn-through time and the ultimate failure load of differently treated suture samples.

### **Results**

Mean burn-through time for suture in direct contact with the RF probe ranged from 57.2 to 14.7 seconds for ultra-high-molecular-weight polyethylene (UHMWPE) sutures, 1.1 seconds for polydioxanone suture, and 0.8 seconds for polyethylene terephthalate suture. One of the UHMWPE sutures was capable of withstanding 3 seconds of direct contact with the RF probe without any compromise in tensile strength. No suture material tested had any mechanical change as long as the RF probe was kept 1 mm from the suture.

### **Conclusions**

Heat from RF tissue ablation probes can cause undetected damage. High-strength UHMWPE sutures were less sensitive to an RF treatment than polyester sutures. The use of different test substrates did not significantly influence the burn through time.

### **Clinical Relevance**

Heat from RF probes can damage some suture material if direct contact is made even briefly. The use of RF devices may be safe for the suture when a distance between probe and suture of >1 mm is maintained. Suture made from UHMWPE may tolerate up to 3 seconds of RF probe contact and not sustain significant damage. Surgeons must use great care when using RF devices in the vicinity of suture placement.

[BACK](#)

## **Hill-Sachs Off-track Lesions as Risk Factor for Recurrence of Instability After Arthroscopic Bankart Repair**

Joel Locher, October 2016 Volume 32, Issue 10, Pages 1993–1999

<http://dx.doi.org/10.1016/j.arthro.2016.03.005>

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### **Purpose**

To evaluate the effect of “off-track” Hill-Sachs lesions, according to the glenoid track concept, as a risk factor for recurrent instability and need for revision surgery after arthroscopic Bankart repair.

### **Methods**

We retrospectively reviewed 254 patients with anteroinferior glenohumeral instability who were managed with an arthroscopic stabilization procedure between 2006 and 2013. Preoperative magnetic resonance imaging and/or computed tomography scans were available for 100 of these patients to calculate the glenoid track and the presence of “on-track” or off-track Hill-Sachs lesions. Recurrence of instability was evaluated at a mean follow-up of 22.4 months.

## Results

Of 100 patients whose magnetic resonance imaging and/or computed tomography scans were available, 88 had an on-track Hill-Sachs lesion and 12 had an off-track Hill-Sachs lesion. Revision surgery for recurrent instability was performed in 5 patients (6%) with an on-track Hill-Sachs lesion and in 4 patients (33%) with an off-track Hill-Sachs lesion (odds ratio, 8.3; 95% confidence interval, 1.85-37.26;  $P = .006$ ).

## Conclusions

An off-track Hill-Sachs lesion is a significant and important risk factor for recurrence of instability and need for revision surgery after arthroscopic Bankart repair when compared with an on-track Hill-Sachs lesion.

## Level of Evidence

Level IV, prognostic case series.

[BACK](#)

## Risk Factors for Retear After Arthroscopic Repair of Full-Thickness Rotator Cuff Tears Using the Suture Bridge Technique: Classification System

In-Bo Kim, Moo-Won Kim,

November 2016 Volume 32, Issue 11, Pages 2191–2200

<http://dx.doi.org/10.1016/j.arthro.2016.03.012>

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## Purpose

To identify factors that predict retears after arthroscopic repair of full-thickness rotator cuff tears.

## Methods

Factors included age, sex, diabetes, smoking, symptom duration (group I, <12 months; group II, ≥12 months), tear size according to the Kim classification (group I, A and B; group II, C; group III, D), tendon involvement (group I, supraspinatus; group II, supraspinatus and subscapularis; group III, supraspinatus and infraspinatus; group IV, all 3 tendons), and degree of fatty degeneration of the supraspinatus and infraspinatus (group I, Goutallier stages 1 and 2 for each tendon; group II, Goutallier stages 3 and 4 for each tendon).

## Results

Two hundred eighty-two patients underwent arthroscopic repairs of full-thickness rotator cuff tears. The overall retear rate was 13.1%. Age, sex, diabetes, smoking, and degree of fatty degeneration of the supraspinatus and infraspinatus did not affect retear rates. However, symptom duration ( $P = .006$ ), Kim classification ( $P < .001$ ), and tendon involvement ( $P < .001$ ) did affect retear rates. The retear rates were 8.5% (14 of 165 patients) and 19.7% (23 of 117) in symptom duration groups I and II, respectively; 8.0% (13 of 163), 15.2% (16 of 105), and 57.1% (8 of 14) in Kim classification groups I, II, and III, respectively; and 6.6% (11 of 167), 22.2% (18 of 81), 10.0% (2 of 20), and 42.9% (6 of 14) in tendon involvement groups I, II, III, and IV,

respectively. In the multiple logistic regression analysis, the respective odds ratios of symptom duration group II, Kim classification group III, tendon involvement group II, and tendon involvement group IV were 2.853 ( $P = .011$ ), 18.108 ( $P = .001$ ), 4.184 ( $P = .001$ ), and 5.727 ( $P = .021$ ), respectively.

### **Conclusions**

To preoperatively predict retears after arthroscopic repair of full-thickness rotator cuff tears, the duration of symptoms before surgery, tear size, and tendon involvement can be used. In addition, regarding tear size, the Kim classification can be used more effectively than the modified DeOrto and Cofield classification.

### **Level of Evidence**

Level IV, prognostic case series.

[BACK](#)

## **Suprascapular Nerve Block Versus Interscalene Block as Analgesia After Arthroscopic Rotator Cuff Repair: A Randomized Controlled Noninferiority Trial**

Asuka Desroches, Shahnaz Klouche, Charles Schlur, Thomas Bauer, Thomas Waitzenegger, Philippe Hardy

November 2016 Volume 32, Issue 11, Pages 2203–2209

<http://dx.doi.org/10.1016/j.arthro.2016.03.013>

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**Purpose** To compare the efficacy of suprascapular nerve block (SSB) and interscalene block (ISB) as postoperative analgesia within the first 24 hours after arthroscopic supraspinatus and/or infraspinatus tendon repair.

### **Methods**

A single-blind, randomized controlled study was performed between 2013 and 2014. The inclusion criteria were arthroscopic supraspinatus and/or infraspinatus tendon repair confirmed intraoperatively, with or without associated procedures, and informed consent. The exclusion criteria were a previously operated shoulder, repair of the subscapularis tendon, and an allergy to local anesthetics. ISB was performed under ultrasound guidance by an anesthesiologist, whereas SSB was performed based on specific anatomic landmarks by a surgeon. The primary evaluation criterion was mean shoulder pain score during the first postoperative 24 hours assessed on a visual analog scale by the patient. The secondary criteria were complications of locoregional anesthesia, the use of analgesics in the recovery room (the first 2 hours) until postoperative day 7, and pain (visual analog scale) during the first week. Forty-four patients were needed for this noninferiority study. An institutional review board approved the study.

### **Results**

Seventy-four patients were randomized, and 59 met the intraoperative inclusion criteria. Six patients were excluded (1 for pneumothorax after ISB, 1 for unsuccessful SSB, and 4 for incomplete questionnaires). None of the patients were lost to follow-up. There was no significant difference between the SSB and ISB groups in mean pain score for the first 24 hours ( $P = .92$ ) or the first 7 days ( $P = .05$ ). However, there was significantly less pain in the ISB group

in the recovery room ( $P = .01$ ). Consumption of analgesics was comparable between the groups, but the SSB group took significantly more morphine in the recovery room.

### **Conclusions**

In this prospective, randomized controlled study, SSB was as effective as ISB for mean pain control within the first 24 hours but ISB was more effective in relieving pain in the recovery room after arthroscopic supraspinatus and/or infraspinatus tendon repair.

### **Level of Evidence**

Level I, therapeutic, randomized controlled study.

[BACK](#)

## **The Effects of Patient Obesity on Early Postoperative Complications After Shoulder Arthroscopy**

David C. Sing, David Y. Ding, Thomas U. Aguilar, Tammy Luan, C. Benjamin Ma, Brian T. Feeley, Alan L. Zhang,

November 2016 Volume 32, Issue 11, Pages 2212–2217

<http://dx.doi.org/10.1016/j.arthro.2016.03.022>

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**Purpose** To report the prevalence of obesity in shoulder arthroscopy, determine a body mass index (BMI) threshold most predictive of complication within 30 days, and evaluate obesity as an independent risk factor for medical and surgical complications.

### **Methods**

Using the National Surgical Quality Improvement Program database, we reviewed all patients who underwent shoulder arthroscopy during 2011 to 2013. Receiver operating characteristic and Youden coefficient were calculated to find an optimal BMI cutoff to predict complications within 30 days of surgery. A case-control matched analysis was then performed by stratifying patient BMI by this cutoff and matching patients one to one according to age, sex, type of shoulder arthroscopy, American Society of Anesthesiology rating, surgical setting, and 8 comorbidities. Operating time, complications, and readmissions were also compared.

### **Results**

Of the 15,589 patients who underwent shoulder arthroscopy, 6,684 (43%) were classified as obese when using the optimal cutoff point of BMI = 30 according to the Youden coefficient. Obese patients had a higher risk of superficial site infection than nonobese patients (0.3% vs 0.0%; odds ratio [OR]: 6.00; 95% confidence interval [CI], 1.3 to 26.8;  $P = .015$ ). Obese patients did not have significantly increased risk for overall early postoperative complication (1.2% compared with nonobese 0.8%; OR: 1.54; 95% CI, 1.0 to 2.4), readmissions (OR: 0.85; 95% CI, 0.5 to 1.5), or increased operating time ( $P = .068$ ).

### **Conclusions**

Up to 43% of patients undergoing shoulder arthroscopy can be classified as obese, but early perioperative complications are uncommon. Higher patient BMI is associated with increased risk of superficial site infection but not an overall risk for complication, readmission, or increased operating time.

### **Level of Evidence**

Level III, retrospective comparative study.

[BACK](#)

## **Double-Row Capsulolabral Repair Increases Load to Failure and Decreases Excessive Motion**

Lucas S. McDonald, Matthew Thompson, David W. Altchek, Michelle H. McGarry, Thay Q. Lee, Vanna J. Rocchi, Joshua S. Dines

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### **Purpose**

Using a cadaver shoulder instability model and load-testing device, we compared biomechanical characteristics of double-row and single-row capsulolabral repairs. We hypothesized a greater reduction in glenohumeral motion and translation and a higher load to failure in a mattress double-row capsulolabral repair than in a single-row repair.

### **Methods**

In 6 matched pairs of cadaveric shoulders, a capsulolabral injury was created. One shoulder was repaired with a single-row technique, and the other with a double-row mattress technique. Rotational range of motion, anterior-inferior translation, and humeral head kinematics were measured. Load-to-failure testing measured stiffness, yield load, deformation at yield load, energy absorbed at yield load, load to failure, deformation at ultimate load, and energy absorbed at ultimate load.

### **Results**

Double-row repair significantly decreased external rotation and total range of motion compared with single-row repair. Both repairs decreased anterior-inferior translation compared with the capsulolabral-injured condition, however, no differences existed between repair types. Yield load in the single-row group was  $171.3 \pm 110.1$  N, and in the double-row group it was  $216.1 \pm 83.1$  N ( $P = .02$ ). Ultimate load to failure in the single-row group was  $224.5 \pm 121.0$  N, and in the double-row group it was  $373.9 \pm 172.0$  N ( $P = .05$ ). Energy absorbed at ultimate load in the single-row group was  $1,745.4 \pm 1,462.9$  N-mm, and in the double-row group it was  $4,649.8 \pm 1,930.8$  N-mm ( $P = .02$ ).

### **Conclusions**

In cases of capsulolabral disruption, double-row repair techniques may result in decreased shoulder rotational range of motion and improved load-to-failure characteristics.

### **Clinical Relevance**

In cases of capsulolabral disruption, repair techniques with double-row mattress repair may provide more secure fixation. Double-row capsulolabral repair decreases shoulder motion and increases load to failure, yield load, and energy absorbed at yield load more than single-row repair.

[BACK](#)

## **Arthroscopic Suprapectoral and Open Subpectoral Biceps Tenodesis: Radiographic Characteristics**

Justin L. Hodgins, David Kovacevic, Stephen Purcell, Charles M. Jobin, William N. Levine, Christopher S. Ahmad

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### **Purpose**

To provide a detailed account of the location of the long head of the biceps (LHB) tenodesis tunnels using an all-arthroscopic suprapectoral technique in a prospective group of patients. These patients were then compared with a retrospective group of open subpectoral tenodesis patients of similar characteristics.

### **Methods**

Postoperative radiographs from a prospective group of all-arthroscopic suprapectoral LHB tenodeses were compared with a retrospective group of open subpectoral tenodeses. Digital anteroposterior images were used to measure distances from clinically pertinent radiographic landmarks to tenodesis tunnel sites.

### **Results**

Forty patients (20 all-arthroscopic, 20 open) met the inclusion criteria. The inferior border of the bicipital groove was located a mean distance of  $33.7 \pm 6.9$  mm from the top of the humeral head. The mean distance measured in the open group was approximately 28 mm ( $P < .001$ ) distal compared with the arthroscopic group. The humeral diameter was  $7.5 \pm 5.4$  mm narrower at the subpectoral tenodesis site ( $P < .001$ ). All 20 patients in the open subpectoral group had tenodesis tunnels placed distal to the bicipital groove compared with 17 of 20 patients (85%) in the all-arthroscopic group. There were 2 cases of lateral wall cortical reaming during subpectoral tenodesis but no periprosthetic humeral fractures. There were 2 cases of bicortical reaming during the all-arthroscopic tenodesis with no known complications.

### **Conclusions**

The location of biceps tenodesis significantly differs between all-arthroscopic suprapectoral and open subpectoral techniques, and the open subpectoral method achieves fixation in a significantly narrower region of the humerus.

### **Level of Evidence**

Level III, retrospective comparative study.

[BACK](#)

## **The Effect of Purified Human Bone Marrow–Derived Mesenchymal Stem Cells on Rotator Cuff Tendon Healing in an Athymic Rat**

Ryan M. Degen, Andrew Carbone, Camila Carballo, Jianchun Zong, Tony Chen, Amir Lebaschi, Liang Ying, Xiang-Hua Deng, Scott A. Rodeo,

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### **Purpose**

To evaluate the ability of purified human bone marrow–derived mesenchymal stem cells (MSCs) to augment healing of an acute small- to medium-sized rotator cuff repair in a small-animal model, evaluating the structure and composition of the healing tendon-bone interface with histologic and biomechanical analyses.

### **Methods**

Fifty-two athymic rats underwent unilateral detachment and transosseous repair of the supraspinatus tendon augmented with either fibrin glue (control group) or fibrin glue with 106 human MSCs (experimental group) applied at the repair site. Flow cytometry verified the stem cell phenotype of the cells as CD73+, CD90+, CD105+, CD14–, CD34–, and CD45–. Rats were killed at 2 and 4 weeks, with 10 from each group used for biomechanical testing and 3 for histologic analysis.

### **Results**

Safranin O staining identified increased fibrocartilage formation at the repair site at 2 weeks in the human MSC group ( $18.6\% \pm 2.9\%$  vs  $9.1\% \pm 1.6\%$ ,  $P = .026$ ). Picrosirius staining identified decreased energy ( $36.88 \pm 4.99$  J vs  $54.97 \pm 8.33$  J,  $P = .04$ ) and increased coherence in the human MSC group ( $26.96\% \pm 15.32\%$  vs  $14.53\% \pm 4.10\%$ ,  $P = .05$ ), indicating improved collagen orientation. Biomechanical testing showed a significant increase in failure load ( $11.5 \pm 2.4$  N vs  $8.5 \pm 2.4$  N,  $P = .002$ ) and stiffness ( $7.1 \pm 1.2$  N/mm vs  $5.7 \pm 2.1$  N/mm,  $P < .001$ ) in the experimental group compared with the control group at 2 weeks. These effects dissipated by 4 weeks, with no significant differences in fibrocartilage formation ( $35\% \pm 5.0\%$  vs  $26.6\% \pm 0.6\%$ ,  $P = .172$ ) or biomechanical load to failure ( $24.6 \pm 7.1$  N vs  $21.5 \pm 4.1$  N,  $P = .361$ ) or stiffness ( $13.5 \pm 3.1$  N/mm vs  $16.1 \pm 5.6$  N/mm,  $P = .384$ ). All failures occurred at the bone-tendon interface.

### **Conclusions**

Rotator cuff repair augmentation with purified human MSCs improved early histologic appearance and biomechanical strength of the repair at 2 weeks, although the effects dissipated by 4 weeks with no significant differences between groups.

### **Clinical Relevance**

Human MSCs may improve early rotator cuff healing during the first 2 weeks after repair.

[BACK](#)

## **Patients Have Strong Preferences and Perceptions for Biceps Tenotomy Versus Tenodesis**

Balazs Galdi, Daniel L. Southren, M., Eugene W. Brabston, Charles A. Popkin, Charles M. Jobin, William N. Levine, Christopher S. Ahmad,

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### **Purpose**

To evaluate what factors are important in the patients' preference and their perception of a successful surgical outcome.

### **Methods**

A biceps-specific questionnaire was developed using a series of questions assessing current symptoms, previous knowledge of biceps tendon surgery, surgical outcome priorities, and patient demographics and administered to 100 patients with proximal biceps pathology after approval by the Institutional Review Board. The patients were asked which surgery they would prefer. A set of  $\chi^2$  tests were used to test the association between categorical variables. All tests were 2-sided and considered significant at  $P < .05$ .

### **Results**

A total of 100 patients enrolled in the study, with 49 female and 51 male patients at an average age of 49 years (range, 19 to 79 years). Of the 100 patients, 64 (64%) chose to have biceps tenodesis. Factors predictive of choosing a biceps tenodesis included female sex, and concern of cosmetic deformity and residual postoperative pain with a tenotomy ( $P < .05$ ). Factors predictive of choosing a tenotomy included male sex, high level of current bicipital groove pain, and concerns regarding the use of additional hardware and longer recovery with a tenodesis ( $P < .05$ ). Age, body mass index, occupation, income level, and concerns regarding postoperative strength and muscle cramping were not found to have a significant predictive effect toward either procedure.

### **Conclusions**

Patient age should not be used as the sole criterion when deciding between biceps tenotomy and tenodesis. Our results can be consolidated to 5 predictive, reliable questions that will assist orthopaedic surgeons in making individualized patient-specific decisions regarding proximal biceps tendon surgery by emphasizing what factors are most important to patients for a successful surgical outcome.

[BACK](#)

## **Intra- and Inter-rater Agreement on Magnetic Resonance Imaging Evaluation of Rotator Cuff Integrity After Repair**

Akihiko Hasegawa, Teruhisa Mihata, Kenji Yasui, Takeshi Kawakami, Yasuo Itami, Masashi Neo,

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### **Purpose**

To investigate the intra- and inter-rater agreement of magnetic resonance imaging (MRI) evaluations of rotator cuff integrity at 6 and 24 months after arthroscopic rotator cuff repair (ARCR).

### **Methods**

Three shoulder surgeons reviewed 68 MRI scans from 34 patients who had undergone ARCR and MRI examination at both 6 and 24 months after surgery. Postoperative rotator cuff integrity was investigated by using Owen, Sugaya, and Hayashida classifications to determine whether the rotator cuff was intact or whether there was a partial-thickness re-tear or full-thickness re-tear.

and Burks score to assess tendon appearance. Multirater kappa statistics were used to measure intra- and inter-rater agreement. Kappa values were interpreted according to guidelines adapted from the work of Landis and Koch.

### **Results**

All classifications had similar intra- and inter-rater agreement ( $\kappa = 0.14$  to  $0.67$ ,  $0.23$  to  $0.60$ , respectively), but no intra- or inter-rater agreement scored “excellent.” Inter-rater agreement after ARCR was higher at 24 months ( $\kappa = 0.31$  to  $0.60$ ) than at 6 months ( $\kappa = 0.23$  to  $0.44$ ) in all evaluations. Reviewers identified full-thickness retears with a moderate to good degree of inter-rater agreement in all evaluations, at both 6 months ( $\kappa = 0.42$  to  $0.73$ ) and 24 months ( $\kappa = 0.61$  to  $0.80$ ) after ARCR. However, poor inter-rater agreement ( $\kappa = 0.13$  to  $0.19$ ) was found in the identification of partial-thickness retears in all evaluations at 6 months after ARCR.

### **Conclusions**

Shoulder surgeons showed better intra- and inter-rater agreement in predicting full-thickness tears compared with partial-thickness tears. The inter-rater agreement at 24 months after ARCR was superior to that at 6 months in predicting not only full-thickness re-tear but also partial-thickness re-tear. MRI evaluation of rotator cuff integrity at 6 months after ARCR may be less reliable, regardless of which classification system is used.

### **Level of Evidence**

Level III, retrospective comparative study.

[BACK](#)

## **Diagnostic Value of the Supine Napoleon Test for Subscapularis Tendon Lesions**

Yoshitsugu Takeda, Koji Fujii, Katsutoshi Miyatake, Yoshiteru Kawasaki, Takashi Nakayama, Kosuke Sugiura,

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### **Purpose**

The purpose of this study was to compare the diagnostic value of the supine Napoleon test (a variation of the belly-press test that reduces compensatory motion) with other clinical tests for subscapularis tendon (SSC) tears.

### **Methods**

One hundred thirty consecutive patients who were scheduled for arthroscopic rotator cuff repair were evaluated preoperatively with the lift-off test, Napoleon test, bear-hug test, and supine Napoleon test. The supine Napoleon test was performed by placing the patient's hand on their belly while they lay supine with an examiner holding their hand and shoulder to prevent compensatory motion. The patient was asked to move their elbow upward and the test was considered positive if they were unable to do so. During surgery, SSC lesions were classified with the Lafosse classification system. Sensitivity, specificity, accuracy, and positive and negative likelihood ratios (LR+, LR-) were calculated for each test. The ability to detect partial SSC tears was compared among the clinical tests.

### **Results**

Fifty-two of 130 patients (40%) had SSC tears confirmed arthroscopically. For diagnosis of these tears, the supine Napoleon test was the most sensitive (84%), followed by the bear-hug test (74%), and the bear-hug test was the most specific (97%), followed by the supine Napoleon test (96%). The LR+ was greatest for the bear-hug test (28.4) and next greatest for the supine Napoleon test (21.9). The LR- was lowest for the supine Napoleon test (0.16) and the bear-hug test was second (0.27). The sensitivity of the supine Napoleon test (65%) was highest for detecting partial tears.

### **Conclusions**

In comparison with other clinical tests for SSC tears, the supine Napoleon test had the greatest diagnostic value for full-thickness SSC tears and was most able to detect partial tears.

### **Level of Evidence**

Level III, diagnostic nonrandomized study.

[BACK](#)

## **Remplissage of an Off-track Hill-Sachs Lesion Is Necessary to Restore Biomechanical Glenohumeral Joint Stability in a Bipolar Bone Loss Model**

Robert U. Hartzler, Christopher N.H. Bui, Woong K. Jeong, Masaki Akeda, Alex Peterson, Michelle McGarry, Patrick J. Denard, Stephen S. Burkhart, Thay Q. Lee,

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### **Purpose**

To validate the glenoid track concept in a cadaveric bipolar bone loss model and to test whether “on-track” and “off-track” lesions can be stabilized with Bankart repair (BR) with or without Hill-Sachs remplissage (HSR).

### **Methods**

Eight fresh-frozen cadaveric shoulders were tested in a custom apparatus with passive axial rotation and then progressive translational loading (10 to 40 N) at mid-range (60°) and end-range external rotation (90°). Injury conditions included glenoid bone loss of 15% with on-track (15%) and off-track (30%) Hill-Sachs lesions. Repair conditions included BR with HSR and BR without HSR.

### **Results**

For on-track lesions, engagement occurred with translation testing in one shoulder (12.5%) at end-range rotation. After BR, engagement was prevented for this shoulder. For off-track lesions, engagement with translation testing occurred in 8 shoulders (100%) at end-range rotation and in 6 (75%) at mid-range rotation. After BR, engagement was prevented in 4 of 6 engaging shoulders (67%) at mid-range rotation but was prevented in zero of 8 (0%) at end-range rotation. Adding HSR prevented engagement in all 14 engaging shoulders with off-track lesions (100%). BR with HSR resulted in supraphysiological stiffness for off-track lesions at mid- and end-range rotation (13.3 N/m vs 7.0 N/m and 10.0 N/m vs 5.0 N/m,  $P = .0002$ ) and for on-track lesions at end-range rotation (10.1 N/m vs 5.0 N/m,  $P = .0002$ ). Stiffness of BR with HSR was not different from the intact shoulder for on-track lesions at mid-range rotation (7.2 N/m vs 7.0 N/m,  $P > .99$ ).

### **Conclusions**

The patterns of engagement of Hill-Sachs lesions with a 15% glenoid defect in this model give support to the glenoid track concept. BR plus remplissage resulted in supraphysiological shoulder stiffness but was necessary to prevent engagement of off-track bipolar bone lesions.

### **Clinical Relevance**

This biomechanical study provides evidence to aid in surgical decision making by examining the effects of bipolar bone loss and soft-tissue reconstruction on shoulder stability.

[BACK](#)

## **Changes of Muscle Atrophy According to the Immediate Postoperative Time Point in Magnetic Resonance Imaging After Arthroscopic Rotator Cuff Repair**

Chris Hyunchul Jo, Ji Wan Park, Ji Sun Shin,

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### **Purpose**

The purpose of this study was to investigate changes of rotator cuff muscles after arthroscopic rotator cuff repair by measuring the muscle atrophy (MA) of rotator cuff muscles at the preoperative, immediate postoperative, and 1-year postoperative time points.

### **Methods**

Inclusion criteria were (1) arthroscopic rotator cuff repair of a full-thickness rotator cuff tear and (2) the presence of the preoperative (approximately 1 month before surgery), immediate postoperative (approximately 3 days after surgery), and 1-year postoperative magnetic resonance imaging (MRI) undertaken at our institution. Exclusion criteria were (1) the absence of any of the 3 MRIs, (2) isolated subscapularis repair, and (3) rotator cuff repair with margin convergence only. The MA was assessed with the modified tangent sign (TS), the occupation ratio (OR), and the cross-sectional areas (CSAs) of the supraspinatus and infraspinatus. Structural integrity was evaluated using Sugaya's classification. Measurements 1 year after surgery were compared with those of the preoperative and the immediate postoperative time points according to the integrity.

### **Results**

Seventy-seven patients were included in the study. The TS improved in 23.4% of patients and worsened in 6.5% with the preoperative baseline, while it improved in 5.2% of patients and worsened in 23.4% ( $P < .001$ ). The OR improved in 24.5% of patients but worsened in 3.9% with the preoperative baseline, while it improved in 13.0% and worsened in 11.7% patients ( $P < .001$ ). The CSAs of the supraspinatus and infraspinatus changed by  $8.7\% \pm 24.5\%$  and  $-0.3\% \pm 16.1\%$  with the preoperative baseline and by  $-12.8\% \pm 20.3\%$  and  $-10.5\% \pm 14.9\%$  with the immediate postoperative baseline (all  $P < .001$ ).

### **Conclusions**

The results of the study showed that changes of the MA after arthroscopic rotator cuff repair were different with respect to the baselines and the integrity. Generally, the MA measured with the immediate postoperative baseline worsened, whereas that measured with the preoperative baseline improved.

### **Level of Evidence**

Level III, retrospective comparative study.

[BACK](#)

## **Proximity of the Triangular Fibrocartilage Complex to Key Surrounding Structures and Safety Assessment of an Arthroscopic Repair Technique: A Cadaveric Study**

Marshall A. Kuremsky, Nahir Habet, Richard D. Peindl, R. Glenn Gaston,

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### **Purpose**

To quantify the distance of the dorsal ulnar sensory branch, floor of the extensor carpi ulnaris (ECU) subsheath, and ulnar neurovascular bundles from the triangular fibrocartilage complex (TFCC), and secondarily to assess the safety of an all-inside arthroscopic repair of the TFCC with a commonly used meniscal repair device with respect to the aforementioned structures.

### **Methods**

A custom K-wire with 1-mm gradation was used to determine the distance of at-risk structures from the periphery of the TFCC in 13 above-elbow human cadaver specimens. An all-inside repair of the TFCC at the location of a Palmer 1B tear was then performed using a commonly employed meniscal repair device. The distance from the deployed devices to the structure in closest proximity was then measured using digital calipers.

### **Results**

The mean distance from the deployed device to the nearest structure of concern for iatrogenic injury was 9.4 mm (range, 5-15 mm). The closest structure to iatrogenic injury was usually, but not always, the dorsal ulnar sensory nerve in 9 of 13 wrists (69.2%) at 9.3 mm (range, 5-15 mm); on 3 occasions it was instead the ulnar nerve (23.1%) at 9.5 mm (range, 9-10 mm), and on 1 occasion 6 mm from the flexor digitorum profundus to the little finger (7.7%). Forearm rotation had no significant effect on measured distances (ulnar nerve:  $P = .98$ ; dorsal sensory:  $P = .89$ ; ECU:  $P = .90$ ). The largest influence of forearm rotation was a 0.4-mm difference between pronation and supination with respect to the distance of the TFCC periphery on the ECU subsheath.

### **Conclusions**

An all-inside arthroscopic TFCC repair using a commonly used meniscal repair device appears safe with respect to nearby neurovascular structures and tendons under typical arthroscopic conditions.

### **Clinical Relevance**

An all-inside arthroscopic TFCC repair using a commonly employed meniscal repair device appears safe in terms of proximity to important structures although further clinical investigation is warranted.

[BACK](#)

# The True Recurrence Rate and Factors Predicting Recurrent Instability After Nonsurgical Management of Traumatic Primary Anterior Shoulder Dislocation: A Systematic Review

David N. Wasserstein, Ujash Sheth, Kristina Colbenson, Patrick D.G. Henry, Jaskarndip Chahal, Tim Dwyer, John E. Kuhn

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## Purpose

To (1) define the cumulative recurrence rate after primary anterior shoulder dislocation in Level I and II comparative studies and (2) to pool risk ratios for common risk factors to provide a clinically practical hierarchy of modifiable and nonmodifiable risk factors for recurrence.

## Methods

Level I and II prognostic studies were identified using the electronic databases CINAHL, Embase, and MEDLINE from inception to December 2014. Included studies ( $n = 15$ ) had recurrent dislocation as the main outcome, and a minimum 2-year follow-up. The cumulative odds ratio of prognostic factors was calculated where appropriate. Bias was assessed in each study using the Quality in Prognosis Studies (QUIPS) tool.

## Results

The reported rate of recurrence ranged from 19% to 88% (pooled overall = 21%; pooled Level I only = 47%). The pooled time to recurrence was 10.8 months (standard deviation 0.42). Male sex ( $n = 6$  studies) conferred a 2.68 (1.66-4.31;  $P < .001$ ) and patient age  $<20$  years ( $n = 4$  studies) conferred a 12.76 (5.77-28.2;  $P < .001$ ; vs  $>20$  years) increased odds of recurrence. An associated greater tuberosity fracture ( $n = 7$  studies) decreased the odds of recurrence by 3.8 times (2.94-5.00;  $P < .001$ ). The quality of evidence was moderate for age, low for sex, and very low for all other prognostic variables.

## Conclusions

The pooled rate of recurrence after primary anterior shoulder instability was found to be 21% among moderate- to high-quality prognostic studies. Male sex and younger age predicted a significantly higher risk of recurrent instability (approaching 80%), whereas concurrent fracture of the greater tuberosity significantly decreased the risk of subsequent recurrent dislocation. However, considering the quality of available evidence for these predictors, there remains a clear need for further high-quality prospective studies.

## Level of Evidence

Level II, systematic review of Level I and II prognostic studies.

[BACK](#)

**Outcomes After Arthroscopic Pancapsular Capsulorrhaphy With Suture Anchors for the Treatment of Multidirectional Glenohumeral Instability in Athletes**

M. Brett Raynor, Marilee P. Horan, Joshua A. Greenspoon, J. Christoph Katthagen, and Peter J. Millett

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<http://ajs.sagepub.com/content/44/12/3188.abstract>

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Background: Outcomes after arthroscopic pancapsular capsulorrhaphy (APC) with suture anchors for multidirectional instability (MDI) of the shoulder are not widely reported.

Purpose: To compare intraoperative findings and midterm outcomes of APC with suture anchors for MDI between female and male athletes and between a classic, atraumatic onset versus clinical onset of MDI after a traumatic event.

Study Design: Cohort study; Level of evidence, 3.

Methods: Patients who underwent APC with suture anchors for MDI and were at least 2 years out from surgery were included. Data were prospectively collected and retrospectively reviewed and included the onset of MDI, intraoperative pathoanatomic findings, level of sports participation, and patient satisfaction as well as the American Shoulder and Elbow Surgeons (ASES), Single Assessment Numeric Evaluation (SANE), Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH), and Short Form–12 Physical Component Summary (SF-12 PCS) scores. Information regarding shoulder instability and return to sport was collected, and Kaplan-Meier survivorship analysis was performed.

Results: Forty-one patients (45 shoulders; 25 male, 20 female), consecutively treated between October 2006 and January 2013, were included. The onset of MDI was atraumatic in 22 shoulders and traumatic in 23 shoulders. At surgery, 29 of 45 (64.4%) had labral detachment. Seven shoulders (16.7%) experienced instability episodes postoperatively, and 3 of these underwent revision surgery. The mean follow-up was 3.3 years (range, 2.0-6.6 years). All subjective outcome scores improved significantly from preoperative levels ( $P < .005$ ). At final follow-up, the mean ASES score was 92.0, and 76.7% (23/30) indicated that they had returned to sports participation equal to or slightly below their preinjury level. Kaplan-Meier analysis showed a survivorship rate of 87% at 3 years. Male patients were 2.3 times more likely to have a traumatic onset of instability (68% vs 30%, respectively;  $P = .017$ ) and were 2.1 times more likely to have concomitant lesions (84% vs 40%, respectively;  $P = .004$ ) than female patients. Furthermore, male patients demonstrated a higher mean postoperative ASES score than female patients ( $97.0 \pm 4.7$  vs  $85.5 \pm 16.4$ , respectively;  $P = .023$ ). Female patients were 6.9 times more likely to undergo an additional rotator interval closure (RIC) procedure (58% vs 4.7%, respectively;  $P < .001$ ) and to experience postoperative subluxations (40% vs 22%,



respectively;  $P = .035$ ) than male patients. A traumatic onset of MDI was associated with a higher mean postoperative ASES score ( $96.4 \pm 6.9$  vs  $87.0 \pm 15.7$ , respectively;  $P = .048$ ), higher median satisfaction score (10 vs 9, respectively;  $P = .029$ ), and higher return-to-sport rate (83% vs 44%, respectively;  $P = .030$ ) than an atraumatic onset.

Conclusion: APC with suture anchors can be an effective and safe treatment for patients with MDI. Labral tears were commonly found, even in patients with a classic, atraumatic onset. Male patients and patients with a traumatic onset of MDI had more favorable outcomes. Female patients may be more challenging to treat as they were more likely to undergo an additional RIC procedure and experience postoperative subluxations.

[BACK](#)

### **Arthroscopic Bankart Repair Versus Open Bristow-Latarjet for Shoulder Instability: A Matched-Pair Multicenter Study Focused on Return to Sport**

Davide Blonna, Enrico Bellato, Francesco Caranzano, Marco Assom, Roberto Rossi, and Filippo Castoldi

Am J Sports Med December 2016 44 3198-3205

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Background: The arthroscopic Bankart repair and open Bristow-Latarjet procedure are the 2 most commonly used techniques to treat recurrent shoulder instability.

Purpose: To compare in a case control–matched manner the 2 techniques, with particular emphasis on return to sport after surgery.

Study Design: Cohort study; Level of evidence, 3.

Methods: A study was conducted in 2 hospitals matching 60 patients with posttraumatic recurrent anterior shoulder instability with a minimum follow-up of 2 years (30 patients treated with arthroscopic Bankart procedure and 30 treated with open Bristow-Latarjet procedure). Patients with severe glenoid bone loss and revision surgeries were excluded. In one hospital, patients were treated with arthroscopic Bankart repair using anchors; in the other, patients underwent the Bristow-Latarjet procedure. Patients were matched according to age at surgery, type and level of sport practiced before shoulder instability (Degree of Shoulder Involvement in Sports [DOSIS] scale), and number of dislocations. The primary outcomes were return to sport (Subjective Patient Outcome for Return to Sports [SPORTS] score), rate of recurrent instability, Oxford Shoulder Instability Score (OSIS), Subjective Shoulder Value (SSV), Western Ontario Shoulder Instability Index (WOSI), and range of motion (ROM).

Results: After a mean follow-up of 5.3 years (range, 2-9 years), patients who underwent arthroscopic Bankart repair obtained better results in terms of return to sport (SPORTS score: 8

vs 6;  $P = .02$ ) and ROM in the throwing position ( $86^\circ$  vs  $79^\circ$ ;  $P = .01$ ), and they reported better subjective perception of the shoulder (SSV: 86% vs 75%;  $P = .02$ ). No differences were detectable using the OSIS or WOSI. The rate of recurrent instability was not statistically different between the 2 groups (Bankart repair 10% vs Bristow-Latarjet 0%;  $P = .25$ ), although the study may have been underpowered to detect a clinically important difference in this parameter. The multiple regression analysis showed that the independent variables associated with return to sport were preoperative DOSIS scale, type of surgery, and recurrent dislocations after surgery. Patients who played sports with high upper extremity involvement (eg, swimming, rugby, martial arts) at a competitive level (DOSIS scale 9 or 10) had a lower level of return to sport with both repair techniques.

Conclusion: Arthroscopic stabilization using anchors provided better return to sport and subjective perception of the shoulder compared with the open Bristow-Latarjet procedure in the population studied. Recurrence may be higher in the arthroscopic Bankart group; further study is needed on this point.

[BACK](#)

### **Survivorship and Patient-Reported Outcomes After Comprehensive Arthroscopic Management of Glenohumeral Osteoarthritis: Minimum 5-Year Follow-up**

Justin J. Mitchell, Marilee P. Horan, Joshua A. Greenspoon, Travis J. Menge, Dimitri S. Tahal, and Peter J. Millett

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Background: There are little data on midterm outcomes after the arthroscopic management of glenohumeral osteoarthritis (GHOA) in young active patients.

Purpose: To report outcomes and survivorship for the comprehensive arthroscopic management (CAM) procedure for the treatment of GHOA at a minimum of 5 years postoperatively.

Study Design: Case series; Level of evidence, 4.

Methods: The CAM procedure was performed on a consecutive series of 46 patients (49 shoulders) with advanced GHOA who met criteria for shoulder arthroplasty but instead opted for a joint-preserving, arthroscopic surgical option. The procedure included glenohumeral chondroplasty, capsular release, synovectomy, humeral osteoplasty, axillary nerve neurolysis, subacromial decompression, loose body removal, microfracture, and biceps tenodesis. Outcome measures included the American Shoulder and Elbow Surgeons (ASES), Single Assessment Numeric Evaluation (SANE), Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH), Short Form-12 (SF-12) Physical Component Summary (PCS), visual analog scale for pain, and

satisfaction scores. Kaplan-Meier survivorship analysis was performed with failure defined as progression to total shoulder arthroplasty (TSA).

Results: Forty-six consecutive patients (49 shoulders) who underwent a CAM procedure at a minimum of 5 years from surgery were included. Two patients were excluded for refusing to participate before study initiation. The mean age at surgery was 52 years (range, 27-68 years) in 15 women and 29 men. All patients were recreational athletes with 7 former collegiate or professional athletes. Twelve shoulders (26%) progressed to TSA at a mean of 2.6 years (range, 0.5-8.2 years). For survivorship analysis, the status of the shoulder (preservation of the native joint or progression to TSA) at a minimum of 5 years was known for 45 of 47 (96%) shoulders. Survivorship was 95.6% at 1 year, 86.7% at 3 years, and 76.9% at 5 years. For surviving shoulders, minimum 5-year subjective outcome data were available for 28 of 32 (87.5%) shoulders at a mean of 5.7 years (range, 5-8 years). The mean ( $\pm$ SD) ASES score was  $84.5 \pm 17$ , the mean SANE score was  $82 \pm 18$ , the mean QuickDASH score was  $15 \pm 13$ , the mean SF-12 PCS score was  $51.0 \pm 9.1$ , and median patient satisfaction was 9 of a possible 10 points.

Conclusion: This study demonstrates significant improvements in midterm clinical outcomes and high patient satisfaction after the arthroscopic CAM procedure for GHOA, with a 76.9% survivorship rate at a minimum of 5 years postoperatively. For patients looking for an alternative to TSA, the CAM procedure can provide reasonable outcomes and should be considered an effective procedure in appropriately selected, young active patients. Further studies are warranted to evaluate long-term outcomes and durability after this procedure.

[BACK](#)

## JBJS

### **Clinical Validation of the Glenoid Track Concept in Anterior Glenohumeral Instability**

James S. Shaha, MD; Jay B. Cook, MD; Douglas J. Rowles, MD; Craig R. Bottoni, MD; Steven H. Shaha, PhD, DBA; John M. Tokish, MD

*J Bone Joint Surg Am*, 2016 Nov 16; 98 (22): 1918 -1923

<http://jbjs.org/content/98/22/1918>

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**Background:** Glenoid and humeral bone loss are well-described risk factors for failure of arthroscopic shoulder stabilization. Recently, consideration of the interactions of these types of bone loss (bipolar bone loss) has been used to determine if a lesion is “on-track” or “off-track.” The purpose of this study was to study the relationship of the glenoid track to the outcomes of arthroscopic Bankart reconstructions.

**Methods:** Over a 2-year period, 57 shoulders that were treated with an isolated, primary arthroscopic Bankart reconstruction performed at a single facility were included in this study. The mean patient age was 25.5 years (range, 20 to 42 years) at the time of the surgical procedure, and the mean follow-up was 48.3 months (range, 23 to 58 months). Preoperative magnetic resonance imaging was used to determine glenoid bone loss and Hill-Sachs lesion size and location and to measure the glenoid track to classify the shoulders as on-track or off-track. Outcomes were assessed according to shoulder stability on examination and subjective outcome.

**Results:** There were 10 recurrences (18%). Of the 49 on-track patients, 4 (8%) had treatment that failed compared with 6 (75%) of 8 off-track patients ( $p = 0.0001$ ). Six (60%) of 10 patients with recurrence of instability were off-track compared with 2 (4%) of 47 patients in the stable group ( $p = 0.0001$ ). The positive predictive value of an off-track measurement was 75% compared with 44% for the predictive value of glenoid bone loss of  $>20\%$ .

**Conclusions:** The application of the glenoid track concept to our cohort was superior to using glenoid bone loss alone with regard to predicting postoperative stability. This method of assessment is encouraged as a routine part of the preoperative evaluation of all patients under consideration for arthroscopic anterior stabilization.

**Level of Evidence:** Therapeutic Level III. See Instructions for Authors for a complete description of levels of evidence

[BACK](#)

## The Relationship Between Shoulder Stiffness and Rotator Cuff Healing

A Study of 1,533 Consecutive Arthroscopic Rotator Cuff Repairs

William J. McNamara; Patrick H. Lam, PhD; George A.C. Murrell, MD, DPhil

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**Background:** Retear and stiffness are not uncommon outcomes of rotator cuff repair. The purpose of this study was to evaluate the relationship between rotator cuff repair healing and shoulder stiffness.

**Methods:** A total of 1,533 consecutive shoulders had an arthroscopic rotator cuff repair by a single surgeon. Patients assessed their shoulder stiffness using a Likert scale preoperatively and at 1, 6, 12, and 24 weeks (6 months) postoperatively, and examiners evaluated passive range of motion preoperatively and at 6, 12, and 24 weeks postoperatively. Repair integrity was determined by ultrasound evaluation at 6 months.

**Results:** After rotator cuff repair, there was an overall significant loss of patient-ranked and examiner-assessed shoulder motion at 6 weeks compared with preoperative measurements ( $p <$

0.0001), a partial recovery at 12 weeks, and a full recovery at 24 weeks. Shoulders that were stiff before surgery were more likely to be stiff at 6, 12, and, to a lesser extent, 24 weeks after surgery ( $r = 0.10$  to  $0.31$ ;  $p < 0.0001$ ). A stiffer shoulder at 6 and 12 weeks (but not 24 weeks) postoperatively correlated with better rotator cuff integrity at 6 months postoperatively ( $r = 0.11$  to  $0.18$ ;  $p < 0.001$ ). The retear rate of patients with  $\leq 20^\circ$  of external rotation at 6 weeks postoperatively was 7%, while the retear rate of patients with  $> 20^\circ$  of external rotation at 6 weeks was 15% ( $p < 0.001$ ).

**Conclusions:** In patients who developed stiffness after surgery, a rotator cuff repair was more likely to heal.

**Level of Evidence:** Therapeutic Level III. See Instructions for Authors for a complete description of levels of evidence.

[BACK](#)

## CORR

None

[BACK](#)

## BJJ

### **Anatomy of the terminal branch of the posterior circumflex humeral artery: Relevance to the deltopectoral approach to the shoulder**

C. D. Smith, S. J. Booker, H. S. Uppal, J. Kitson, T. D. Bunker

*Bone Joint J* 2016;98-B:1395–8. **DOI:** 10.1302/0301-620X.98B10.38011. 30 September 2016

<http://www.bjj.boneandjoint.org.uk/content/98-B/10/1395>

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**Aims** Despite the expansion of arthroscopic surgery of the shoulder, the open deltopectoral approach is increasingly used for the fixation of fractures and arthroplasty of the shoulder. The anatomy of the terminal branches of the posterior circumflex humeral artery (PCHA) has not been described before. We undertook an investigation to correct this omission.

**Patients and Methods** The vascular anatomy encountered during 100 consecutive elective deltopectoral approaches was recorded, and the common variants of the terminal branches of the PCHA are described.

**Results** In total, 92 patients (92%) had a terminal branch that crossed the space between the deltoid and the proximal humerus and which was therefore vulnerable to tearing or avulsion during the insertion of the blade of a retractor during the deltopectoral approach to the shoulder. In 75 patients (75%) there was a single vessel, in 16 (16%) a double vessel and in one a triple vessel.

**Conclusion** The relationship of these vessels to the landmark of the tendon of the insertion of pectoralis major into the proximal humerus is described. Damage to these previously undocumented branches can cause persistent bleeding leading to prolonged surgery and post-operative haematoma and infection, as well as poor visualisation during the procedure.

[BACK](#)

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## Lower extremity

### Arthroscopy

#### Two-Year Outcomes After Arthroscopic Lateral Meniscus Centralization

Hideyuki Koga, Takeshi Muneta, Toshifumi Watanabe, Tomoyuki Mochizuki, Masafumi Horie, Tomomasa Nakamura, Koji Otabe, Yusuke Nakagawa, Ichiro Sekiya

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#### **Purpose**

To evaluate clinical and radiographic outcomes of arthroscopic centralization for lateral meniscal extrusion.

#### **Methods**

Twenty-one patients who underwent arthroscopic centralization of the lateral meniscus were included. In cases with an extruded lateral meniscus (9 patients) or discoid meniscus (12 patients), the capsule at the margin between the midbody of the lateral meniscus and the capsule was sutured to the lateral edge of the lateral tibial plateau and centralized using suture anchors to reduce or prevent meniscal extrusion. Clinical outcomes included clinical examination findings, Lysholm score, Knee Injury and Osteoarthritis Outcome Score, and subjective rating scales regarding patient satisfaction and sports performance level. Radiographic outcomes included meniscal extrusion width (MEW) on magnetic resonance imaging and lateral joint space width on a standing 45° flexion posteroanterior view. All clinical and radiographic outcomes were reported pre-operatively and at 2 years post-operatively, whereas MEW was reported at 1 year; outcomes were compared with baseline.

#### **Results**

Clinical outcomes were significantly improved at 2 years postoperatively compared with baseline: Lysholm score (97 v 69,  $P < .0001$ ) and all subscores of the Knee Injury and Osteoarthritis Outcome Score except activities of daily living (pain, 89 v 72,  $P = .0010$ ; symptoms, 91 v 74,  $P = .0002$ ; activities of daily living, 94 v 89,  $P = .091$ ; sport and recreational function, 79 v 42,  $P = .0028$ ; and quality of life, 78 v 46,  $P = .0029$ ). Patient satisfaction (84 v 22,  $P < .0001$ ) and sports performance level (82 v 15,  $P < .0001$ ) were also improved. At 1 year, MEW was significantly reduced compared with baseline for both the extrusion group (1.0 mm v 5.0 mm,  $P < .0001$ ) and the discoid group (0.3 mm v 1.6 mm,  $P = .047$ ). Lateral joint space width increased at 2 years in the extrusion group (5.6 mm v 4.8 mm,  $P = .041$ ) and was maintained in the discoid group (5.5 mm v 5.4 mm).

#### **Conclusions**

Arthroscopic centralization of the lateral meniscus improved clinical and radiographic outcomes for meniscal extrusion as well as for discoid menisci at 2-year follow-up.

## **Level of Evidence**

Level IV, therapeutic case series.

[BACK](#)

## **Cross-cultural Adaptation and Validation of the Simplified Chinese Version of the Knee Outcome Survey Activities of Daily Living Scale**

Zhen-Yu Jia, Wei Wang, Xin-Wen Nian, Xiao-Xi Zhang, Zhi-ping Huang, Jin Cui, Wei-Dong Xu

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### **Purpose**

To perform a cross-cultural adaptation and translation of the original version of the Activities of Daily Living Scale of the Knee Outcome Survey into Simplified Chinese and validate of the Simplified Chinese version.

### **Methods**

The original version was translated and cross-culturally adapted into Simplified Chinese according to the guidelines and the recommendations of the American Academy of Orthopaedic Surgeons Outcome Committee. A total of 213 patients (96 male, 117 female) were selected to participate in our investigation. The inclusion criteria were as follows: 18 years of age and older, able to speak Chinese Mandarin and read Simplified Chinese, and referred to physical therapy for evaluation and treatment for a knee disorder. The exclusion criteria were as follows: patients who had disorders or impairments involving both knees, patients who had other conditions that could affect lower extremity function, patients with physical therapy related to the knee in the previous 1 month, and patients with psychological problems. Each participant was asked to complete the Knee Outcome Survey Activities of Daily Living Scale (KOS-ADLS), International Knee Documentation Committee Subjective Knee Form, Western Ontario and McMaster Universities Osteoarthritis Index, and Short Form 36 forms and to provide baseline demographic data. Each participant completed the KOS-ADLS twice on 2 nonconsecutive days for reliability evaluation. A portion of the participants ( $n = 161$ ) finished the KOS-ADLS a third time 4 weeks after physical treatment to test responsiveness.

### **Results**

The original version of the KOS-ADLS was well adapted and translated into Simplified Chinese. Simplified Chinese of KOS-ADLS was shown to have good internal consistency (Cronbach's  $\alpha = 0.855$  to  $0.929$ ), great test-retest reliability (intraclass correlation coefficient =  $0.935$  to  $0.961$ ), high construct validity as we hypothesized (significant correlations with Short Form 36 subscales, Western Ontario and McMaster Universities Osteoarthritis Index, and International Knee Documentation Committee Subjective Knee Form), and high responsiveness (standard response means =  $0.97$  to  $1.23$ , standard effect size =  $0.81$  to  $0.91$ ).



## **Conclusions**

Simplified Chinese of KOS-ADLS was shown to have good reliability, validity, and responsiveness for use in patients with knee disorders in China.

## **Level of Evidence**

Level II, testing of previously developed diagnostic criteria in a series of consecutive patients with universally applied gold standard.

[BACK](#)

## **Isometric Characteristics of the Anterolateral Ligament of the Knee: A Cadaveric Navigation Study**

Pierre Imbert, Christian Lutz, Matthew Daggett, Lucas Niglis, Benjamin Freychet, François Dalmay, Bertrand Sonnery-Cottet

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### **Purpose**

To measure the variations in length during flexion and internal tibial rotation of the 3 different femoral insertions of the anterolateral ligament (ALL) while maintaining a fixed tibia insertion.

### **Methods**

Twelve fresh-frozen cadaver knees were analyzed using a navigation system. Maximal distance variations of the 3 different anatomic femoral insertions of the ALL were measured during knee flexion and internal tibial rotation at 20° (IR20°) and 90° (IR90°). The 3 different femoral attachments were, as published, at the center of the lateral epicondyle, distal and anterior from this position, and proximal and posterior. Each of these 3 femoral insertions was coupled to the same tibial insertion at the tibial margin, halfway between the tip of the fibular head and the prominence of the Gerdy tubercle.

### **Results**

During IR20°, variation in the distance between paired points is not different between the proximal-posterior, epicondyle, and distal-anterior femoral insertions. These variations were statistically different during IR90° for the 3 different femoral locations. In increasing degrees of flexion, there was a length decrease between paired points observed with the proximal-posterior position. A length increase was observed for both the epicondyle location and the distal-anterior location.

### **Conclusions**

The ALL did not reveal an isometric behavior at any of the femoral insertion locations but had different length change patterns during knee flexion and internal tibial rotation at 90°. The proximal and posterior to epicondyle femoral position is the only position with a favorable isometry, as shown by being tight in extension and in internal rotation at 20° and then relaxed when the knee goes to flexion at 120° and during internal rotation at 90°.

## **Clinical Relevance**

Clinical relevance is significant with respect to optimizing the femoral position of an ALL reconstruction.

[BACK](#)

## **Effects of Multiple Intra-articular Injections of 0.5% Bupivacaine on Normal and Osteoarthritic Joints in Rats**

Koji Iwasaki, Hideki Sudo, Yasuhiko Kasahara, Katsuhisa Yamada, Takashi Ohnishi, Takeru Tsujimoto, Norimasa Iwasaki

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### **Purpose**

To determine the in vivo effects of multiple local anesthetic injections of 0.5% bupivacaine on normal and osteoarthritic articular cartilage.

### **Methods**

Rats with normal knee joints received an intra-articular injection of 0.9% saline solution or 0.5% bupivacaine in their right knees joint once a week for 5 consecutive weeks, starting 4 weeks after the beginning of the experiment. Rats were humanely killed at 8, 16, and 24 weeks. In a parallel experiment, rats underwent anterior cruciate ligament transection to induce osteoarthritic changes. These rats were subjected to the same protocol as those with normal knee joints, starting 4 weeks after the procedure. Static weight-bearing tests were performed on both hind limbs to evaluate changes in weight-bearing ability throughout the experiments. Rats were humanely killed at 8 and 16 weeks. Cell viability was assessed with confocal microscopy, using samples from the distal femur. Histologic assessment of osteoarthritis was performed using samples from the tibial plateau based on the Osteoarthritis Research Society International (OARSI) cartilage histopathology assessment system (i.e., OARSI score).

### **Results**

Static weight-bearing tests showed no significant changes after intra-articular injection of saline solution or bupivacaine, and bupivacaine injection did not increase weight bearing compared with saline solution injection, regardless of whether there were osteoarthritic changes. There were also no significant differences in cell viability, cell density, or OARSI scores between the saline solution and bupivacaine groups at each time point, regardless of whether osteoarthritic changes were induced.

### **Conclusions**

This study suggested that single or intermittent intra-articular bupivacaine injections might not have deleterious effects on either osteoarthritic or normal joints.

### **Clinical Relevance**

There is no strong evidence that intra-articular bupivacaine injection induces degenerative

changes in articular cartilage. Therefore, these results may apply to normal and osteoarthritic joints.

[BACK](#)

## **Combined Intra-articular and Extra-articular Reconstruction in Anterior Cruciate Ligament–Deficient Knee: 25 Years Later**

Andrea Ferretti, Edoardo Monaco, Antonio Ponzo, Luca Basiglini, Raffaele Iorio, Ludovico Caperna, Fabio Conteduca

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### **Purpose**

To determine whether an anterior cruciate ligament (ACL)–reconstructed knee with hamstring autograft has a greater incidence of degenerative changes when an extra-articular reconstruction is added and to determine the effect of the combined reconstruction on knee stability and function at long-term follow-up.

### **Methods**

For this retrospective study, patients who underwent ACL reconstruction between January 2002 and December 2003 were selected and classified into 2 groups, I and II. Group I consisted of patients operated by a standard ACL reconstruction, and group II consisted of patients in whom, owing to the presence of risk factors (severe pivot shift graded +++ or high-risk sports), an extra-articular reconstruction performed with ileo-tibial tract according to McIntosh as modified by Cocker Arnold technique, was used in conjunction with intra-articular ACL reconstruction. At final follow-up, Lysholm, International Knee Documentation Committee (IKDC), and Tegner scores were used. An arthrometric KT-1000 evaluation was done. Comparative weight-bearing radiographs were taken, including a skyline view for the patellofemoral joint and analyzed according to Fairbank, Kellgren, and IKDC classification.

### **Results**

Seventy-two of the 75 (96%) patients in group I and 68 of the 75 patients in group II were available at the final follow-up (minimum 10 years). Subjective scores improved significantly in both groups, with no significant difference. Objectively, the number of patients receiving C and D IKDC objective activity scores in group I (7/56; 12.5%) was significantly higher than in group II (0/60) ( $P = .01$ ). Considering as a failure a side-to-side arthrometric difference more than 5 mm or a pivot shift test graded as ++ or +++, or any giving way episode occurring postoperatively, we found 8 cases in group I and no cases in group II ( $P = .01$ ) despite the presence of risk factors that group I did not include. Radiologic evaluation showed less arthritic changes in group II in both tibiofemoral and patellofemoral joints.

### **Conclusions**

On the basis of the results of this study, adding an extra-articular reconstruction to an anatomically placed intra-articular ACL reconstruction, followed by a modern rehabilitation protocol, does not increase the risk of osteoarthritis and may be able to reduce the rate of failure.

### **Level of Evidence**

Level III, retrospective comparative study.

[BACK](#)

## **Biomechanical Evaluation of an Adjustable Loop Suspensory Anterior Cruciate Ligament Reconstruction Fixation Device: The Value of Retensioning and Knot Tying**

Benjamin C. Noonan, Joshua S. Dines, Answorth A. Allen, David W. Altchek, Asheesh Bedi

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### **Purpose**

To evaluate the effects of retensioning and knot tying on the biomechanical properties of an adjustable loop anterior cruciate ligament (ACL) reconstruction device.

### **Methods**

Testing consisted of 3 phases, which used both adjustable loop devices (ALD) and closed loop devices (CLD) tested under cyclic loading to 4,500 cycles. Phase 1 consisted of implant-only testing using cyclic loading from 50 to 250 N. Phase 2 used relatively unloaded cyclic loading of 10 to 250 N. Phase 3 used a tendon/bone/implant model. Subsets of the ALD implants were subjected to isolated retensioning, isolated knot tying, or a combination of both to allow for independent examination of these interventions.

### **Results**

In phase 1, retensioning and knot tying reduced final ALD elongation by 60% (0.38 v 0.96 mm;  $P = .00004$ ). In phase 2, retensioning and knot tying reduced final ALD elongation by 88% (0.51 v 4.22 mm,  $P = .014$ ). In phase 3, retensioning and knot tying reduced final ALD elongation by 45% (1.5 v 2.7 mm;  $P = .001$ ), which was half of the elongation of the CLD (3.0 mm;  $P = .0007$ ).

### **Conclusions**

The ALD did demonstrate an increase in cyclic elongation as compared with the CLD during both extended loading conditions. The phase 1 ALD elongation (0.96 mm), while statistically greater than the CLD (0.52 mm), was likely not of clinical importance. However, the ALD elongation in phase 2 (4.22 mm) could be of clinical concern. Both of these increased elongations were eliminated by retensioning and knot tying. Furthermore, when evaluating in a graft-femur construct, retensioning and knot tying of the ALD reduced final cyclic elongation by 50% when compared with CLD.

### **Clinical Relevance**

Retensioning and knot tying after initial reduction of the tendon graft with an adjustable loop ACL fixation device may help to further reduce concerns of loop slippage and displacement with cyclic loading during postoperative rehabilitation.

[BACK](#)

## **Visibility of Anterolateral Ligament Tears in Anterior Cruciate Ligament–Deficient Knees With Standard 1.5-Tesla Magnetic Resonance Imaging**

David E. Hartigan, Kevin W. Carroll, Frank J. Kosarek, Dana P. Piasecki, James F. Fleischli, Donald F. D'Alessandro

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<http://dx.doi.org/10.1016/j.arthro.2016.02.012>

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### **Purpose**

To attempt to visualize the ligament with standard 1.5-tesla magnetic resonance imaging (MRI) in the acute anterior cruciate ligament (ACL)–torn knee, and if it is visible, attempt to characterize it as torn or intact at its femoral, meniscal, and tibial attachment sites.

### **Methods**

This was a retrospective MRI study based on arthroscopic findings of a known ACL tear in 72 patients between the years 2006 and 2010. Patients all had hamstring ACL reconstructions, no concomitant lateral collateral ligament, or posterolateral corner injury based on imaging and physical examination, and had a preoperative 1.5-tesla MRI scan with standard sequences performed within 3 weeks of the injury. Two fellowship-trained musculoskeletal radiologists retrospectively reviewed the preoperative MRI for visualization of the anterolateral ligament (ALL) for concomitant tears. Inter- and intraobserver reliability was calculated. Learning effect was analyzed to determine if radiologists' agreement improved as reads progressed.

### **Results**

Both radiologists were able to visualize the ALL in 100% of the scans. Overall, ALL tears were noted in 26% by radiologist 1 and in 62% by radiologist 2. The agreement between the ligament being torn or not had a kappa of 0.54 between radiologists. The agreements in torn or not torn between radiologists in the femoral, meniscal, and tibial sites were 0.14, 0.15, and 0.31. The intraobserver reliability by radiologist 1 for femoral, meniscal, and tibial tears was 0.04, 0.57, and 0.54 respectively. For radiologist 2, they were 0.75, 0.61, and 0.55. There was no learning effect noted.

### **Conclusions**

ALL tears are currently unable to be reliably identified as torn or intact on standard 1.5-tesla MRI sequences. Proper imaging sequences are of crucial importance to reliably follow these tears to determine their clinical significance.

## Level of Evidence

Level IV, therapeutic case series study.

[BACK](#)

## Biomechanical Strength and Elongation of the T-Block Modification for Bone–Patella Tendon–Bone Allografts

Michael A. Nasert, Alan Barber

October 2016 Volume 32, Issue 10, Pages 2066–2071

<http://dx.doi.org/10.1016/j.arthro.2016.02.014>

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### Purpose

To assess the biomechanical performance of 2 different T-block modifications of bone–patella tendon–bone (BPTB) allografts.

### Methods

The matched knee pairs from 10 human cadavers (mean age 49 years) were fashioned into 30 BPTB allografts and divided into 3 groups (10 each): group 1, standard patella tendon-tibial attachment; group 2, T-block tibial attachment with 10 mm of unattached bone proximal to the patella tendon insertion with 15 mm of tendon attached; group 3, T-block tibial attachment with 15 mm of unattached bone proximal to the patella tendon insertion and 10 mm of tendon attached. A biocomposite interference screw secured each graft into a 10-mm tunnel in 15 pcf polyurethane foam. A 10-N preload was applied followed by 500 cycles of 10- to 150-N loading at 0.5 Hz. Grafts completing cyclic loading were destructively tested at 200 mm/min. Failure load, stiffness, elongation, and failure mode were recorded.

### Results

Failure loads and elongation for groups 1, 2, and 3 (790, 729, and 700 N; 0.15, 0.16, and 0.19 mm, respectively) were not statistically different ( $P > .1$ ). Graft stiffness for groups 1 and 2 (214 and 186 N/mm) were not statistically different, but group 3 (170 N/mm) was different from group 1. All group 1 and 2 tests failed by graft pullout as did 8 of 10 from group 3. The other 2 failed by tendon tearing from bone.

### Conclusions

A T-block BPTB allograft harvested with 10 or 15 mm of unattached bone proximal to the tibial patella tendon insertion has no ultimate failure strength difference after cyclic loading compared with the standard BPTB allograft. The 15-mm T-block showed lower stiffness and more elongation at failure than the standard BPTB allograft whereas the 10-mm T-block exhibited comparable stiffness and elongation measurements to the standard BPTB allograft control specimens.

### Clinical Relevance

The T-block BPTB allograft construct should increase the availability of BPTB allografts for anterior cruciate ligament reconstruction and facilitate the use of grafts possessing longer tendon

segments that are currently being discarded.

[BACK](#)

## **Comparative Study of Opening-Wedge High Tibial Osteotomy With and Without a Combined Computed Tomography–Based and Image-Free Navigation System**

Yasushi Akamatsu, Hideo Kobayashi, Yoshihiro Kusayama, Ken Kumagai, Tomoyuki Saito

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### **Purpose**

To assess whether a combined computed tomography (CT)–based and image-free navigation system results in better coronal and sagittal alignment than the conventional method for performing opening-wedge high tibial osteotomy (OWHTO) and whether CT-based navigation results in acquisition of an accurate osteotomy plane.

### **Methods**

Sixty-two consecutive knees were randomly divided into navigated and conventional groups. The intraoperative correction angle was determined by the change in hip-knee-ankle angle in the navigated group and by the predicted medial opening width in the conventional group. Outliers of femorotibial angle (FTA) and tibial posterior slope (TPS) were defined as angles of  $>175^\circ$  or  $<165^\circ$  and angles of  $>2.5^\circ$  or  $<-2.5^\circ$ , respectively. Radiographic and clinical data were compared between the 2 groups at 2 years postoperatively.

### **Results**

Mean postoperative FTAs were  $168.5^\circ$  in the navigated group and  $168.1^\circ$  in the conventional group. Mean change in TPS of  $-0.2^\circ$  in the navigated group was significantly lower than that of  $1.6^\circ$  in the conventional group ( $P = .005$ ). On postoperative CT, mean angle between the tibial plateau and osteotomy planes in the sagittal plane showed a significantly higher anterior opening of  $12^\circ$  in the conventional than in the navigated group ( $P < .001$ ). There was a significantly greater proportion of TPS outliers in the conventional (51.6%) than in the navigated group (12.9%) ( $P = .001$ ), and a significantly greater proportion within the normal range in both planes in the navigated (74.2%) than in the conventional group (48.4%) ( $P = .037$ ).

### **Conclusions**

Combined CT-based and image-free navigation in OWHTO better preserves the original TPS and more frequently restores normal coronal and sagittal plane knee joint alignment. CT-based navigation also enabled acquisition of our target osteotomy plane in the sagittal plan. The navigation system in OWHTO was helpful for simultaneous control of the alignment in 2 planes.

### **Level of Evidence**

Level II, lesser-quality prospective randomized trial.

[BACK](#)

## **Assessment of Quality and Content of Online Information About Hip Arthroscopy**

Bridget Ellsworth, Hiren Patel, Atul F. Kamath

October 2016 Volume 32, Issue 10, Pages 2082–2089

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### **Purpose**

The purpose of this study was to assess the quality of information available to patients on the Internet when using popular search engines to search the term “hip arthroscopy.”

### **Methods**

We analyzed the quality and content of information about hip arthroscopy (HA) on the first 50 websites returned by the search engines Google and Bing for the search term “hip arthroscopy.” The sites were categorized by type, and quality and content were measured using the DISCERN score, along with an HA-specific content score. The HA-specific content score was used to assess each website for the presence or absence of 19 topics about HA determined to be important for a patient seeking information about the procedure. The Health on the Net Code (HONcode) status of each website was also noted.

### **Results**

The mean DISCERN score for all websites analyzed was 39.5, considered “poor,” while only 44.6% of sites were considered “fair” or “good.” Governmental and nonprofit organization (NPO) websites had the highest average DISCERN score. The mean HA-specific content score was 8.6 (range, 2 to 16). The commercial website category had the highest average HA-specific content score, followed by the governmental and NPO category. Sites that bore the HONcode certification obtained significantly higher DISCERN scores than those without the certification ( $P = .0032$ ) but did not obtain significantly higher HA-specific content scores.

### **Conclusions**

“Hip arthroscopy” is a fairly general term, and there is significant variability in the quality of HA information available online. The HONcode is useful to identify quality patient information websites; however, it is not commonly used in HA-specific websites and does not encompass all quality websites about HA.

### **Clinical Relevance**

This study increases awareness of the quality of information on HA available online.

[BACK](#)

## **Arthroscopic Central Acetabular Decompression: Clinical Outcomes at Minimum 2-Year Follow-up Using a Matched-Pair Analysis**



Parth Lodhia, Chengcheng Gui, Timothy J. Martin, Sivashankar Chandrasekaran, Carlos Suárez-Ahedo, John P. Walsh, Benjamin G. Domb

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### **Purpose**

To assess 2-year clinical outcomes of patients who underwent hip arthroscopy for central acetabular osteophytes (CAO) treated with central acetabular decompression (CAD), and to compare these outcomes with those of a matched control group.

### **Methods**

Data were prospectively gathered for patients undergoing CAD during hip arthroscopy from February 2008 to July 2012. All patients were assessed pre- and postoperatively at 3 months, 1 year, and 2 years with modified Harris Hip Score, Non-Arthritic Hip Score, Hip Outcome Score-Activities of Daily Living, Hip Outcome Score-Sport-Specific Subscale, and visual analog scale (VAS) for pain. Patient satisfaction (0 to 10) was collected. A matched control group of patients without CAOs who did not undergo CAD was selected on a 1:3 ratio.

### **Results**

Forty-nine hips were included in the CAD group and 147 in the control group. The mean change in patient-reported outcome (PRO) scores at 2-year follow-up in the CAD group for modified Harris Hip Score, Hip Outcome Score-Activities of Daily Living, Hip Outcome Score-Sport-Specific Subscale, Non-Arthritic Hip Score, and VAS was 11.0, 19.6, 15.2, 21.4, and -2, respectively. The mean change in PRO scores at 2-year follow-up in the control group was 17.0, 19.8, 24.0, 20.9, and -2.75, respectively. All improvements in PRO scores for both groups were statistically significant compared with the data collected preoperatively ( $P < .001$ ). There was no statistically significant difference in postoperative PRO scores and VAS between the groups. Postoperative patient satisfaction at the latest follow-up was 7.14 and 7.60 for CAD and control groups, respectively.

### **Conclusions**

This study showed that patients with a CAO treated with CAD during hip arthroscopy had favorable outcomes at minimum 2 years postoperatively. Furthermore, the study group showed similar PRO scores and VAS to the control group. We conclude that CAD is a viable treatment option for CAO, yielding clinical improvement at short-term follow-up.

### **Level of Evidence**

Level III, prospective comparative study.

[BACK](#)

## Cyclists Have Greater Chondromalacia Index Than Age-Matched Controls at the Time of Hip Arthroscopy

Austin V. Stone, Elizabeth A. Howse, Sandeep Mannava, Allston J. Stubbs

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### Purpose

To evaluate the clinical symptoms and intraoperative pathology associated with hip pain in the cyclist compared with a matched hip arthroscopy surgical group.

### Methods

In an institutional review board–approved study, we retrospectively reviewed a prospective database of 1,200 consecutive hip arthroscopy patients from 2008 to 2015. Adult patients were identified who reported cycling as a major component of their activity. Patients were age, gender, and body mass index matched to a control, noncycling group. Pain symptoms, preoperative examinations, radiographic and operative findings were compared. Primary outcome variables included the femoral and acetabular Outerbridge chondromalacia grade. Additional outcome measurements included the involved area and the chondromalacia index (CMI; the product of the Outerbridge chondromalacia grade and surface area [ $\text{mm}^2 \times \text{severity}$ ]).

### Results

A total of 167 noncyclists were matched to the cycling group ( $n = 16$ ). Cyclists had significantly greater femoral head chondromalacia grade (2.0 [95% confidence interval (CI), 1.5-2.5] v 1.4 [95% CI, 1.3-1.6],  $P = .043$ ), femoral head chondromalacia area ( $242 \text{ mm}^2$  [95% CI, 191-293  $\text{mm}^2$ ] v  $128 \text{ mm}^2$  [95% CI, 113-141  $\text{mm}^2$ ],  $P < .001$ ), and femoral head CMI (486 [95% CI, 358-615] v 247 [95% CI, 208-286],  $P = .001$ ) assessed intraoperatively. Hip pain in cyclists positively correlated with an increased acetabular center-edge angle ( $R = 0.261$ ,  $P < .001$ ) and an increased Tonnis grade ( $R = 0.305$ ,  $P < .001$ ). Cyclists were also more likely to have a coxalgic gait on physical examination ( $R = 0.250$ ,  $P = .006$ ).

### Conclusions

Cyclists had a greater degree of femoral chondromalacia than a matched group of noncyclists. Cycling activity positively correlated with the presence of femoral chondromalacia with clinically significant gait alterations. These data support the hypothesis that cyclists with hip pain have more chondral pathology than a similar group of other patients with hip pain. Ultimately, cyclists with hip pain should be identified as higher risk for more advanced chondral damage.

### Level of Evidence

Level III, case-control study, therapeutic.

[BACK](#)

## **The Effect of Different Bone Marrow Stimulation Techniques on Human Talar Subchondral Bone: A Micro-Computed Tomography Evaluation**

Arianna L. Gianakos, Youichi Yasui, Ethan J. Fraser, Keir A. Ross, Marcelo P. Prado, Lisa A. Fortier, John G. Kennedy

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### **Purpose**

To evaluate morphological alterations, microarchitectural disturbances, and the extent of bone marrow access to the subchondral bone marrow compartment using micro-computed tomography analysis in different bone marrow stimulation (BMS) techniques.

### **Methods**

Nine zones in a 3 × 3 grid pattern were assigned to 5 cadaveric talar dome articular surfaces. A 1.00-mm microfracture awl (s.MFX), a 2.00-mm standard microfracture awl (I.MFX), or a 1.25-mm Kirschner wire (K-wire) drill hole was used to penetrate the subchondral bone in each grid zone. Subchondral bone holes and adjacent tissue areas were assessed by micro-computed tomography to analyze adjacent bone area destruction and communicating channels to the bone marrow. Grades 1 to 3 were assigned, where 1 = minimal compression/sclerosis; 2 = moderate compression/sclerosis; 3 = severe compression/sclerosis. Bone volume/total tissue volume, bone surface area/bone volume, trabecular thickness, and trabecular number were calculated in the region of interest.

### **Results**

Visual assessment revealed that the s.MFX had significantly more grade 1 holes ( $P < .001$ ) and that the I.MFX had significantly more poor/grade 3 holes ( $P = .002$ ). Bone marrow channel assessment showed a statistically significant increase in the number of channels in the s.MFX when compared with both K-wire and I.MFX holes ( $P < .001$ ). Bone volume fraction for the s.MFX was significantly less than that of the I.MFX ( $P = .029$ ).

### **Conclusions**

BMS techniques using instruments with larger diameters resulted in increased trabecular compaction and sclerosis in areas adjacent to the defect. K-wire and I.MFX techniques resulted in less open communicating bone marrow channels, denoting a reduction in bone marrow access. The results of this study indicate that BMS using larger diameter devices results in greater microarchitecture disturbances.

[BACK](#)

## **Osteochondral Autograft Transfer Versus Microfracture in the Knee: A Meta-analysis of Prospective Comparative Studies at Midterm**

Ayoosh Pareek, Patrick J. Reardon, Jeffrey A. Macalena, Bruce A. Levy, Michael J. Stuart, Riley J. Williams III, Aaron J. Krych

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### **Purpose**

To compare microfracture (MFX) and osteochondral autograft transfer (OAT) surgical techniques to determine (1) postoperative activity level, (2) subjective patient outcomes, (3) failure rates, and (4) assess if any lesion characteristics favored one technique over the other.

### **Methods**

A comprehensive review of literature was performed of all studies comparing MFX and OAT. Studies included were all prospective studies that reported on activity-based outcome measures such as Tegner activity scores and subjective outcomes such as the International Knee Documentation Committee score. Failure rates, as determined by the publishing authors, were recorded for each study. Meta-analyses were conducted using a random-effects model. Paired standardized mean differences (Hedges's *g* to account for small sample bias) were used for continuous outcome measures, and risk ratios (Mantel-Haenszel method for small sample bias) for dichotomous outcome measures.

### **Results**

Six prospective studies satisfied the eligibility criteria and included 249 patients (186 male, 120 female) with an average age of 26.4 years and follow-up of 67.2 months. Tegner scores were superior in patients treated with OAT compared with MFX ( $\Delta$ OAT-MFX for pre-post scores = 0.94 Tegner points, standardized mean difference [SMD] = 0.469,  $P = .005$ ). Failure rates of MFX were higher than OAT (OAT = 11%, MFX = 32%, risk ratio = 2.42,  $P < .036$ ). OAT was superior to MFX at 3 years in relation to subjective outcome scores (SMD = 0.404,  $P = .008$ ). When assessing OAT lesions larger than 3 cm<sup>2</sup>, OAT was superior to MFX with respect to activity level (SMD = 0.506,  $P = .001$ ).

### **Conclusions**

OAT may achieve higher activity levels and lower risk of failure when compared with MFX for cartilage lesions greater than 3 cm<sup>2</sup> in the knee, although there was no significant difference for lesions less than 3 cm<sup>2</sup> at midterm. However, because of variability in patient-specific factors such as age, preinjury activity level, lesion location and size, the superiority of OAT over MFX cannot be generalized to all patient populations and therefore requires individualized patient care.

### **Level of Evidence**

Level II, meta-analysis of Level I and II studies.

[BACK](#)

## **Comprehensiveness of Outcome Reporting in Studies of Articular Cartilage Defects of the Knee**

Eric C. Makhni, Maximilian A. Meyer, Bryan M. Saltzman, Brian J. Cole

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### **Purpose**

To assess the comprehensiveness of outcome reporting after treatment of focal articular cartilage defects in the knee.

### **Methods**

A systematic review of literature published over the past 5 years (October 2010 to October 2015) in 5 high-impact orthopaedic journals was completed to identify all recent clinical studies tracking outcomes after surgery for focal articular cartilage defects in the knee. A metric reporting score was calculated for each study, according to reporting of 6 cardinal domains: pain, satisfaction, osteoarthritis progression, subjective knee function, objective knee function, and patient-reported outcomes.

### **Results**

Of the 122 studies included for review, 117 (96%) tracked patient-reported outcomes during follow-up. Nearly two-thirds of studies (63%) monitored progression of osteoarthritis at follow-up. Fewer than half of studies (39%) specifically monitored pain outcomes in patients. One-third of studies (30%) tracked patient satisfaction. Only 21% of studies monitored subjective knee function using proxies such as return to play, and only 17% of studies reported on objective knee function during return visits to the clinic. The average metric reporting score of all studies was 2.6, and nearly half of studies (48%) reported on only 1 or 2 domains of interest.

### **Conclusions**

There is substantial variability in outcome reporting after cartilage surgery in high-impact orthopaedic journals. Furthermore, most studies do not comprehensively track outcomes across domains. Both factors hinder comparison of results across studies. Future outcome metrics should focus on patient-centered factors to improve both accuracy of results reporting and standardization across studies.

### **Level of Evidence**

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

[BACK](#)

## **Distal Femoral Osteotomy for the Valgus Knee: Medial Closing Wedge Versus Lateral Opening Wedge: A Systematic Review**

James D. Wylie, Daniel L. Jones, Melissa K. Hartley, Ashley L. Kapron, Aaron J. Krych, Stephen K. Aoki, Travis G. Maak

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### **Purpose**

(1) To determine the radiographic correction/healing rate, patient-reported outcomes, reoperation rate, and complication rate after distal femoral osteotomy (DFO) for the valgus knee with lateral compartment pathology. (2) To summarize the reported results of medial closing wedge and lateral opening wedge DFO.

### **Methods**

We conducted a systematic review of PubMed, MEDLINE, and CINAHL to identify studies reporting outcomes of DFOs for the valgus knee. Keywords included “distal femoral osteotomy,” “chondral,” “cartilage,” “valgus,” “joint restoration,” “joint preservation,” “arthritis,” and “gonarthrosis.” Two authors first reviewed the articles; our study exclusion criteria were then applied, and the articles were included on the basis relevance defined by the aforementioned criteria. The Methodological Index for Nonrandomized Studies scale judged the quality of the literature. Sixteen studies were relevant to the research questions out of 191 studies identified by the original search.

### **Results**

Sixteen studies were identified reporting on 372 osteotomies with mean follow-up of 45 to 180 months. All studies reported mean radiographic correction to a near neutral mechanical axis, with 3.2% nonunion and 3.8% delayed union rates. There was a 9% complication rate and a 34% reoperation rate, of which 15% were converted to arthroplasty. There were similar results reported for medial closing wedge and lateral opening wedge techniques, with a higher conversion to arthroplasty in the medial closing wedge that was confounded by longer mean follow-up in this group (mean follow-up 100 v 58 months).

### **Conclusions**

DFOs for the valgus knee with lateral compartment disease provide improvements in patient-reported knee health–related quality of life at midterm follow-up but have high rates of reoperation. No evidence exists proving better results of either the lateral opening wedge or medial closing wedge techniques.

### **Level of Evidence**

Level IV, systematic review of Level IV studies.

[BACK](#)

## **Outcomes and Risk Factors of Rerevision Anterior Cruciate Ligament Reconstruction: A Systematic Review**

Daniel J. Liechti, Jorge Chahla, Chase S. Dean, Justin J. Mitchell, Erik Slette, Travis J. Menge, Robert F. LaPrade

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### **Purpose**

The purpose of this study was to systematically review the literature on rerevision anterior cruciate ligament (ACL) reconstruction, focusing on patient outcomes. The secondary aims of this study were to (1) identify risk factors that contribute to multiple ACL reconstruction failures (defined as a complete tear of a revision ACL graft with knee instability) and (2) assess concomitant knee injuries, such as articular cartilage and menisci lesions.

### **Methods**

A systematic review of the literature was performed. Inclusion criteria were as follows: outcomes of rerevision ACL reconstruction, English language, minimum of 2 years of follow-up, and human studies. We excluded cadaveric studies, animal studies, basic science articles, editorial articles, surgical technique descriptions, surveys, and rerevision ACL articles in which rerevision reconstruction subgroups were not reported independently of first-time ACL revision groups.

### **Results**

Six studies met the inclusion criteria and were considered for review. One was a case-control study (Level III evidence), and 5 studies were case series (Level IV evidence). Compared with preoperative scores, patient outcomes improved after rerevision ACL reconstruction. However, more meniscal and cartilage pathologies were present in rerevision cases compared with after primary and revision ACL reconstruction.

### **Conclusions**

Although rerevision ACL reconstruction can restore stability and improve functional outcomes compared with the preoperative state, outcomes remained inferior when compared with primary ACL reconstructions, particularly regarding a patient's ability to return to his or her preinjury level of activity. Additional factors that place increased stress on the ACL graft, such as increased posterior tibial sagittal plane slope or undiagnosed concomitant ligament injuries, should be investigated, especially in atraumatic failures. If present, operative treatment of these factors should be considered.

### **Level of Evidence**

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

[BACK](#)

## **Long-term Outcomes After Osteochondral Allograft: A Systematic Review at Long-term Follow-up of 12.3 Years**

Andrew T. Assenmacher, Ayoosh Pareek, Patrick J. Reardon, Jeffrey A. Macalena, Michael J. Stuart, Aaron J. Krych

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### **Purpose**

To (1) evaluate long-term outcomes of osteochondral allograft (OCA) with regard to clinical outcome scores, reoperation and failure rates, and (2) examine if certain factors predispose patients to worse outcomes.

### **Methods**

A comprehensive review was performed with specific inclusion criteria for studies with long-term outcomes after OCA. Studies reported on patient clinical scores such as Hospital for Special Surgery score, Knee Society Score (knee and function score), and Lysholm score. Reoperation and failure rates were recorded for each study. Modified Coleman Methodology Scores assessed study methodological quality.

### **Results**

Five studies with a total of 291 patients (55% male, 45% female) and average age of 34.8 years (range, 15 to 69 years) were included. Of all lesions, 67% were on the femoral condyles, 29% on the tibial plateau, and 4% were patellofemoral. All scores (Knee Society Function Score, Knee Society Knee Score, and Lysholm score) have significant mean improvement from preoperative to final follow-up. The mean postoperative Hospital for Special Surgery score was 84.1. The mean failure rate was 25% at 12.3 years with a reoperation rate of 36%. A total of 72% of the failures were conversion to total (68%) or unicompartmental (4%) knee arthroplasty and 28% involved graft removal, graft fixation, and graft revision. Patellofemoral lesions (83%) had a significantly higher reoperation rate than lesions involving the tibial plateau or the femoral condyles (34%,  $P = .01$ ).

### **Conclusions**

Overall, OCA demonstrated significant improvements in clinical outcome scores and good durability with successful outcomes in 75% of the patients at 12.3 years after surgery. Patellofemoral lesions are associated with decreased clinical improvement and more frequent reoperations. The orthopaedic literature is limited by heterogeneity in surgical technique, lesion and patient characteristics, and reporting of nonstandardized outcome measures.

### **Level of Evidence**

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

[BACK](#)



## **Hip-Spine Syndrome: Is There an Association Between Markers for Cam Deformity and Osteoarthritis of the Lumbar Spine?**

Jeremy J. Gebhart, Douglas S. Weinberg, Keegan T. Conry, William Z. Morris, Lee M. Sasala, Raymond W. Liu,

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### **Purpose**

To examine a large osteological collection to assess the relations between the well-described means of quantifying cam deformities of the proximal femur—alpha angle (AA) and anterior femoral neck offset (AFNO)—and osteoarthritis of the lumbar spine.

### **Methods**

AA and AFNO were measured on paired femurs of 550 well-preserved cadaveric skeletons by use of standardized cephalocaudal digital photographs. Degenerative disease of these specimens' lumbar spines was graded from 0 to 4 with a validated grading system. Proximal femurs showing obvious arthritic changes such as lipping or osteophytes were excluded. Correlations between AA and spine osteoarthritis (SOA), as well as between AFNO and SOA, were evaluated by multiple regression analysis.

### **Results**

The average age for the skeletons was  $47.8 \pm 16.2$  years. There were 456 male and 94 female specimens. The mean AA and AFNO were  $52.4^\circ \pm 11.4^\circ$  and  $6.8 \pm 1.5$  mm, respectively. The average SOA score was  $2.1 \pm 0.9$  (0 in 31 specimens, 1 in 82, 2 in 287, 3 in 106, and 4 in 44). There was a significant correlation between increasing AA and SOA (standardized  $\beta = 0.061$ ,  $P = .041$ ). There was also a significant correlation between decreasing AFNO and SOA (standardized  $\beta = -0.067$ ,  $P = .025$ ). There was a strong correlation between age and SOA (standardized  $\beta = 0.582$ ,  $P < .0005$ ).

### **Conclusions**

This study provides important insight into the understanding of the hip-spine connection. Although it has no way of showing a causative or clinically significant relation, this study did show that the cam-type deformity markers of increasing AA and decreasing AFNO were significantly associated with SOA in a large osteological collection.

### **Clinical Relevance**

Clinical and biomechanical studies to assess whether cam deformity in the younger individual may contribute to the accelerated development of SOA in later life are warranted.

[BACK](#)

## The Success of Hip Arthroscopy in an Active Duty Population

Jason R. Dutton, Nicholas A. Kusenzov, Joseph T. Lanzi, E'Stephan J. Garcia, Mark P. Pallis,

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### Purpose

To examine the outcomes of arthroscopic treatment of the hip in a young, active military population. Specifically, the ability to return to duty was the prime indicator of success. In addition, an objective evaluation of various demographic and surgery-related variables was performed to identify predictors for success or failure of treatment in this military population.

### Methods

A retrospective chart review was undertaken to ascertain the **Results** of hip arthroscopy at a single academic military medical center. A total of 206 patients underwent 223 hip arthroscopies during a 13-year period (2000-2013). Of these, 159 patients met the inclusion criteria, which included active duty military service and at least 12-month follow-up. Veterans Affairs Beneficiaries, active duty dependents, and those with less than 12 months of follow-up were excluded. Surgeries were performed by 1 of 5 fellowship-trained orthopaedic surgeons. Data were collected from the Armed Forces Health Longitudinal Technology Application, Electronic profiling system, and Physical Evaluation Board.

### Results

A total of 159 patients were available for the study, 102 males and 57 females. The average age of the patients overall was  $30.9 \pm 8.3$  years (range, 18-52 years). Junior enlisted, which is considered entry level, made up 64.2% of the subjects. The most common diagnosis was femoroacetabular impingement, and the most common procedure performed was acetabuloplasty. Twenty-two percent of patients underwent evaluation by the medical retention board after hip arthroscopy and were separated from military service. Seventy-eight percent of soldiers were maintained on active duty after hip arthroscopy. The overall complication rate was 15.7%, with a major complication rate of 1.25% defined as femoral neck fracture, abdominal compartment syndrome, osteonecrosis, deep vein thrombosis and/or pulmonary embolus, and septic arthritis. Univariate analysis of risk factors showed the presence of a complication to be a significant predictor for failure to return to active duty (odds ratio [OR] 4.04,  $P = .0035$ ) as was senior noncommissioned officer rank (OR 0.20,  $P = .0347$ ). Multivariate analysis showed only the presence of a complication to be a significant predictor for failure to return to active duty (OR 3.71,  $P = .0083$ ).

### Conclusions

Hip arthroscopy in a military population is effective in treating multiple causes and retaining soldiers on active duty status. Complications of any kind from surgery or postoperatively are significant predictors of medical separation and may warrant earlier initiation of a medical evaluation board.

### Level of Evidence

Level IV, therapeutic case series.

[BACK](#)

## **Reconstruction of the Medial Patellofemoral Ligament Using a Synthetic Graft With Arthroscopic Control of Patellofemoral Congruence**

Jun Suganuma, Ryuta Mochizuki, Tadashi Sugiki, Yutaka Inoue, Kazuya Kitamura, Seiji Akutsu, Hiroyuki Ono,

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### **Purpose**

To compare the Results of reconstruction of the medial patellofemoral ligament (MPFL) using a synthetic graft (Poly-Tape) between knee joints in which the patella was reduced to the strict center and those in which it was slightly lateral to the center of the trochlea to determine whether patellar position within this range affects the Results.

### **Methods**

Forty-six knee joints in 46 patients were examined retrospectively with a minimum follow-up of 2 years. The position of the patellar central ridge in the trochlea on arthroscopy immediately after reconstruction of the MPFL was measured. The joints were classified into group 1 (6 male and 12 female patients), in which the patella was reduced to the strict center of the trochlea, and group 2 (10 male and 18 female patients), in which the patella was reduced slightly lateral to the center. The mean age was 20.7 years in group 1 and 20.3 years in group 2. Knee joints were assessed using the Kujala score and the International Knee Documentation Committee (IKDC) subjective evaluation score.

### **Results**

The mean Kujala and IKDC scores improved significantly in both groups after surgery (both  $P < .001$ ). There was no significant difference between the groups for any assessment before surgery or in the Kujala score after surgery ( $P = .075$ ). However, the IKDC score after surgery was significantly better in group 2 ( $91.3 \pm 9.1$ ) than in group 1 ( $82.8 \pm 13.1$ ) ( $P = .012$ ).

### **Conclusions**

When recurrent dislocation of the patella was treated with MPFL reconstruction using a synthetic graft, subjective evaluations were better in knee joints in which the patella was repositioned slightly lateral to the center of the trochlea than in those in which the patella was reduced to the strict center, although there was no significant difference in knee function between them.

### **Level of Evidence**

Level III, retrospective comparative study.

[BACK](#)

## **Repair of Meniscal Ramp Lesions Through a Posteromedial Portal During Anterior Cruciate Ligament Reconstruction: Outcome Study With a Minimum 2-Year Follow-up**

Mathieu Thauinat, Nicolas Jan, Jean Marie Fayard, Charles Kajetanek, Colin G. Murphy, Barbara Pupim, Roland Gardon, Bertrand Sonnery-Cottet,

<http://dx.doi.org/10.1016/j.arthro.2016.02.026>

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### **Purpose**

To evaluate the Results of arthroscopic all-inside suture repair of medial meniscal ramp lesions through a posteromedial portal during anterior cruciate ligament (ACL) reconstruction.

### **Methods**

All patients who underwent a suture of the posterior segment of the medial meniscus using a suture hook device through a posteromedial portal during ACL reconstruction with minimum 2 year-follow-up were included in the study. Repair was performed for longitudinal tears within the rim of less than 3 mm (capsulomeniscal junction or red-red zone) or 3 to 5 mm (red-white zone) of an unstable torn meniscus. Patients were assessed pre- and postoperatively with IKDC score and Tegner activity scale. Instrumented knee testing was performed with the Rolimeter arthrometer. Complications including reoperation for failed meniscal repair were also recorded.

### **Results**

One hundred thirty-two patients met the inclusion criteria. The mean follow-up time was 27 months (range, 24 to 29 months). The average subjective IKDC rose from  $63.8 \pm 13.5$  (range, 27 to 92) preoperatively to  $85.7 \pm 12$  (range, 43 to 100) at last follow-up ( $P < .0001$ ). The Rolimeter test decreased from a side-to-side difference in anterior knee laxity of 7 mm (range, 5 to 14 mm) to a mean value of 0.4 mm (range, -3 to 5 mm) at last follow-up ( $P < .0001$ ). The Tegner activity scale at the last follow-up ( $6.9 \pm 1.72$ ) was slightly lower than that before surgery ( $7.2 \pm 1.92$ ;  $P = .0017$ ). Nine patients (6.8%) had failure of the meniscal repair. In 5 cases, recurrent tears were related to a newly formed tear located anterior to the initial tear.

### **Conclusions**

Our Results show that arthroscopic meniscal repair of ramp lesions during ACL reconstruction through a posteromedial portal provided a high rate of meniscus healing at the level of the tear and appeared to be safe and effective in this group of patients.

### **Level of Evidence**

Level IV, therapeutic study, case series (no control group).

[BACK](#)

## **Anterior Cruciate Ligament Injuries in Baseball Players**

Jeffrey R. Dugas, Benjamin B. Bedford, John S. Andrachuk, Anthony J. Scillia, Kyle T. Aune, E. Lyle Cain, James R. Andrews, Glenn S. Fleisig,

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### **Purpose**

To determine common mechanisms of anterior cruciate ligament (ACL) injury in baseball players and to quantify the rate of return to play after primary surgical reconstruction and review intermediate clinical outcomes.

## **Methods**

Surgical injuries involving the ACL in youth, high school, collegiate, and professional baseball players were queried for an 11-year period (2001 to 2011). Over the study period, 42 baseball players were identified who had undergone arthroscopically assisted primary ACL reconstruction by 1 of 3 attending surgeons. Retrospective chart review was performed for all 42 patients to evaluate variables of age, level of competition, position, mechanism of injury, graft choice, and associated meniscal injuries. Twenty-six patients were reached for telephone survey and International Knee Documentation Committee questionnaire and they answered questions about their original injury and playing history.

## **Results**

The most common mechanism of injury was fielding, followed by base running. Infielders and outfielders (32% each) were the most commonly injured position, followed by pitchers (29%). Among the 32 players for whom it could be determined, 30 (94%) were able to return to playing baseball at a mean follow-up of 4.2 years (range 1.0 to 9.9 years). The mean International Knee Documentation Committee score was 84.0 (range 63 to 91). Among the 26 patients contacted for telephone interview, no one required revision ACL surgery, but 3 required a subsequent procedure for meniscal tear. Twenty-five patients (96%) denied any episodes of instability in the knee after reconstruction.

## **Conclusions**

The overwhelming majority of baseball players that sustain ACL injuries do so while fielding or base running. Outfielders are significantly more likely than infielders to suffer ACL injuries while fielding versus base running. The Results with respect to return to play are promising, as nearly all patients were able to return to baseball and none required a revision ACL surgery at a mean follow-up of 4.2 years.

## **Level of Evidence**

Level IV, therapeutic case series.

[BACK](#)

## **Cadaveric Study Comparing the Biomechanical Properties of Grafts Used for Knee Anterolateral Ligament Reconstruction**

Karine Wytrykowski, Pascal Swider, Nicolas Reina, Jérôme Murgier, Jean Michel Laffosse, Philippe Chiron, Etienne Cavaignac

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## **Purpose**

To measure the biomechanical properties (maximum load, stiffness, and elongation) of the anterolateral ligament (ALL), gracilis, and iliotibial band (ITB) within the same subject.

## **Methods**

Thirteen unpaired knees were used (7 women, 6 men). The donors had a mean age at death of 54 years (range: 37 to 70 years). The mechanical properties of two types of ALL grafts were evaluated: ITB and two-strand gracilis. The mechanical properties of ALL were also measured.

Validated Methods were used to perform the tensile tests to failure and to record the Results. Student's *t*-test was used to compare the various samples.

### Results

The maximum load to failure was 141 N ( $\pm 40.6$ ) for the ALL, 200.7 N ( $\pm 48.7$ ) for the gracilis, and 161.1 N ( $\pm 27.1$ ) for the ITB. Only the gracilis had a significantly higher failure load than ITB and ALL ( $P = .001$  and  $P = .03$ ). The stiffness was 21 N mm<sup>-1</sup> ( $\pm 8.2$ ) for the ALL, 131.7 N mm<sup>-1</sup> ( $\pm 43.7$ ) for the gracilis, and 39.9 N mm<sup>-1</sup> ( $\pm 6$ ) for the ITB. The elongation at failure was 6.2 mm ( $\pm 3.2$ ) for the ALL, 19.9 mm ( $\pm 6.5$ ) for the gracilis, and 20.8 mm ( $\pm 14.7$ ) for the ITB.

### Conclusions

The gracilis had the highest maximum load to failure. The ITB's mechanical properties most closely resemble those of the ALL.

### Clinical Relevance

The biomechanical properties of each potential ALL graft can be factored in when deciding which type of graft to use.

[BACK](#)

## High Femoral Anteversion Is Related to Femoral Trochlea Dysplasia

Michael Christian Liebensteiner, Julia Ressler, Gerd Seitlinger, Tanja Djurdjevic, Rene El Attal, Peter Wilhelm Ferlic

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### Purpose

To investigate the possible relation between femoral anteversion (AV) and trochlear morphology.

### Methods

Among 560 available lower-limb computed tomography (CT) scans, those with previous fracture, arthroplasty, or osteotomy were excluded and 40 cases were randomly selected. The following 4 lines were determined from the CT scans: 1 through the center of the femoral head and neck; 1 through the lesser trochanter and the center of the femoral shaft; 1 as a tangent to the dorsal part of the distal femur, just above the gastrocnemius insertion; and 1 as a tangent to the posterior condyles. Between the respective lines, the following parameters of femoral AV were determined: (1) total AV, (2) proximal AV, (3) diaphyseal AV, and (4) distal AV. Trochlea parameters were determined from 2 separate axial CT slices (proximal trochlea and 5 mm farther distally): trochlea height (medial, central, lateral), transverse trochlea shift, trochlea depth, sulcus angle, lateral trochlea slope, and Dejour trochlea type. To prove or disprove our study hypothesis, a correlation analysis was performed between the variables of AV and trochlear morphology.

### Results

The total AV was significantly correlated with the trochlea parameters trochlea depth ( $P = .032$ ), sulcus angle ( $P = .05$ ), and lateral trochlea slope ( $P = .001$ ). The diaphyseal AV was significantly correlated with the sulcus angle ( $P = .009$ ). The distal AV showed significant correlations with medial, central, and lateral trochlea height ( $.005 < P < .032$ ) and with Dejour trochlea type ( $P = .043$ ).

## Conclusions

The morphology of the trochlea is significantly related to femoral AV. Increased AV is associated with a flatter, more dysplastic trochlea. This was particularly true for AV located at the distal femur.

## Level of Evidence

Level III, diagnostic study of nonconsecutive patients.

[BACK](#)

## Anatomic Posterolateral Corner Reconstruction Using a Fibula Cross-Tunnel Technique: A Cadaveric Biomechanical Study

Hideya Ishigooka, Sean T. Campbell, Ryan J. Quigley, Michelle H. McGarry, Yu Jen Chen, Akash Gupta, Christopher N.H. Bui, Thay Q. Lee

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## Purpose

To compare the biomechanical properties of a fibula cross-tunnel technique for posterolateral corner (PLC) reconstruction with those of intact knees.

## Methods

Seven fresh-frozen cadaveric knees were tested while intact, after PLC tear, and after reconstruction. Testing of the parameters listed above was performed at 0°, 30°, 60°, and 90° of knee flexion. Reconstruction was performed using 2 independent tendon autografts. Afterward, the fibula and graft were loaded to failure.

## Results

Reconstruction restored external rotation (0°:  $11.75^\circ \pm 2.02^\circ$  to  $9.81^\circ \pm 1.81^\circ$ ,  $P = .57$ ; 30°:  $17.91^\circ \pm 1.32^\circ$  to  $13.96^\circ \pm 2.84^\circ$ ,  $P = .12$ ; 60°:  $15.86^\circ \pm 1.68^\circ$  to  $13.26^\circ \pm 3.58^\circ$ ,  $P = .41$ ; 90°:  $15.53^\circ \pm 1.62^\circ$  to  $14.07^\circ \pm 2.95^\circ$ ,  $P = .54$ ) to the intact state, and posterior translation (0°:  $3.66 \pm 0.85$  mm to  $3.31 \pm 0.89$  mm,  $P = .87$ ; 60°:  $3.15 \pm 0.45$  mm to  $2.96 \pm 0.45$  mm,  $P = .73$ ; 90°:  $2.74 \pm 0.33$  mm to  $3.05 \pm 0.41$  mm,  $P = .41$ ) and varus angulation (0°:  $0.92^\circ \pm 0.35^\circ$  to  $1.98^\circ \pm 0.42^\circ$ ,  $P = .55$ ; 30°:  $2.65^\circ \pm 0.27^\circ$  to  $1.09^\circ \pm 0.90^\circ$ ,  $P = .37$ ; 90°:  $4.29^\circ \pm 0.44^\circ$  to  $2.53^\circ \pm 1.13^\circ$ ,  $P = .19$ ) under most conditions. During load to failure testing, the construct revealed properties similar to those of native structures (yield load:  $330.4 \pm 45.8$  N; ultimate load:  $420.9 \pm 37.4$  N).

## Conclusions

This technique restored external rotation to the intact state after PLC injury in all testing conditions, as well as posterior translation at 0°, 60°, and 90° of flexion, and varus angulation under all conditions tested except 60° of flexion.

## Clinical Relevance

Clinically, this surgical technique may eliminate the need for a tibial tunnel for posterolateral corner reconstruction.

[BACK](#)

## Anterior Cruciate Ligament Revision Surgery: Ipsilateral Quadriceps Versus Contralateral Semitendinosus-Gracilis Autografts

Martin Häner, Sebastian Bierke, Wolf Petersen,

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### Purpose

To evaluate the subjective outcomes, knee stability, and donor-site morbidity after revision ACL reconstruction using either autologous ipsilateral quadriceps tendon or contralateral semitendinosus-gracilis tendon.

### Methods

A sample size calculation suggested that we needed 25 patients in each group to detect equality between both groups. Therefore, we evaluated 30 consecutive patients who underwent an ACL revision surgery with ipsilateral bone–quadriceps tendon grafts and 30 consecutive patients with the contralateral semitendinosus-gracilis grafts between January 2010 and December 2012. Because of follow-up and exclusion criteria, finally 51 patients were evaluated. All patients were followed prospectively for at least 2 years with KT1000 arthrometer testing and the International Knee Documentation Committee (IKDC) objective grading. At the 24-month follow-up, additional clinical scores were evaluated: the Knee Injury Osteoarthritis Outcome Score (KOOS), the Lysholm score, assessing pain during kneeling, and anterior knee pain.

### Results

The KT1000 postoperative arthrometer side-to-side difference was  $2.0 \pm 1.2$  mm for the quadriceps group and  $3.0 \pm 2.9$  mm for the semitendinosus-gracilis group. The difference was not statistically significant ( $P = .461$ ). There was also no difference in the rate of positive pivot-shift tests between groups ( $P = .661$ ). The Lysholm score was  $82.5 \pm 18$  in the quadriceps group and  $73.8 \pm 19$  in the semitendinosus-gracilis group. The difference was not statistically significant ( $P = .060$ ). There was also no significant difference in the single KOOS subscores, assessing pain while kneeling and anterior knee pain (included in the KOOS score). No rerupture occurred during follow-up.

### Conclusions

Revision ACL reconstruction using the quadriceps tendon graft showed clinical outcomes similar to those of the contralateral semitendinosus-gracilis graft in terms of knee stability and function. Thus, the bone–quadriceps tendon graft may be a good alternative to the contralateral semitendinosus-gracilis tendon graft for revision ACL reconstruction.

### Level of Evidence

Level II, prospective comparative study.

[BACK](#)

**The Influence of Knee Flexion Angle for Graft Fixation on Rotational Knee Stability During Anterior Cruciate Ligament Reconstruction: A Biomechanical Study**



Aníbal Debandi, Akira Maeyama, Yuichi Hoshino, Shigehiro Asai, Bunsei Goto, Patrick Smolinski, Freddie H. Fu

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### **Purpose**

To evaluate the effect of knee flexion angle for hamstring graft fixation, full extension (FE), or 30°, on acceleration of the knee motion during pivot-shift testing after either anatomic or nonanatomic anterior cruciate ligament (ACL) reconstruction using triaxial accelerometry.

### **Methods**

Two types of ACL reconstructions (anatomic and nonanatomic) using 2 different angles of knee flexion during graft fixation (FE and 30°) were performed on 12 fresh-frozen human knees making 4 groups: anatomic-FE, anatomic-30°, nonanatomic-FE, and nonanatomic-30°. Manual pivot-shift testing was performed at ACL-intact, ACL-deficient, and ACL-reconstructed conditions. Three-dimensional acceleration of knee motion was recorded using a triaxial accelerometer.

### **Results**

The anatomic-30° group showed the smallest overall magnitude of acceleration among the ACL-reconstructed groups ( $P = .0039$ ). There were no significant differences among the anatomic-FE group, the nonanatomic-FE group, and the nonanatomic-30° group (anatomic-FE vs nonanatomic-FE,  $P = .1093$ ; anatomic-FE vs nonanatomic-30°,  $P = .8728$ ; and nonanatomic-FE vs nonanatomic-30°,  $P = .1093$ ). After ACL transection, acceleration was reduced by ACL reconstruction with the exception of the nonanatomic-FE group that did not show a significant difference when compared with the ACL-deficient ( $P = .4537$ ).

### **Conclusions**

The anatomic ACL reconstruction with the graft fixed at 30° of knee flexion better restored rotational knee stability compared with FE. An ACL graft fixed with the knee at FE in anatomic position did not show a significant difference compared with the nonanatomic ACL reconstructions.

### **Clinical Relevance**

Knee flexion angle at the time of graft fixation for ACL reconstruction can be considered to maximize the rotational knee stability.

[BACK](#)

## **Bone Contusions After Acute Noncontact Anterior Cruciate Ligament Injury Are Associated With Knee Joint Laxity, Concomitant Meniscal Lesions, and Anterolateral Ligament Abnormality**

Guan-yang Song, Hui Zhang, Qian-qian Wang, Jin Zhang, Yue Li, Hua Feng

November 2016 Volume 32, Issue 11, Pages 2331–2341

<http://dx.doi.org/10.1016/j.arthro.2016.03.015>

### **Purpose**

To examine the associated findings with bone contusions in patients after acute noncontact anterior cruciate ligament (ACL) injuries.

### **Methods**

From January 1, 2011, to December 31, 2013, patients who underwent ACL reconstructions performed by the senior author (H.F.) were retrospectively analyzed. Presence and severity of bone contusion were determined from preoperative magnetic resonance images (MRIs) for each anatomic site including the lateral femoral condyle (LFC), lateral tibial plateau (LTP), medial femoral condyle (MFC), and medial tibial plateau (MTP). Multivariable logistic regression was used to calculate adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for the associated findings (demographic data, preoperative physical examinations, concomitant meniscal lesions, intra-articular cartilage damages, and anterolateral ligament [ALL] abnormality) with bone contusions. Outcomes included the presence of bone contusions at each anatomic site (LFC, LTP, MFC, and MTP) and severity of lateral bone contusions (moderate/severe vs none/minimal).

### **Results**

Among the 697 consecutive cases, 193 were finally selected. Prevalence of bone contusions seen on MRI was as follows: 60.6% LFC, 73.1% LTP, 6.2% MFC, and 21.2% MTP. Presence of bone contusions at LFC and LTP were significantly associated with high-grade (grade II and III) pivot-shift ( $OR_{LFC}, 7.39$ ; 95% CI, 1.99, 27.44;  $OR_{LTP}, 2.52$ ; 95% CI, 1.02, 6.24), concomitant lateral meniscal lesions ( $OR_{LFC}, 3.23$ ; 95% CI, 1.93, 11.31;  $OR_{LTP}, 10.17$ ; 95% CI, 1.86, 55.47), and ALL abnormality ( $OR_{LFC}, 3.79$ ; 95% CI, 1.46, 9.84;  $OR_{LTP}, 4.47$ ; 95% CI, 1.28, 15.58). However, none of the above associated findings was correlated with the presence of bone contusions at MFC and MTP. Furthermore, moderate/severe lateral bone contusions were still found to be significantly associated with high-grade (grade II and III) pivot-shift ( $OR_{LFC}, 14.89$ ; 95% CI, 2.71, 82.11;  $OR_{LTP}, 6.76$ ; 95% CI, 1.27, 36.06), concomitant lateral meniscal lesions ( $OR_{LFC}, 17.34$ ; 95% CI, 3.91, 76.87;  $OR_{LTP}, 22.01$ ; 95% CI, 5.08, 95.42), and ALL abnormality ( $OR_{LFC}, 4.02$ ; 95% CI, 1.33, 12.09;  $OR_{LTP}, 2.57$ ; 95% CI, 1.09, 6.04).

### **Conclusions**

For acute noncontact ACL injury, both the presence and the severity of lateral bone contusions are associated with high-grade (grade II and III) pivot-shift, concomitant lateral meniscal lesions, and ALL abnormality.

### **Level of Evidence**

Level III, retrospective comparative study.

[BACK](#)

## **Tibial Tubercle Osteotomy for Patellar Chondral Pathology in an Active United States Military Population**

Tuesday F. Fisher, Brian R. Waterman, Justin D. Orr, Courtney A. Holland, Julia Bader, Philip J. Belmont Jr.,

November 2016 Volume 32, Issue 11, Pages 2342–2349

<http://dx.doi.org/10.1016/j.arthro.2016.03.027>

## **Purpose**

To quantify rates of perioperative complications, secondary surgery, subjective pain relief, and knee-related medical separation in an active military population after a tibial tubercle osteotomy (TTO) for the primary indication of chondral pathology.

## **Methods**

All active-duty service members undergoing TTO with a minimum of 2 years' follow-up were isolated from the Military Health System database. The exclusion criteria were patients with patellar instability, other periarticular osteotomy, and insufficient follow-up. Demographic information and surgical characteristics were read from the electronic health record and correlated with improvement in pain and medical discharge from the military.

## **Results**

A total of 76 patients (86 knees) who underwent TTO for patellofemoral chondromalacia were identified with a mean age of 32.3 years. Major and minor complications occurred in four patients (4.7%) and three patients (3.5%), respectively, and the overall improvement in the visual analog scale score after TTO was 1.5 ( $P < .0001$ ). At a mean follow-up of 3.4 years (range, 2.0 to 7.3 years), 37% of patients were unable to return to modified military activity because of knee-related limitations. Junior military rank group ( $P = .0084$ ), age younger than 35 years ( $P = .0031$ ), bilateral TTO procedures ( $P = .0294$ ), and tobacco use ( $P = .0218$ ; odds ratio, 3.29; 95% confidence interval, 1.19 to 9.12) were risk factors for medical separation, whereas absence of concomitant chondral repair ( $P = .5408$ ), previous knee procedures ( $P = .9674$ ), and greater occupational demands ( $P = .7062$ ) were not.

## **Conclusions**

At short-term to midterm follow-up, 63% of patients successfully returned to military function with a low rate of perioperative complications (8%). The postoperative decrease in pain after TTO is of unknown clinical significance. Age younger than 35 years, junior military rank, bilateral TTO procedures, and tobacco use were significant risk factors for medical separation, whereas absence of concomitant cartilage repair, previous knee procedures, and lower occupational demands were not associated with improved visual analog scale scores or prevention of knee-related medical discharge.

## **Level of Evidence**

Level IV, therapeutic case series.

[BACK](#)

## **Thromboembolic Events After Arthroscopic Knee Surgery: Increased Risk at High Elevation**

Jared J. Tyson, Brian P. Bjerke, James W. Genuario, Thomas J. Noonan,

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## **Purpose**

To evaluate the incidence of thromboembolic events in patients undergoing arthroscopic surgery of the knee in centers located at elevations near sea level and compare those rates with the patients undergoing the same operations in centers at high elevation.

## Methods

A retrospective review was conducted using a database of a major health care system with surgery centers located throughout the United States. More than 115 centers located in 15 different states were analyzed for any reported thromboembolic events including deep vein thromboses and pulmonary embolism (PE) in patients who had undergone knee arthroscopy over a 2-year period. The centers located at elevations lower than 1,000 ft were considered sea level centers. Centers located at elevations above 4,000 ft were considered high-elevation centers. Centers located between 1,000 ft and 4,000 ft elevation were excluded.

## Results

A total of 35,877 patients underwent a knee arthroscopy at a low-elevation center and 10,181 patients underwent a knee arthroscopy at a high-elevation center between 2011 and 2012. During that same time period, 45 total venous thromboembolic events (VTEs) including 12 PEs occurred at centers considered low elevation, whereas 50 VTEs including 4 PEs occurred at centers considered high elevation. The incidence of VTE at low-elevation centers was 0.13%. The incidence of VTE at high-elevation centers was 0.49%. The difference was statistically significant,  $P < .0001$ . The relative risk of developing a VTE was 3.8 times higher at high elevation. There was no difference in PE incidence between high- and low-elevation centers (0.04% vs 0.03%, respectively;  $P = .78$ ).

## Conclusions

Patients undergoing arthroscopic procedures of the knee in centers at high elevation are at 3.8 times higher risk of developing a VTE than those undergoing the same procedures in centers at low elevations. There was no observed increased risk of PE.

## Level of Evidence

Level III, retrospective comparative study.

[BACK](#)

## Failure Rate and Clinical Outcomes of Anterior Cruciate Ligament Reconstruction Using Autograft Hamstring Versus a Hybrid Graft

Brian M. Leo, Michael Krill, Leticia Barksdale, Andres M. Alvarez-Pinzon,

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## Purpose

To compare the revision rate and subjective outcome measures of autograft hamstring versus a soft tissue hybrid graft combining both autograft hamstring and tibialis allograft for isolated anterior cruciate ligament (ACL) reconstruction.

## Methods

A single-center retrospective, nonrandomized, comparative study of isolated ACL reconstruction revision rates for subjects who underwent arthroscopic reconstruction of the ACL using autograft hamstring or a soft tissue hybrid graft using both autograft hamstring and tibialis allograft was performed. Patients with isolated ACL tears were included and underwent anatomic single-bundle reconstruction using an independent tunnel drilling technique and a minimum of 24 months'

follow-up. The primary outcome assessed was the presence or absence of ACL rerupture. Secondary clinical outcomes consisted of the International Knee Documentation Committee, University of California at Los Angeles (UCLA) ACL quality of life assessment, and the visual analog pain scale.

### **Results**

Between February 2010 and April 2013, 95 patients with isolated ACL tears between ages 18 and 40 met the inclusion criteria and were enrolled. Seventy-one autograft hamstring and 24 soft tissue hybrid graft ACL reconstructions were performed during the course of this study. The follow-up period was 24 to 32 months (mean 26.9 months). There were no statistically significant differences in patient demographics or Outerbridge classification. No statistically significant differences in ACL retears (5.6% auto, 4.2% hybrid;  $P = .57$ ) were found between groups. Clinical International Knee Documentation Committee and UCLA ACL quality of life assessment improvement scores revealed no statistically significant differences in autograft and hybrid graft reconstructions ( $41 \pm 11$ ,  $43 \pm 13$ ;  $P = .65$ ) ( $38 \pm 11$ ,  $40 \pm 10$ ;  $P = .23$ ). The mean pain level decreased from 8.1 to 2.8 in the autograft group and 7.9 to 2.5 in the hybrid group ( $P = .18$ ).

### **Conclusions**

The use of a hybrid soft tissue graft has a comparable rerupture rate and clinical outcome to ACL reconstruction using autograft hamstring.

### **Level of Evidence**

Level III, retrospective comparative study.

[BACK](#)

## **Magnetic Resonance Imaging Findings in Symptomatic Patients After Arthroscopic Partial Meniscectomy for Torn Discoid Lateral Meniscus**

Chang-Rack Lee, Seong-Il Bin, Jong-Min Kim, Nam-Ki Kim,

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### **Purpose**

To evaluate the change in the thickness and width of the residual meniscus using magnetic resonance imaging (MRI) in patients who underwent arthroscopic partial meniscectomy for discoid lateral meniscus (DLM), to assess whether the degeneration of the articular cartilage in the lateral compartment of the knee progressed, and to evaluate clinical Results.

### **Methods**

Among the patients who underwent arthroscopic partial meniscectomy for DLM between January 1997 and December 2011, those who were aged 40 or below at surgery were followed up for at least 3 years, and received at least 2 follow-up MRIs that were retrospectively reviewed. MRIs were done in symptomatic knees. Using MRI, the relative thickness and width were measured in the anterior horn, midportion, and posterior horn. To determine whether the degeneration of the lateral compartment would progress, the articular cartilage was graded based on the Outerbridge classification in MRIs. The clinical **Results** were evaluated using the Lysholm score.

### **Results**

A total of 20 patients (21 knees) were included. The average follow-up period was 6.8 years. In residual meniscus, the relative thickness of the midportion decreased from  $9.0\% \pm 2.4\%$  to  $7.3\% \pm 2.3\%$  ( $P < .001$ ), the relative thickness of the anterior horn decreased from  $15.6\% \pm 4.3\%$  to  $14.3\% \pm 6.7\%$  ( $P = .030$ ), and the relative thickness of the posterior horn decreased from  $20.0\% \pm 4.4\%$  to  $16.7\% \pm 6.7\%$  ( $P = .019$ ). A decrease in the relative width was observed in the midportion ( $12.4\% \pm 4.8\%$  to  $10.9\% \pm 4.9\%$ ,  $P = .003$ ). No significant changes in size were observed in the medial meniscus. A progression of degeneration in the lateral compartment was observed. However, the clinical Results did not present significant changes.

### **Conclusions**

In symptomatic patients after arthroscopic partial meniscectomy for DLM, the thickness and width of the residual meniscus decreases over time. The arthritic change of the lateral compartment of the knee progressed. However, the change in the size of the residual meniscus was of unknown clinical significance.

### **Level of Evidence**

Level IV, therapeutic case series.

[BACK](#)

## **Role of Ankle Arthroscopy in Management of Acute Ankle Fracture**

Kwok Bill Chan, Tun Hing Lui

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### **Purpose**

To report the operative findings of ankle arthroscopy during open reduction and internal fixation of acute ankle fractures.

### **Methods**

This was a retrospective review of 254 consecutive patients with acute ankle fractures who were treated with open reduction and internal fixation of the fractures, and ankle arthroscopy was performed at the same time. The accuracy of fracture reduction, the presence of syndesmosis disruption and its reduction, and the presence of ligamentous injuries and osteochondral lesions were documented. Second-look ankle arthroscopy was performed during syndesmosis screw removal 6 weeks after the key operation.

### **Results**

There were 6 patients with Weber A, 177 patients with Weber B, 51 patients with Weber C, and 20 patients with isolated medial malleolar fractures. Syndesmosis disruption was present in 0% of patients with Weber A fracture, 52% of patients with Weber B fracture, 92% of patients with Weber C fracture, and 20% of the patients with isolated medial malleolar fracture. Three patients with Weber B and one patient with Weber C fracture have occult syndesmosis instability after screw removal. Osteochondral lesion was present in no patient with Weber A fracture, 26% of the Weber B cases, 24% of the Weber C cases, and 20% of isolated medial malleolar fracture cases. The association between the presence of deep deltoid ligament tear and syndesmosis disruption (warranting syndesmosis screw fixation) in Weber B cases was statistically significant but not in

Weber C cases. There was no statistically significant association between the presence of posterior malleolar fracture and syndesmosis instability that warrant screw fixation.

### **Conclusions**

Ankle arthroscopy is a useful adjuvant tool to understand the severity and complexity of acute ankle fracture. Direct arthroscopic visualization ensures detection and evaluation of intra-articular fractures, syndesmosis disruption, and associated osteochondral lesions and ligamentous injuries.

### **Level of Evidence**

Level IV, case series.

[BACK](#)

## **Changes in Patellar Height After Opening Wedge and Closing Wedge High Tibial Osteotomy: A Meta-analysis**

Seong-II Bin, Hyun-Jung Kim, Hyeong-Sik Ahn, Daniel Sungku Rim, Dae-Hee Lee

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### **Purpose**

To test that patellar height decreases (patellar baja) after opening wedge high tibial osteotomy (HTO) and increases (patellar alta) after closing wedge HTO. In addition, this meta-analysis evaluated whether the method of measuring patellar height affected the change in patellar height after opening and closing HTO.

### **Methods**

Following Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines, all studies comparing pre- and postoperative patellar height using various indices, including the Insall-Salvati index (ISI), Blackburne-Peel index, and Caton Deschamps index, in patients who underwent opening or closing wedge HTO were included. The main outcome of this meta-analysis, mean change in patellar height from before to after surgery, was analyzed with a random effects model. Publication bias was evaluated using funnel plots and Egger's test.

### **Results**

Twenty-three studies were included in the meta-analysis. Pooled data, including subgroups of the 3 measurement Methods showed that patellar height decreased 7% after opening wedge HTO (95% confidence interval [CI]: 0.05 to 0.10;  $P < .001$ ), except when patellar height was assessed by ISI (95% CI:  $-0.02$  to  $0.06$ ;  $P = .34$ ), but that there was no change in patellar height after closing HTO (95% CI:  $-0.01$  to  $0.04$ ;  $P = .29$ ).

### **Conclusions**

The patellar height decreased after opening wedge HTO, except when assessed by ISI. In contrast, patellar height was unchanged after closing wedge HTO, regardless of the measurement method.

### **Level of Evidence**

Level II, meta-analysis of Level I and II studies.

[BACK](#)

## **Acetabular Labral Debridement/Segmental Resection Versus Reconstruction in the Comprehensive Treatment of Symptomatic Femoroacetabular Impingement: A Systematic Review**

Csaba Forster-Horvath, Noah von Rotz, Brian D. Giordano, Benjamin G. Domb,

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### **Purpose**

To perform a systematic review comparing outcomes of labral debridement/segmental resection with labral reconstruction as part of a comprehensive treatment strategy for femoroacetabular impingement.

### **Methods**

A systematic review was conducted according to established PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) guidelines using defined inclusion and exclusion criteria. The study groups were divided into labral debridement/segmental resection (group 1) and labral reconstruction (group 2). Multiple search engines were queried (PubMed, Medline) for this analysis.

### **Results**

After an exhaustive search of the available literature, 20 publications were included. Twelve studies explored outcomes after labral debridement/resection in a total of 400 hips, whereas 7 studies reported on outcomes after labral reconstruction in a total of 275 hips. One additional matched-pair control study compared labral resection (22 hips) with reconstruction (11 hips). The surgical intervention was a revision in 0% to 100% for group 1 versus 5% to 55% for group 2. A direct anterior approach was not performed in group 2, and cam-type impingement appeared to make up a larger percentage of group 1. The Tönnis grade ranged from 0 to 1 for group 1 versus 0.3 to 1.1 for group 2. Joint replacements were performed in 0% to 30% and 0% to 25%, respectively. The modified Harris Hip Score was the most widely used patient-reported outcome measure and suggested that labral reconstruction was not inferior to labral debridement/segmental resection.

### **Conclusions**

Clinical outcomes after labral debridement/segmental resection versus labral reconstruction were found to be comparable. In the setting of unsalvageable labral pathology, labral reconstruction was used more frequently as a revision option whereas debridement may be more commonly used in the index setting.

### **Level of Evidence**

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

[BACK](#)



## Adolescent Femoroacetabular Impingement: Gender Differences in Hip Morphology

Perry Hooper, Sameer R. Oak, T. Sean Lynch, Gehan Ibrahim, Ryan Goodwin, James Rosneck,

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### Purpose

To compare the hip morphology of adolescent male patients and female patients who underwent hip arthroscopy for femoroacetabular impingement (FAI) and determine if gender differences exist.

### Methods

We retrospectively reviewed the records of 177 adolescents, aged 13 to 18 years, who were treated for FAI with hip arthroscopy. We examined and analyzed preoperative magnetic resonance imaging (MRI) scans and plain radiographs, measuring the lateral center-edge angle, Tönnis angle, and alpha angle. The intraclass correlation coefficient between readers was calculated. We created multiple linear regression models incorporating age, gender, and body mass index (BMI) with the radiographic measurements. Intraoperative findings using the Outerbridge grading system, as well as procedure performed, were documented. We compared these findings with our preoperative imaging measurements using the  $\chi^2$  test and the Wilcoxon rank sum test.

### Results

The intraclass correlation coefficient showed moderate to strong agreement between the 3 image readers. The BMI- and age-adjusted mean alpha angle was higher in male patients than female patients on both plain radiographs ( $55.9^\circ$  vs  $45.2^\circ$ ,  $P < .0001$ ) and axial oblique MRI scans ( $54.1^\circ$  vs  $42.5^\circ$ ,  $P < .0001$ ). An alpha angle greater than  $55^\circ$  was found in 38.9% of male patients compared with only 1% of female patients ( $P < .0001$ ). The lateral center-edge angle and Tönnis angle on MRI scans and plain radiographs displayed no statistically significant differences between genders after we controlled for BMI and age. Male patients were more likely to have chondral damage intraoperatively than female patients ( $56.3\%$  vs  $32.5\%$ ,  $P = .0041$ ).

### Conclusions

Distinct differences between genders were seen both on preoperative imaging and at the time of hip arthroscopy. We found that male patients with FAI displayed a larger mean alpha angle, and therefore a more severe cam-type deformity, than female patients. Our study also found that male patients were more likely to show evidence of chondral damage than female patients at the time of surgery.

### Level of Evidence

Level IV.

[BACK](#)

## Clinical Outcomes of Hip Arthroscopy in Patients 60 or Older: A Minimum of 2-Year Follow-up

Brian M. Capogna, Michael K. Ryan, John P. Begly, Kristofer E. Chenard, Siddharth A. Mahure.

### **Purpose**

To examine clinical outcomes and survivorship in patients aged 60 years or older who underwent hip arthroscopy for management of hip pain.

### **Methods**

Prospectively collected data for patients 60 or older undergoing hip arthroscopy were obtained. All patients were indicated for hip arthroscopy based on standard preoperative examination as well as routine and advanced imaging. Demographic data, diagnosis, and details regarding operative procedures were collected. Baseline preoperative modified Harris Hip Scores (mHHS) and Non-arthritic Hip Scores (NAHS) were compared to mHHS and NAHS at the 2-year follow-up. Survivorship was assessed to determine failure rates, with failure defined as any subsequent ipsilateral revision arthroscopic surgery and/or hip arthroplasty.

### **Results**

Forty-two patients met inclusion criteria. Mean age (standard deviation) and body mass index were 65.8 years (4.5 years) and 26.1 (4.7), respectively. Baseline mean mHHS and NAHS for all patients improved from 47.8 ( $\pm 12.5$ ) and 47.3 ( $\pm 13.6$ ) to 75.6 ( $\pm 17.6$ ) and 78.3 ( $\pm 18.6$ ), respectively ( $P < .001$  for both). Five patients (11.9%) met failure criteria and underwent additional surgery at an average of 14.8 (8-30) months. Three underwent conversion to total hip arthroplasty (7.1%), whereas 2 had revision arthroscopy with cam/pincer resection and labral repair for recurrent symptoms (4.7%). One- and 2-year survival rates were 95.2% and 88.9%, respectively.

### **Conclusions**

Our results suggest that in patients 60 or older with Tonnis grade 0 or 1 osteoarthritic changes on initial radiographs—treatment with hip arthroscopy can lead to reliable improvement in early outcomes. As use of hip arthroscopy for treatment of mechanical hip pain increases, additional studies with long-term follow-up are needed.

### **Level of Evidence**

Level IV, therapeutic case series.

[BACK](#)

## **Revision Arthroscopic Acetabular Labral Treatment: Repair or Reconstruct?**

Brian J. White, Julie Patterson, R.N., Mackenzie M. Herzog

December 2016 Volume 32, Issue 12, Pages 2513–2520

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### **Purpose**

To compare the outcome of labral repair versus labral reconstruction in patients presenting to a single surgeon for revision hip arthroscopy following previous labral treatment.

## Methods

Patients who underwent revision labral repair or labral reconstruction using iliotibial band allograft, after previous labral debridement or repair, between 2009 and 2013 were identified. Hips that underwent revision labral reconstruction were further stratified into 2 graft groups (freeze-dried vs frozen allograft). Exclusion criteria were age <16 years, previous open hip surgery, or previous labral reconstruction. Failure was defined by subsequent intra-articular hip surgery.

## Results

113 hips (15 repair, 98 reconstruction) met the inclusion criteria. Patients who underwent revision labral repair were younger than patients who underwent revision labral reconstruction (27.8 years vs 34.6 years;  $P = .02$ ). Follow-up was obtained from 14 (93%) labral repairs at an average of 4.7 years postoperation (range: 2.0-6.0 years) and 90 (92%) labral reconstructions at an average of 2.4 years postoperation (range: 2.0-4.0 years). Seven of 14 (50%) labral repair hips failed compared with 11/90 (12%) labral reconstruction hips ( $P < .01$ ). Six of 61 (10%) frozen allografts failed compared with 5/29 (17%) freeze-dried allografts ( $P = .32$ ). Patients who underwent revision labral repair were 4.1 (95% confidence interval 1.9, 8.8) times more likely to fail than patients who underwent revision labral reconstruction.

## Conclusions

Patients who underwent revision labral repair following previous repair or debridement were 2.6 times more likely to fail than patients who underwent revision labral reconstruction, controlling for calendar time. In addition, revision labral reconstruction with frozen allograft had lower propensity of failure than freeze-dried allograft. However, there was no statistically significant difference in patient-reported outcome scores between the 2 groups. Based on these results, complete labral reconstruction with longer, nonsegmental graft led to a lower failure rate in this study population and can be considered for treatment of patients presenting for revision labral treatment.

## Level of Evidence

Level III, retrospective comparative study.

[BACK](#)

## Anatomic Double-Bundle Anterior Cruciate Ligament Reconstruction With a Hamstring Tendon Autograft and Fresh-Frozen Allograft: A Prospective, Randomized, and Controlled Study

Shaoqi Tian, Yuanhe Wang, Bin Wang, Lun Liu, Chengzhi Ha, Qicai Li, Kang Sun,

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## Purpose

To compare the clinical outcome of anatomic double-bundle (DB) anterior cruciate ligament (ACL) reconstruction with a hamstring tendon autograft versus fresh-frozen allograft.

## Methods

Between January 2010 and December 2011, in a prospective randomized study, we included 157 patients who were planned to receive anatomic DB ACL reconstruction with a hamstring tendon

autograft or fresh-frozen allograft. All surgeries were performed by the same senior surgeon with the DB reconstruction technique. The fixation of femoral side grafts was by means of an EndoButton, and the tibial side grafts were fixed with a bioabsorbable interference screw augmented with a staple. The same rehabilitation protocol was applied to all the patients. Patients were evaluated preoperatively and at the follow-up points. Evaluations included detailed history, physical examination, radiograph, functional knee ligament testing, KT-2000 arthrometer testing, Harner's vertical jump and Daniel's one-leg hop tests, Lysholm score, Tegner score, the International Knee Documentation Committee (IKDC) standard evaluation form, and Cincinnati knee score.

## Results

One hundred and twenty-one patients (Auto, 62; Allo, 59) fulfilled complete follow-up and got full clinical evaluations. The mean follow-up was 4.6 years (4.0 to 5.5 years) for both groups. No significant differences were found between the 2 groups according to the evaluations aforementioned except that patients in the Allo group had shorter operation time compared with the Auto group ( $P = .001$ ). Fifty-three (85.5%) patients in the Auto group and 50 (84.7%) patients in the Allo group had a side-to-side difference of less than 3 mm. Four (6.5%) patients in the Auto group and 4 (6.8%) patients in the Allo group had a side-to-side difference of more than 5 mm. Fifty-nine (95.8%) patients in the Auto group and 55 (93.2%) patients in the Allo group were normal or nearly normal according to the overall IKDC. According to the subjective IKDC, the average scores were 90 and 89 points, respectively, for the Auto and Allo groups. The mean Lysholm and Tegner scores were 90 points and 7.9 points for the Auto group, respectively, and 89 points and 7.8 points for the Allo group, respectively. For the Cincinnati knee score, the average scores were 91 and 90 points, respectively, for the Auto and Allo groups. A total of 11.3% (7 of 62) of patients in the Auto group and 11.9% (7 of 59) of patients in the Allo group had an arthritic progression. There was no statistical difference between the 2 groups at the final follow-up.

## Conclusions

With the anatomic DB ACL reconstruction technique, comparable objective and subjective clinical results can be achieved with the use of a fresh-frozen hamstring tendon allograft compared with an autograft.

## Level of Evidence

Level II, prospective randomized clinical trial.

[BACK](#)

## Dynamic Evaluation of Pivot-Shift Phenomenon in Double-Bundle Anterior Cruciate Ligament Reconstruction Using Triaxial Accelerometer

Kaori Nakamura, Hideyuki Koga, Ichiro Sekiya, Toshifumi Watanabe, Tomoyuki Mochizuki, Masafumi Horie, Tomomasa Nakamura, Koji Otabe, Takeshi Muneta,

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## Purpose

To evaluate the effect of initial graft tension on rotational stability and to determine the minimum required tension (MRT) based on the pivot-shift phenomenon in isolated anteromedial bundle

(AMB), isolated posteromedial bundle (PLB), and double-bundle anterior cruciate ligament (ACL) reconstructions using a triaxial accelerometer during surgery.

### **Methods**

Primary double-bundle ACL reconstructions were included. The pivot-shift test and N-test were performed before and during surgery with the acceleration measurements using a triaxial accelerometer. The pivot-shift test was also manually graded. The AMB and PLB were fixed to a graft tensioning system during surgery with the following settings: (1) AMB only (AMB), (2) PLB only (PLB), and (3) AMB and PLB (A+P). The total graft tension was first set at 20 N and then was increased in increments of 10 N until the pivot-shift test became negative, which was defined as the MRT in each setting.

### **Results**

Twenty-five patients were evaluated. The MRT in the AMB setting averaged 26 N (range, 20 to 40 N); in the PLB setting, 28 N (range, 20 to 40 N); and in the A+P setting, 24 N (range, 20 to 40 N). The MRT in the A+P setting was significantly smaller than that in the PLB setting ( $P = .008$ ). The acceleration in the A+P setting was significantly smaller than that in the AMB and PLB settings both in the pivot-shift test (vs AMB:  $P = .007$ , vs PLB:  $P = .011$ ) and in the N-test (vs AMB:  $P < .001$ , vs PLB:  $P < .001$ ).

### **Conclusions**

Double-bundle ACL reconstruction better controlled rotational stability with smaller MRT than isolated PLB reconstruction at the time of surgery. In double-bundle reconstruction, the MRT based on the pivot-shift phenomenon could be larger than previously reported MRT based on anteroposterior laxity.

### **Level of Evidence**

Level IV, therapeutic case series.

[BACK](#)

## **Risk Factors for Radiographic Progression of Osteoarthritis After Meniscus Allograft Transplantation**

Ji Hyun Ahn, Ho Won Kang, Tae Yeong Yang, Jang Yun Lee,

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### **Purpose**

To identify risk factors that predict radiographic progression of osteoarthritis after meniscus allograft transplantation (MAT) using multivariate logistic regression.

### **Methods**

Inclusion criteria were consecutive patients who underwent medial or lateral MATs from January 2005 to September 2012 by one surgeon. Exclusion criteria were lack of postoperative magnetic resonance image, loss to follow-up for a minimum of 3 years, and simultaneous surgery on articular cartilage or the anterior cruciate ligament. According to the change of Kellgren-Lawrence (KL) grade at the mean final follow-up of 56.2 months, the enrolled MATs were sorted into the no progression of osteoarthritis (NOA) and progression of osteoarthritis (POA) groups. Multivariate logistic regression was used to analyze risk factors, including age, sex, body mass index, time

from previous meniscectomy to MAT, extent of previous meniscectomy, previous anterior cruciate ligament reconstruction, knee alignment angle, KL grade, side of transplanted meniscus, Outerbridge grade, posterior repair technique, and relative percentage of extrusion.

### **Results**

In comparison between the NOA (n = 38) and the POA (n = 31) groups, a significant risk factor for radiographic progression of osteoarthritis after MAT was medial MAT compared with lateral MAT. Medial MAT compared with lateral MAT was also a significant risk factor (adjusted odds ratio, 3.763; 95% confidence interval, 1.212-11.683).

### **Conclusions**

Patients need to be counseled about the increased risk of osteoarthritis progression after MAT over time, particularly for medial MAT.

### **Level of Evidence**

Level III, retrospective case control study.

[BACK](#)

## **Prospective Randomized Comparison of Knee Stability and Proprioception for Posterior Cruciate Ligament Reconstruction With Autograft, Hybrid Graft, and $\gamma$ -Irradiated Allograft**

Jia Li, Fanlong Kong, Xianda Gao, Yong Shen, Shijun Gao

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### **Purpose**

To evaluate posterior stability and proprioception after arthroscopic posterior cruciate ligament reconstruction with autograft, hybrid graft, and  $\gamma$ -irradiated allograft.

### **Methods**

This prospective, randomized controlled trial (with 5 years' follow-up) included 90 patients who underwent posterior cruciate ligament reconstruction with autograft (gracilis and semitendinosus tendons), hybrid graft ( $\gamma$ -irradiated tibialis anterior tendon allograft and semitendinosus tendon autograft), or  $\gamma$ -irradiated allograft (tibialis anterior tendons). All the  $\gamma$ -irradiated allografts (tibialis anterior tendons) received an irradiation dose of 2.5 Mrad before distribution. Patients in this study had undergone a preoperative magnetic resonance imaging scan and physical examination. Patients were excluded from the study if they had a concomitant injury to other knee ligaments, previous surgery on the injured knee, or articular cartilage lesions greater than Outerbridge grade II. Clinical and proprioceptive evaluation results were collected preoperatively and at 3, 6, 12, 24, 36, and 60 months after surgery.

### **Results**

The autograft, allograft, and hybrid graft groups were followed up for  $5.5 \pm 0.2$  months (range, 5 to 6 years),  $5.7 \pm 0.3$  months (range, 5 to 6 years), and  $5.6 \pm 0.5$  months (range, 5 to 6 years), respectively. No statistically significant differences were found among the 3 groups regarding preoperative demographic factors ( $P > .05$ ). The differences in physical examination findings and subjective evaluations among the 3 groups were not significant ( $P > .05$ ). However, a significant

difference was detected in instrumented anteroposterior measurements, with more laxity shown in the  $\gamma$ -irradiated allograft group than in the other 2 groups ( $P = .006$ ).

### **Conclusions**

The differences in proprioceptive and functional outcomes among the 3 groups were not significant. In contrast, a significant difference was detected in instrumented anteroposterior measurements, which showed more laxity in the  $\gamma$ -irradiated allograft group than in the other 2 groups. However, this may not be clinically significant.

### **Level of Evidence**

Level II, prospective comparative study.

[BACK](#)

## **Risk Factors for Infection After Knee Arthroscopy: Analysis of 595,083 Cases From 3 United States Databases**

R. Carter Clement, Kevin P. Haddix, R. Alexander Creighton, Jeffrey T. Spang, Joshua N. Tennant, M.P.H., Ganesh V. Kamath,

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### **Purpose**

To identify and quantify patient- and procedure-related risk factors for post-arthroscopic knee infections using a large dataset.

### **Methods**

An administrative health care database including 8 years of records from 2 large commercial insurers and Medicare (a 5% random sample) was queried to identify all knee arthroscopies performed on patients aged at least 15 years using Current Procedural Terminology (CPT) codes. Each CPT code was designated as a high- or low-complexity procedure, with the former typically requiring accessory incisions or increased operative time. Deep infections were identified by a CPT code for incision and drainage within 90 days of surgery. Superficial infections were identified by *International Classification of Diseases, Ninth Revision* infection codes without any record of incision and drainage. Patients were compared based on age, sex, body mass index, tobacco use, presence of diabetes, and Charlson Comorbidity Index.

### **Results**

A total of 526,537 patients underwent 595,083 arthroscopic knee procedures. Deep postoperative infections occurred at a rate of 0.22%. Superficial infections occurred at a rate of 0.29%. Tobacco use and morbid obesity were the largest risk factors for deep and superficial infections, respectively ( $P < .001$ ; relative risk of 1.90 and 2.19, respectively). There were also higher infection rates among patients undergoing relatively high-complexity arthroscopies, men, obese patients, diabetic patients, and younger patients (in order of decreasing relative risk). Increased Charlson Comorbidity Index was associated with superficial and total infections ( $P < .001$ ).

### **Conclusions**

Post-arthroscopic knee infections were more frequent among morbidly obese patients, tobacco users, patients undergoing relatively complex procedures, men, obese patients, diabetic patients,

relatively young patients, and patients with increased comorbidity burdens in this study population. This knowledge may allow more informed preoperative counseling, aid surgeons in patient selection, and facilitate infection prevention by targeting individuals with higher inherent risk.

#### **Level of Evidence**

Level IV, cross-sectional study.

[BACK](#)

## **Acute Proximal Anterior Cruciate Ligament Tears: Outcomes After Arthroscopic Suture Anchor Repair Versus Anatomic Single-Bundle Reconstruction**

Andrea Achtnich, Elmar Herbst, Philipp Forkel, Sebastian Metzloff, Frederike Sprenker, Andreas B. Imhoff, Wolf Petersen,

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#### **Purpose**

To compare clinical and radiologic results of primary anterior cruciate ligament (ACL) suture anchor repair and microfracturing with anatomic ACL single-bundle reconstruction in patients with acute proximal ACL avulsion tears.

#### **Methods**

Between January 2010 and December 2013, 420 patients underwent ACL treatment. Forty-one patients were included in this study. The inclusion criteria were as follows: unilateral acute proximal ACL rupture, concomitant meniscus lesions, no previous knee ligament surgery, and no additional ligament injuries or absence of ligament injury of the contralateral knee. Preoperative magnetic resonance imaging confirming a proximal avulsion tear of the ACL was required. Patients had to undergo surgical treatment within 6 weeks after injury. Follow-up examination included Lachman and pivot-shift testing, KT-1000 measurement, and the International Knee Documentation Committee score.

#### **Results**

At a mean follow-up of 28 months (range, 24 to 31 month), 20 patients in each group were available. A mean KT-1000 arthrometer result of less than 3 mm indicated stability in all patients ( $P = .269$ ). Three patients had a 1+ Lachman test ( $P = .072$ ) and 4 patients had a 1+ pivot-shift test in the ACL repair group ( $P = .342$ ). The International Knee Documentation Committee score results did not differ significantly ( $P > .99$ ), but there was a significant correlation between poor results and failure rate ( $P = .001$ ) in the refixation group. The failure rate was 15% in the ACL refixation group and 0% in the reconstruction group ( $P = .231$ ). Magnetic resonance imaging confirmed homogeneous signal and proper ACL position in 100% of patients in the control group and 86% in the ACL repair group.

#### **Conclusions**

Proximal refixation of the ACL using knotless suture anchors and microfracturing restores knee stability and results in comparable functional outcomes to a control group treated with single-bundle ACL reconstruction. The results suggest that refixation of the ACL is a feasible treatment option in selected patients.



## Level of Evidence

Level III, case-control study.

[BACK](#)

## Use of an Objective Structured Assessment of Technical Skill After a Sports Medicine Rotation

Tim Dwyer, Jesse Slade Shantz, Kulamakan Mahan Kulasegaram, Jaskarndip Chahal, , David Wasserstein, , Rachel Schachar, Brian Devitt, John Theodoropoulos, Brian Hodges, Darrell Ogilvie-Harris,

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### Purpose

The purpose of this study was to determine if the use of an Objective Structured Assessment of Technical skill (OSATS), using dry models, would be a valid method of assessing residents' ability to perform sports medicine procedures after training in a competency-based model.

### Methods

Over 18 months, 27 residents (19 junior [postgraduate year (PGY) 1-3] and 8 senior [PGY 4-5]) sat the OSATS after their rotation, in addition to 14 sports medicine staff and fellows. Each resident was provided a list of 10 procedures in which they were expected to show competence. At the end of the rotation, each resident undertook an OSATS composed of 6 stations sampled from the 10 procedures using dry models—faculty used the Arthroscopic Surgical Skill Evaluation Tool (ASSET), task-specific checklists, as well as an overall 5-point global rating scale (GRS) to score each resident. Each procedure was videotaped for blinded review.

### Results

The overall reliability of the OSATS (0.9) and the inter-rater reliability (0.9) were both high. A significant difference by year in training was seen for the overall GRS, the total ASSET score, and the total checklist score, as well as for each technical procedure ( $P < .001$ ). Further analysis revealed a significant difference in the total ASSET score between junior (mean 18.4, 95% confidence interval [CI] 16.8 to 19.9) and senior residents (24.2, 95% CI 22.7 to 25.6), senior residents and fellows (30.1, 95% CI 28.2 to 31.9), as well as between fellows and faculty (37, 95% CI 36.1 to 27.8) ( $P < .05$ ).

### Conclusions

The results of this study show that an OSATS using dry models shows evidence of validity when used to assess performance of technical procedures after a sports medicine rotation. However, junior residents were not able to perform as well as senior residents, suggesting that overall surgical experience is as important as intensive teaching.

### Clinical Relevance

As postgraduate medical training shifts to a competency-based model, methods of assessing performance of technical procedures become necessary.

[BACK](#)

## **Biomechanical Results of Lateral Extra-articular Tenodesis Procedures of the Knee: A Systematic Review**

Erik L. Slette, Jacob D. Mikula, Jason M. Schon, Daniel C. Marchetti, Matthew M. Kheir, Travis Lee Turnbull, Robert F. LaPrade,

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### **Purpose**

To systematically review and compare biomechanical results of lateral extra-articular tenodesis (LET) procedures.

### **Methods**

A systematic review was performed using the PubMed, Medline, Embase, and Cochrane databases. The search terms included the following: extraarticular, anterolateral, iliotibial, tenodesis, plasty, augmentation, procedure, reconstruction, technique, biomechanics, kinematic, robot, cadaver, knee, lateral tenodesis, ACL, Marcacci, Lemaire, Losee, Macintosh, Ellison, Andrews, Hughston, and Muller. The inclusion criteria were nonanatomic, in vitro biomechanical studies, defined as in vitro investigations of joint motion resulting from controlled, applied forces.

### **Results**

Of the 10 included studies, 7 analyzed anterior tibial translation and reported that isolated LET procedures did not restore normal anterior stability to the anterior cruciate ligament (ACL)-deficient knee. Seven of the 8 studies analyzing tibial rotation reported a reduction in internal tibial rotation across various flexion angles in the ACL-deficient knee when compared with the native state. Five studies reported a reduction in intra-articular graft force with the addition of an LET. Two studies evaluated length change patterns, graft course, and total strain range and found that reconstruction techniques in which the graft attached proximal to the lateral epicondyle and coursed deep to the fibular collateral ligament were most isometric.

### **Conclusions**

In the ACL-deficient knee, LET procedures overconstrained the knee and restricted internal tibial rotation when compared with the native state. In addition, isolated LET procedures did not return normal anterior stability to the ACL-deficient knee but did significantly reduce anterior tibial translation and intra-articular graft forces during anteriorly directed loading.

### **Clinical Relevance**

Combined injury to the ACL and anterolateral structures has been reported to exhibit greater anterolateral rotatory instability when compared with isolated ACL injuries. Despite the reported risk of joint over-constraint, consideration should be given to reconstructing the anterolateral structures and the ACL concurrently to maximally restore both anterior tibial translation and rotatory stability.

[BACK](#)

## AJSM

### **Clinical Outcomes of Hip Arthroscopy in Radiographically Diagnosed Retroverted Acetabula**

David E. Hartigan, Itay Perets, John P. Walsh, Mary R. Close, and Benjamin G. Domb

Am J Sports Med October 2016 44 2531-2536

<http://ajs.sagepub.com/content/44/10/2531.abstract>

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**Background:** Symptomatic global retroversion of the acetabulum, as diagnosed on plain radiographs of the pelvis, has traditionally been treated with reverse periacetabular osteotomy, which improves posterior undercoverage and eliminates the anterior pincer lesion. There is a paucity of literature on hip arthroscopy in this group, secondary to theoretical concern of iatrogenic dysplasia, subsequent instability, and arthritis.

**Purpose:** To evaluate the outcomes of hip arthroscopy for patients with a radiographic diagnosis of acetabular retroversion, using patient-reported outcomes, visual analog scale (VAS), patient satisfaction, and pre- and postoperative Tönnis grades.

**Study Design:** Case series; Level of evidence, 4.

**Methods:** Pre- and postoperative data were prospectively collected and retrospectively reviewed for patients who underwent hip arthroscopy at 1 institution between June 2008 and February 2012. Data were analyzed for patients who had adequate radiographs of the pelvis that demonstrated global acetabular retroversion and who were treated with arthroscopic surgery. Complications were tracked in this institution's database. The modified Harris Hip Score, Nonarthritic Hip Score, Hip Outcome Score (HOS)—activities of daily living subscale, and HOS—sport-specific subscale, and VAS were analyzed preoperatively and at latest follow-up. Level of postoperative satisfaction was assessed on a scale of 0 to 10. Pre- and postoperative alpha angle, lateral center-edge angle, anterior center-edge angle, crossover percentage, and Tönnis grade were recorded. Tönnis grade at latest follow-up was utilized to determine progression of osteoarthritis.

**Results:** A total of 82 hips among 78 patients were identified who met the listed criteria. The mean age of the patients was 23 years, and the mean follow-up was 39 months. These patients showed statistically significant improvement in modified Harris Hip Score (preoperative to  $\geq 2$ -year

follow-up: 65 to 81), Nonarthritic Hip Score (65 to 86), HOS–activities of daily living subscale (69 to 88), HOS–sport-specific subscale (47 to 76), and VAS (5.9 to 2.5) ( $P < .0001$ ). In terms of satisfaction with the surgery, they had an mean score of 7.4. There were 3 minor complications, none of which required reoperation. One patient underwent hip arthroplasty at 6 months after hip arthroscopy. Fifteen patients had >2-year radiographic follow-up; none of these patients had an increase in Tönnis grade as compared with the preoperative state.

**Conclusion:** This study demonstrates that hip arthroscopy can successfully treat femoroacetabular impingement associated with a globally retroverted acetabulum at a minimum 2-year follow-up. Survivorship was 99% at 2 years, with 1 patient requiring further surgery in the form of hip arthroplasty. There was no noted progression of Tönnis grade at final follow-up. The procedure was extremely safe, with a minor complication rate of 3.6%.

[BACK](#)

### **Are Short-term Outcomes of Hip Arthroscopy in Patients 55 Years and Older Inferior to Those in Younger Patients?**

Andrew J. Bryan, Aaron J. Krych, Ayoosh Pareek, Patrick J. Reardon, Rebecca Berardelli, and Bruce A. Levy

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**Background:** Hip arthroscopy for young patients with femoroacetabular impingement (FAI) has been successful, but the efficacy of hip arthroscopy in older patients is not clearly defined.

**Purpose:** To evaluate the clinical outcomes of patients 55 years and older who are undergoing hip arthroscopy and to compare outcomes with those of patients younger than 55 years.

**Study Design:** Cohort study; Level of evidence, 3.

**Methods:** A total of 201 (63 male, 138 female) patients undergoing primary hip arthroscopy for FAI without radiographic arthritis (Tönnis grade <3) were isolated from a prospective database and stratified by age to <55-year and ≥55-year groups. Patients were evaluated preoperatively and 1 and 2 years postoperatively using the modified Harris Hip Score (mHHS) and Hip Outcome Score (HOS: functional scores, as well as Activities of Daily Living [ADL] and Sport subscales). A Wilcoxon signed rank sum test was used to evaluate the differences in outcome scores between the cohorts at each interval.

**Results:** The <55-year group included 174 patients (mean age,  $37 \pm 12$  years), and the ≥55-year group included 27 patients (mean age,  $61 \pm 5$  years). The minimum follow-up time was 2 years in each group. Preoperative Tönnis grades and mHHS scores (59 vs 59;  $P = .75$ ) were similar between groups. The ≥55-year cohort underwent labral debridement more frequently (78% vs

36%;  $P = .02$ ) and were more likely to have full-thickness cartilage defects (22% vs 4%;  $P = .04$ ). Despite this, the mHHS in both groups improved significantly from baseline, without significant differences at 1 year (86 [ $\geq 55$  years] vs 81 [ $< 55$  years];  $P = .53$ ) or 2 years (73.88 [ $\geq 55$  years] vs 79.54 [ $< 55$  years];  $P = .06$ ). However, at a minimum 2-year follow-up, patients  $< 55$  years had significant improvements over patients  $\geq 55$  years in the HOS subscales for ADL score (85.6 vs 75.2;  $P = .03$ ), ADL rating (80.1 vs 70.0;  $P = .004$ ), Sport score (70.2 vs 55.6;  $P = .04$ ), and Sport rating (70.2 vs 58.0;  $P = .04$ ).

**Conclusion:** Although younger patients had superior HOS outcomes reported at 2 years compared with older patients after hip arthroscopy for FAI, both groups had significant improvement compared with their baseline. These data suggest that carefully selected patients 55 years and older without radiographic arthritis may benefit from hip arthroscopy.

[BACK](#)

## Revision Hip Arthroscopy: A Matched-Cohort Study Comparing Revision to Primary Arthroscopy Patients

Justin T. Newman, Karen K. Briggs, Shannen C. McNamara, and Marc J. Philippon

Am J Sports Med October 2016 44 2499-2504

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**Background:** As the number of hip arthroscopic surgeries being performed increases, so too does the prevalence of revision hip arthroscopic surgery.

**Hypothesis/Purpose:** The purpose of this study was to compare outcomes in patients requiring revision hip arthroscopic surgery to patients undergoing primary hip arthroscopic surgery. The hypothesis was that patients undergoing revisions would demonstrate similar outcomes to those undergoing primary hip arthroscopic surgery.

**Study Design:** Cohort study; Level of evidence, 2.

**Methods:** Included in the study were patients undergoing revision hip arthroscopic surgery who did not have a history of prior open hip surgery. Each patient in the revision cohort was matched with 2 patients undergoing primary hip arthroscopic surgery. Preoperatively and at a minimum follow-up of 2 years, outcome scores were collected, including the Hip Outcome Score–Activities of Daily Living subscale (HOS-ADL), which was the primary outcome variable; modified Harris hip score (mHHS); Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC); Hip Outcome Score–Sports subscale (HOS-Sports); and the 12-Item Short Form Health Survey (SF12). At follow-up, scores from the Tegner activity scale and patient self-reported satisfaction with surgical outcome were also collected.

**Results:** A total of 246 patients in the revision cohort were matched with 492 patients in the primary cohort. In the revision cohort, 183 patients had 1 prior surgery, 45 had 2 surgeries, and 18 had  $\geq 3$  prior surgeries. Subsequent hip arthroscopic surgery was reported in 39 of 492 (8%) patients in the primary cohort and 5 of 246 (2%) patients in the revision cohort ( $P = .001$ ). Subsequent surgery was reported in 50 of 492 (10%) patients in the primary cohort and 15 of 246 (6%) patients in the revision cohort ( $P = .07$ ). Both groups saw significant improvement in outcome scores from preoperation to follow-up. The HOS-ADL was lower in the revision cohort preoperatively (65 vs 70) and postoperatively (79 vs 87) ( $P = .001$ ). This was also seen in the HOS-Sports, WOMAC, and SF12 physical component scores. Patients who had 1 prior hip arthroscopic procedure had higher postoperative mHHS (81 vs 75) compared with patients with  $>1$  hip arthroscopic procedure; however, there was no difference in postoperative mHHS between the single-revision cohort and the primary cohort. In the revision group, patients whose HOS-ADL improved  $\geq 10$  points had greater joint space. Patients with greater improvement were more likely to have had a previous labral tear that was not repaired and to require capsular plication at revision.

**Conclusion:** Patients who underwent revision hip arthroscopic surgery had significant improvement in outcome scores but did have lower scores compared with patients with primary hip arthroscopies. Patients with  $\geq 2$  revisions had lower outcomes. Improvement in the revision cohort was seen in patients with increased joint space, no prior labral repair, and capsular plication at revision.

[BACK](#)

## **Clinical Outcomes of Hip Arthroscopic Surgery: A Prospective Survival Analysis of Primary and Revision Surgeries in a Large Mixed Cohort**

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**Background:** With the rapid increase in hip preservation procedures, revision hip arthroscopic surgery and conversion to total hip arthroplasty (THA) or hip resurfacing (HR) after primary hip arthroscopic surgery have become a large focus in the recent literature.

**Purpose:** The primary purpose was to perform a survival analysis in a large mixed cohort of patients undergoing hip arthroscopic surgery at a high-volume tertiary referral center for hip preservation with a minimum 2-year follow-up. The secondary purpose was to compare clinical outcomes of primary versus revision hip arthroscopic surgery.

**Study Design:** Cohort study; Level of evidence, 2.

**Methods:** From February 2008 to June 2012, data were prospectively collected on all patients undergoing primary or revision hip arthroscopic surgery. Patients were assessed preoperatively and postoperatively with the modified Harris Hip Score (mHHS), Non-Arthritic Hip Score (NAHS), Hip Outcome Score–Activities of Daily Living (HOS-ADL), and Hip Outcome Score–Sport-Specific Subscale (HOS-SSS). Pain was estimated on a visual analog scale (VAS). Patient satisfaction was measured with the question “How satisfied are you with your surgery results?” (1 = not at all, 10 = the best it could be).

**Results:** There were a total of 1155 arthroscopic procedures performed, including 1040 primary arthroscopic procedures (926 patients) and 115 revision arthroscopic procedures (106 patients). Of these, 931 primary arthroscopic procedures (89.5%) in 824 patients (89.0%) and 107 revision arthroscopic procedures (93.0%) in 97 patients (91.5%) were available for follow-up and included in our study. The mean change in patient-reported outcome (PRO) scores at 2-year follow-up in the primary arthroscopic surgery group was 17.4 for the mHHS, 19.7 for the HOS-ADL, 23.8 for the HOS-SSS, 21.3 for the NAHS, and –3.0 for the VAS, and the mean change in the revision arthroscopic surgery group was 13.4, 10.9, 16.1, 15.4, and –2.7, respectively. All scores improved significantly compared with preoperatively ( $P < .001$ ). PRO scores were higher at all time points for the primary group compared with the revision group ( $P < .05$ ). Mean satisfaction was 7.7 and 7.2 for the primary and revision groups, respectively. Of 931 primary arthroscopic procedures, 52 (5.6%) converted to THA/HR. Of 107 revision arthroscopic procedures, 12 (11.2%) converted to THA/HR. The relative risk of THA/HR was 2.0 after revision procedures compared with primary procedures. The cumulative incidence of competing risks of conversion to THA/HR and revision hip arthroscopic surgery after primary hip arthroscopic surgery was 2.6% and 5.8%, respectively. The overall complication rate was 4.3%.

**Conclusion:** Patients showed significant improvement in all PRO, VAS, and satisfaction scores at 2 years after hip arthroscopic surgery. Patients who underwent primary arthroscopic surgery showed higher PRO scores and a trend toward greater improvement in the VAS score compared with patients who underwent revision arthroscopic surgery. The relative risk of THA/HR was 2.0 after revision procedures compared with primary procedures.

[BACK](#)

### **Patient Characteristics and Early Functional Outcomes of Combined Arthroscopic Labral Refixation and Periacetabular Osteotomy for Symptomatic Acetabular Dysplasia**

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**Background:** Symptomatic labral tears are common in patients with acetabular dysplasia; however, optimal treatment of the labrum remains controversial.

**Purpose:** To present patient characteristics and early functional outcomes associated with combined arthroscopic labral refixation and Bernese periacetabular osteotomy (PAO) for symptomatic acetabular dysplasia with a displaced labral tear from the acetabular rim.

**Study Design:** Cohort study; Level of evidence, 3.

**Methods:** Patients undergoing PAO from a single-center prospective hip preservation registry were eligible (N = 73 patients; mean clinical follow-up, 23 months). Indications for combined arthroscopic labral refixation included symptomatic labral injury and MRI findings suggestive of labral detachment from the acetabular rim indicating a repairable tear. The study group consisted of patients undergoing combined arthroscopic labral refixation and PAO (scope/PAO group: n = 21 patients). Patients undergoing PAO alone (PAO group: n = 52 patients) were included as a comparison. Demographic characteristics, pre- and postoperative radiographic findings, and hip-specific functional outcome scores were recorded.

**Results:** The scope/PAO group was older relative to PAO alone (27 vs 23 years;  $P = .047$ ). Preoperative computed tomography showed increased acetabular version at the 3-o'clock position in the scope/PAO group relative to PAO alone (median [quartile 1, quartile 3]: 24° [20°, 25°] vs 19° [14°, 24°];  $P = .026$ ). PAO operative time, achievement of radiographic correction, or postoperative complications did not differ between groups. Improvements by minimum important change for modified Harris Hip Score, Hip Outcome Score (HOS)–ADL, HOS–Sport, and International Hip Outcome Tool (iHOT-33) were seen in 90%, 79%, 74%, and 100% of patients, respectively, undergoing scope/PAO at most recent follow-up. There was greater improvement from baseline in the iHOT-33 at most recent follow-up in the scope/PAO versus PAO group after adjusting for age and Tönnis grade (mean change  $\pm$  SD: 48  $\pm$  22 [scope/PAO] vs 37  $\pm$  24 [PAO];  $P = .03$ ).

**Conclusion:** Patients undergoing combined arthroscopic labral refixation and PAO were older and had increased acetabular anteversion versus patients undergoing PAO alone. Combined arthroscopic labral refixation and PAO was safe, did not affect PAO operative time or radiographic correction achievement, and may benefit clinical outcomes in this patient subset.

[BACK](#)

## **Analysis of the Current Indications for Microfracture of Chondral Lesions in the Hip Joint**

Darrin J. Trask and James S. Keene

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**Background:** Data on the efficacy of microfracture for treatment of chondral defects in the hip are currently limited, and the recommended criteria for its use (minimal osteoarthritis; a focal, contained lesion <4 cm<sup>2</sup> in size) have been taken from those that were established for the knee.

**Purpose:** To determine if the current microfracture (ie, knee) criteria are appropriate for chondral lesions in the hip.

**Study Design:** Case series; Level of evidence, 4.

**Methods:** Seventy patients who had hip arthroscopy and 2 years of follow-up after treatment of labral tears and cam and pincer bony deformities, as well as microfracture of full-thickness chondral defects, are the basis of this study. The size and location of the chondral defects were recorded on each patient's "hip sheet" and operative note at the time of hip arthroscopy and were confirmed from intraoperative photographs. The chondral defects were debrided and microfractured regardless of their size. All hips were assessed with the 100-point modified Harris Hip Score (mHHS) before arthroscopy and at 3, 6, 12, and 24 months after surgery. Patients who had a total hip arthroplasty or repeat arthroscopy during their 2-year follow-up period were assigned poor results.

**Results:** The average age of the 70 patients was 41 years, and the average size of the lesions microfractured was 143 mm<sup>2</sup>. Outcomes, based on patients' 2-year mHHS or being assigned a poor result for revision surgery, were as follows: 32 excellent, 11 good, 6 fair, and 21 poor; overall, 43 patients (61%) had good and excellent results, and 27 (39%) had fair and poor results. The revision surgery rate was 24%. Seven of the 70 patients had chondral lesions greater than the recommended size for microfracture in the hip (>400 mm<sup>2</sup>) and ranged from 430 to 750 mm<sup>2</sup>. Their 2-year outcomes included 3 excellent, 1 good, 1 fair, and 1 poor result; the outcomes were the same as for the 8 patients with medium (200-400 mm<sup>2</sup>) and the 55 patients with smaller (<200 mm<sup>2</sup>) lesions ( $P = .25$ ). There also was no difference in the 2-year outcomes of the older patients (age ≥50 years;  $P = .91$ ).

**Conclusion:** Microfracture in the hip should not be limited to the criteria of knee lesions (<400 mm<sup>2</sup>) or to younger patients (age <50 years). However, the results also indicate that patients with full-thickness cartilage defects can anticipate a high rate of conversion to total hip arthroplasty within 2 years of their microfracture surgery and that only 60% of them will have good/excellent results over that time period.

[BACK](#)

### **No Effects of Early Viscosupplementation After Arthroscopic Partial Meniscectomy: A Randomized Controlled Trial**

Giuseppe Filardo, Berardo Di Matteo, Francesco Tentoni, Alessia Cavicchioli, Alessandro Di Martino, Mirco Lo Presti, Francesco Iacono, Elizaveta Kon, and Maurilio Marcacci

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**Background:** The management of the postoperative period after knee arthroscopic surgery may be challenging because surgical trauma deeply alters the joint microenvironment, causing the release of several catabolic molecules and proinflammatory factors that might slow down functional recovery. The possibility of using hyaluronic acid (HA) to promote postoperative pain relief and expedite functional improvement seems attractive, considering its biological properties.

**Purpose:** The aim of the present double-blind randomized controlled trial was to evaluate the effects, in terms of pain control and functional recovery, provided by a single HA injection performed at the end of arthroscopic meniscectomy.

**Study Design:** Randomized controlled trial; Level of evidence, 1.

**Methods:** A total of 90 patients, 18 to 55 years old, were included according to the following criteria: (1) chronic, symptomatic meniscal tears requiring partial resection; (2) a healthy contralateral knee; (3) no previous surgery on the index knee; and (4) no other concurrent articular lesions requiring surgical treatment (eg, cartilage or ligament injuries). Patients were randomized into 2 treatment groups: one underwent meniscectomy alone, whereas the other also received an injection of 3 mL HA at the end of the procedure. All patients were evaluated at baseline and then at 15, 30, 60, and 180 days using the following tools: International Knee Documentation Committee (IKDC) subjective, Knee injury and Osteoarthritis Outcome Score (KOOS), visual analog scale (VAS) for pain, VAS for general health status, and Tegner scores. The transpatellar circumference and active and passive ranges of motion were also recorded during the follow-up evaluations.

**Results:** No major adverse events were reported using HA postoperatively. A statistically significant increase in all the clinical scores was reported in both treatment groups, but no significant intergroup difference was documented at any follow-up evaluation. No difference was observed also in the objective measurements. The mean time to return to full sports activity was not different between groups, and a comparable satisfaction rate was recorded in both treatment groups.

**Conclusion:** Early postoperative viscosupplementation did not provide significant clinical benefits after arthroscopic meniscectomy. Despite the lack of major adverse events, the administration of a single HA injection at the end of the surgical procedure is not a successful strategy to provide either faster functional recovery or symptomatic improvement after meniscectomy.

[BACK](#)

## Outcomes After Revision Hip Arthroscopic Surgery in Adolescent Patients Compared With a Matched Cohort Undergoing Primary Arthroscopic Surgery

Justin T. Newman, Karen K. Briggs, Shannen C. McNamara, and Marc J. Philipppo

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**Background:** The incidence of hip arthroscopic surgery is increasing in the young athlete. This has also led to increased numbers of revision hip arthroscopic surgery.

**Hypothesis/Purpose:** The purpose of this study was to describe the outcomes after revision hip arthroscopic surgery in patients  $\leq 18$  years of age in comparison to a matched cohort of patients undergoing primary hip arthroscopic surgery. Our hypothesis was that patients undergoing revision hip arthroscopic surgery would demonstrate similar outcomes to those patients undergoing primary hip arthroscopic surgery.

**Study Design:** Cohort study; Level of evidence, 3.

**Methods:** Patients were included in the study if they underwent revision hip arthroscopic surgery by a single surgeon and did not undergo prior open hip surgery. Each patient in the revision hip arthroscopic surgery cohort was matched with 2 patients undergoing primary hip arthroscopic surgery from the same institution. Cohorts were matched by age, sex, and year of surgery. Preoperatively and at a minimum follow-up of 2 years, outcome scores were collected. The primary outcome measure was the Hip Outcome Score for activities of daily living scale (HOS-ADL), a self-reported validated outcome instrument, in addition to the HOS for sports scale (HOS-Sport), modified Harris Hip Score (mHHS), and 12-Item Short Form Health Survey Physical Component Summary (SF-12 PCS).

**Results:** Forty-two patients were included in the revision group and were matched with 84 patients in the primary group. The mean age in both groups was 16 years (range, 14-18 years). All female patients in the study were  $\geq 14$  years of age, and all male patients were  $\geq 16$  years of age. In patients undergoing revision, 13 underwent 1 prior surgical procedure, 22 underwent 2 prior surgical procedures, and 7 underwent  $\geq 3$  prior surgical procedures. The mean time from last surgery to revision was 18.7 months (range, 4.7-74 months). Eleven patients (26%) had prior femoroacetabular impingement treated, which required osteoplasty or rim trimming at revision. Subsequent hip arthroscopic surgery was reported in 3 of 84 (4%) patients in the primary group and 6 of 42 (14%) patients in the revision group ( $P = .162$ ). The mean follow-up in the revision group was  $43 \pm 17$  months, and scores significantly improved (HOS-ADL: 59.6 to 77.6; HOS-Sport: 37.6 to 64.8; mHHS: 55.3 to 74.3; SF-12 PCS: 41.0 to 50.4;  $P < .05$ ). The mean follow-up in the primary group was  $45 \pm 18$  months, and all scores significantly improved (HOS-ADL: 65.8 to 87.4; HOS-Sport: 46.3 to 79.9; mHHS: 57.5 to 84.2; SF-12 PCS: 39.0 to 51.8;  $P < .05$ ). At follow-up, there were no significant differences between the primary and revision groups for the HOS-ADL values ( $P = .051$ ) and SF-12 PCS values ( $P = .846$ ). Patients in the primary group had significantly higher HOS-Sport values ( $P = .008$ ), mHHS values ( $P = .008$ ), and patient satisfaction ( $P = .008$ ). Patients who underwent 1 prior hip arthroscopic procedure had a higher mean postoperative mHHS value (79.5 vs 72, respectively), HOS-ADL value (91.2 vs 73.4,

respectively), and HOS-Sport value (76 vs 60, respectively) ( $P < .05$ ) compared with those who underwent more than 1 prior procedure. Median patient satisfaction was 9.0 (range, 2-10) in the primary group and 8.0 (range, 2-10) in the revision group.

Conclusion: In conclusion, young patients who required revision hip arthroscopic surgery showed significant improvement in patient-reported outcome scores; however, final outcome scores in the revision group for sport activity, general health, and satisfaction were lower than those in the primary group. Patients who underwent 1 revision surgical procedure had higher outcome scores than patients who underwent more than 1 revision surgical procedure.

[BACK](#)

### **Predictors of Revision Surgery After Anterior Cruciate Ligament Reconstruction**

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Background: Arthroscopically assisted anterior cruciate ligament (ACL) reconstruction is a common orthopaedic procedure. Graft failure after reconstruction remains a devastating complication, often requiring revision surgery and less aggressive or modified rehabilitation. Worse functional and patient-reported outcomes are reported compared with primary reconstruction. Moreover, both rates and risk factors for revision are variable and inconsistent within the literature.

Purpose: To determine the rate of revision surgery after ACL reconstruction in a large cohort of patients, to assess the influence of patient characteristics on the odds of revision, and to compare revision rates between active-duty military members and non-active-duty beneficiaries.

Study Design: Descriptive epidemiology study.

Methods: Using administrative data from the Military Health System, a retrospective study was designed to characterize the rate of ACL revision surgery among patients treated within a military facility. All patients  $\geq 18$  years at the time of ACL reconstruction were identified using the American Medical Association Current Procedural Terminology (CPT) for ACL reconstruction (CPT code 29888) over 7 years (2005-2011). Revision ACL reconstructions were identified as having  $\geq 2$  ACL reconstruction procedure codes on the ipsilateral knee at least 90 days apart. Univariate analysis was performed to calculate odds ratios (ORs) for demographic, perioperative medication use, and concomitant procedure-related risk factors. A multivariate logistic regression model determined risk covariates in the active-duty cohort.

Results: The study population consisted of 17,164 ACL reconstructions performed among 16,336 patients, of whom 83.3% were male with a mean  $\pm$  SD age of  $28.9 \pm 7.6$  years for the nonrevision

group, and was predominantly active duty (89.2%). Patients undergoing ACL reconstruction on both knees only contributed their index knee for analyses. There were 587 patients who underwent revision surgery, corresponding to an overall revision rate of 3.6%. The median time from the index surgery to revision surgery was 500 days (interquartile range, 102-2406 days). Revision rates were higher in the active-duty cohort as compared with non-active-duty beneficiaries (3.8% vs 1.8%, respectively; OR, 2.14; 95% CI, 1.49-3.07). Based on multivariate logistic regression in the active-duty cohort, age  $\geq 35$  years (OR, 0.44; 95% CI, 0.33-0.58) and concomitant meniscal repair (OR, 0.69; 95% CI, 0.53-0.91) were found to be protective with regard to the odds of revision surgery. Perioperative medication use of nonsteroidal anti-inflammatory drugs (NSAIDs) (OR, 1.33; 95% CI, 1.12-1.58; number needed to harm [NNH], 100) and COX-2 inhibitors (OR, 1.31; 95% CI, 1.04-1.66; NNH, 333) was associated with increased odds of revision surgery. No significant findings were detected among sex, race, nicotine use, body mass index, or other concomitant procedures of interest.

Conclusion: In this large cohort study, the rate of revision ACL reconstruction was 3.6%, which is consistent with the existing literature. Increased odds of revision surgery among active-duty personnel were associated with the perioperative use of NSAIDs and COX-2 inhibitors. Age  $\geq 35$  years and concomitant meniscal repair were found to be protective against ACL revision.

[BACK](#)

## **Effect of High-Grade Preoperative Knee Laxity on Anterior Cruciate Ligament Reconstruction Outcomes**

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Background: Knee laxity in the setting of suspected anterior cruciate ligament (ACL) injury is frequently assessed through physical examination using the Lachman, pivot-shift, and anterior drawer tests. The degree of laxity noted on these examinations may influence treatment decisions and prognosis.

Hypothesis: Increased preoperative knee laxity would be associated with increased risk of subsequent revision ACL reconstruction and worse patient-reported outcomes 2 years postoperatively.

Study Design: Cohort study; Level of evidence, 2.

Methods: From an ongoing prospective cohort study, 2333 patients who underwent primary isolated ACL reconstruction without collateral or posterior cruciate ligament injury were identified.

Patients reported by the operating surgeons as having an International Knee Documentation Committee (IKDC) grade D for Lachman, anterior drawer, or pivot-shift examination were classified as having high-grade laxity. Multiple logistic regression modeling was used to evaluate whether having high-grade preoperative laxity was associated with increased odds of undergoing revision ACL reconstruction within 2 years of the index procedure, controlling for patient age, sex, Marx activity level, level of competition, and graft type. Multiple linear regression modeling was used to evaluate whether having high-grade preoperative laxity was associated with worse IKDC score or Knee injury and Osteoarthritis Outcome Score Knee-Related Quality of Life subscale (KOOS-QOL) scores at a minimum 2 years postoperatively, controlling for baseline score, patient age, ethnicity, sex, body mass index, marital status, smoking status, sport participation, competition level, Marx activity rating score, graft type, and articular cartilage and meniscus status.

Results: Pre-reconstruction laxity data were available for 2325 patients (99.7%). Two-year revision data were available for 2259 patients (96.8%), and patient-reported outcomes were available for 1979 patients (84.8%). High-grade preoperative laxity was noted in 743 patients (31.9%). The mean postoperative IKDC score was  $81.8 \pm 15.9$ , and the mean KOOS-QOL score was  $72.0 \pm 22.0$ . The presence of high-grade pre-reconstruction laxity was associated with significantly increased odds of ACL graft revision (odds ratio [OR] = 1.87 [95% CI, 1.19-2.95];  $P = .007$ ). The presence of high-grade pre-reconstruction laxity was not associated with any difference in postoperative IKDC ( $\beta = -0.56$ ,  $P = .44$ ) or KOOS-QOL ( $\beta = 0.04$ ,  $P = .97$ ).

Conclusion: The presence of high-grade pre-reconstruction knee laxity as assessed by manual physical examination under anesthesia is associated with significantly increased odds of revision ACL surgery but has no association with patient-reported outcome scores at 2 years after ACL reconstruction.

[BACK](#)

## **Twenty-Year Outcome of a Longitudinal Prospective Evaluation of Isolated Endoscopic Anterior Cruciate Ligament Reconstruction With Patellar Tendon or Hamstring Autograft**

Simon Michael Thompson, Lucy J. Salmon, Alison Waller, James Linklater, Justin P. Roe, and Leo A. Pinczewski

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Background: Long-term prospective studies of isolated endoscopic anterior cruciate ligament (ACL) reconstruction are limited and may include confounding factors.

Purpose: This study aimed to compare the outcomes of isolated ACL reconstruction using the patellar tendon (PT) autograft and the hamstring (HT) autograft in 180 patients over 20 years.

Study Design: Cohort study; Level of evidence, 2.

Methods: A total of 180 participants undergoing isolated ACL reconstruction between 1993 and 1994 were prospectively recruited. Evaluation was performed at 1, 2, 5, 7, 10, 15, and 20 years after surgery and included the International Knee Documentation Committee (IKDC) knee ligament evaluation with radiographic evaluation, KT-1000 arthrometer side-to-side difference, and subjective scores.

Results: Over 20 years, there were 16 patients (18%) and 9 patients (10%) with an ACL graft rupture in the HT and PT groups, respectively ( $P = .13$ ). ACL graft rupture was associated with male sex (odds ratio [OR], 3.9;  $P = .007$ ), nonideal tunnel position (OR, 3.6;  $P = .019$ ), and age <18 years at the time of surgery (OR, 4.6;  $P = .003$ ). The odds of a contralateral ACL rupture were increased in patients with the PT graft compared with patients with the HT graft (OR, 2.2;  $P = .02$ ) and those aged <18 years at the time of surgery (OR, 3.4;  $P = .001$ ). The mean IKDC scores at 20-year follow-up were 86 and 89 for the PT and HT groups, respectively ( $P = .18$ ). At 20 years, 53% and 57% of the PT and HT groups participated in strenuous or very strenuous activities ( $P = .55$ ), kneeling pain was present in 63% and 20% of the PT and HT groups ( $P = .018$ ), and radiographic osteoarthritic change was found in 61% and 41% of the PT and HT groups ( $P = .008$ ), respectively.

Conclusion: Compared with patients who received the HT graft, patients who received the PT graft had significantly worse outcomes with regard to radiologically detectable osteoarthritis, kneeling pain, and contralateral ACL injury. At 20-year follow-up, both HT and PT autografts continued to provide good subjective outcomes and objective stability. However, further ACL injury is common, particularly in male individuals, younger patients, and those with tunnel malposition.

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## **The Effect of Limited Perioperative Nonsteroidal Anti-inflammatory Drugs on Patients Undergoing Anterior Cruciate Ligament Reconstruction**

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**Background:** The administration of nonsteroidal anti-inflammatory drugs (NSAIDs) to patients undergoing anterior cruciate ligament reconstruction (ACLR) is controversial because it may impair tissue healing and clinical outcomes.

**Purpose:** To assess the effect of NSAID administration on patients undergoing ACLR.

**Study Design:** Cohort study; Level of evidence, 3.

**Methods:** Included patients were aged >15 years and were registered in the Norwegian Knee Ligament Registry from 2008 until 2013 after the primary ACLR. Patients with insufficient data regarding administration of NSAIDs and those with associated knee ligament injuries requiring surgical treatment were excluded from this study. Graft survival was estimated using Kaplan-Meier survival curves, and hazard ratios (HRs) for revision were evaluated using Cox regression analysis. Logistic regression analysis was used to calculate the odds ratio (OR) for a Knee Injury and Osteoarthritis Outcome Score (KOOS)–quality of life (QOL) subscale score <44 at 2-year follow-up.

**Results:** A total of 7822 patients were included in the analysis for graft survival and assessment for risk of revision. Of these, 4144 patients were administered NSAIDs postoperatively. The mean duration of follow-up was 2.8 years (range, 0-5.9 years). Administration of NSAIDs did not influence graft survival ( $P = .568$ ). Adjusted Cox regression analyses demonstrated the same finding regarding risk of revision (HR, 1.0; 95% CI, 0.8-1.3). ACLR using a bone–patellar tendon–bone autograft showed a reduced risk of revision (HR, 0.3; 95% CI, 0.1-0.8) among patients administered NSAIDs. In subgroup analyses of 3144 patients, administration of NSAIDs demonstrated a beneficial effect on the risk of a KOOS-QOL score <44 at 2-year follow-up (OR, 0.8; 95% CI, 0.6-0.9).

**Conclusion:** Administration of NSAIDs to patients after ACLR does not have a negative effect on graft survival, risk of revision, or risk of a KOOS-QOL score <44 at 2-year follow-up. We emphasize using caution when administering NSAIDs by keeping the duration and dosage of NSAIDs as short and low as possible to ensure sufficient pain relief while limiting unwanted exposure to any known and unknown adverse effects of these drugs.

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## JBJS

### **Predictors and Outcomes of Crossover to Surgery from Physical Therapy for Meniscal Tear and Osteoarthritis. A Randomized Trial Comparing Physical Therapy and Surgery**

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**Background:** Arthroscopic partial meniscectomy (APM) combined with physical therapy (PT) have yielded pain relief similar to that provided by PT alone in randomized trials of subjects with a degenerative meniscal tear. However, many patients randomized to PT received APM before assessment of the primary outcome. We sought to identify factors associated with crossing over to APM and to compare pain relief between patients who had crossed over to APM and those who had been randomized to APM.

**Methods:** We used data from the MeTeOR (Meniscal Tear in Osteoarthritis Research) Trial of APM with PT versus PT alone in subjects  $\geq 45$  years old who had mild-to-moderate osteoarthritis and a degenerative meniscal tear. We assessed independent predictors of crossover to APM among those randomized to PT. We also compared pain relief at 6 months among those randomized to PT who crossed over to APM, those who did not cross over, and those originally randomized to APM.

**Results:** One hundred and sixty-four subjects were randomized to and received APM and 177 were randomized to PT, of whom 48 (27%) crossed over to receive APM in the first 140 days after randomization. In multivariate analyses, factors associated with a higher likelihood of crossing over to APM among those who had originally been randomized to PT included a baseline Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) Pain Score of  $\geq 40$  (risk ratio [RR] = 1.99; 95% confidence interval [CI] = 1.00, 3.93) and symptom duration of  $< 1$  year (RR = 1.74; 95% CI = 0.98, 3.08). Eighty-one percent of subjects who crossed over to APM and 82% of those randomized to APM had an improvement of  $\geq 10$  points in their pain score at 6 months, as did 73% of those who were randomized to and received only PT.

**Conclusions:** Subjects who crossed over to APM had presented with a shorter symptom duration and greater baseline pain than those who did not cross over from PT. Subjects who crossed over had rates of surgical success similar to those of the patients who had been randomized to surgery. Our findings also suggest that an initial course of rigorous PT prior to APM may not compromise surgical outcome.

**Level of Evidence:** Prognostic Level II. See Instructions for Authors for a complete description of levels of evidence.

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