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## Upper extremity

[Arthroscopy, Volume 34, Issue 11](#)

### **Arthroscopic Double-Layer Lasso Loop Technique to Repair Delaminated Rotator Cuff Tears**

Gaëtan J. Opsomer, M.D., Ashish Gupta, M.D., David L. Haeni, M.D., Thomas Schubert, M.D., Ph.D., Etienne Lejeune, M.D., Kalojan Petkin, M.D., Jashint Maharaj, M.D., Laurent Lafosse, M.D.

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#### **Purpose**

To evaluate the arthroscopic double-layer lasso loop repair technique for delaminated posterosuperior rotator cuff tears.

#### **Methods**

Forty-one patients underwent arthroscopic rotator cuff repair of a delaminated posterosuperior rotator cuff tear by the double-layer lasso loop technique. Their preoperative and postoperative clinical and functional scores were compared to evaluate surgical outcomes. The prerequisite for inclusion was a minimum follow-up period of 2 years. We excluded patients with a history of shoulder surgery before the double-layer lasso loop repair.

#### **Results**

Statistically significant improvements ( $P < .001$ ) were found in the Constant score (54 vs 83) and University of California, Los Angeles functional score (6.4 vs 9.5). Pain and strength improved according to the Jobe test, bear-hug test, belly-press test, Gerber lift-off test, and external rotation test ( $P < .001$ ). No significant difference in strength was noted between the operated and nonoperated sides. There was only 1 complete rerupture (3.1%), whereas 5 patients (15.6%) had partial ruptures.

#### **Conclusions**

The arthroscopic double-layer lasso loop repair technique for delaminated posterosuperior rotator cuff tears is an effective procedure. Our series showed a low rerupture rate. At a mean follow-up of 44 months, postoperative recovery with resultant functional, pain, and patient satisfaction scores was good to excellent and was comparable with the nonoperated side.

#### **Level of Evidence**

Level IV, case series.

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## **Remplissage Using Interconnected Knotless Anchors: Superior Biomechanical Properties to a Knotted Technique?**

Tadanao Funakoshi, M.D. Ph.D., Robert Hartzler, M.D., M.S., Eduardo Stewien, M.D., Stephen Burkhart, M.D.

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### **Purpose**

To evaluate the biomechanical fixation strength and gap formation of 2 different remplissage fixation methods (double pulley knotted construct and interconnected knotless repair construct) in cadaver specimens.

### **Methods**

Seven matched pairs of human cadaveric shoulders were used for testing (mean age,  $56 \pm 10$  years). A shoulder from each matched pair was randomly selected to receive a Hill-Sachs remplissage using either a knotted (No. 2 FiberWire double pulley with 3.0-mm SutureTak anchors) or knotless (coreless No. 2 FiberWire interconnected between 3.9-mm knotless CorkScrew anchors) double mattress construct. The tendon was cycled between 10 and 100 N at 1 Hz for 100 cycles, followed by a single-cycle pull to failure at 33 mm/s. Cyclic displacement, load to clinical failure (5 mm), yield load, and mode of failure were recorded.

### **Results**

Neither construct demonstrated clinical failure under cyclic loading. Load to clinical failure was higher for the knotless repair than that of the knotted repair ( $788 \pm 162$  N vs  $488 \pm 227$  N;  $P = .003$ ). The yield load was higher for the knotless repair than that of the knotted repair ( $1,080 \pm 298$  N vs  $591 \pm 265$  N;  $P = .008$ ). The most common failure mode for the knotted repair was knot failure or tendon tearing, whereas the failure mode for the knotless repair was by anchor pull-out or tendon tear with no failures occurring via the interconnected suture construct mechanism.

### **Conclusions**

In this biomechanical study comparing cyclic and ultimate loading for 2 double mattress remplissage repairs, the construct using interconnected, knotless sutures outperformed the knotted construct. No failure of the interconnected suture construct mechanism by slippage or breakage was observed in the knotless group.

### **Clinical Relevance**

The use of the interconnected knotless suture technique might improve the biomechanical strength of arthroscopic remplissage repairs in treating shoulder instability.

## **The Superior Glenohumeral Joint Capsule Alone Does Not Prevent Superior Translation of the Humeral Head: An In Vitro Biomechanical Study**

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### **Purpose**

To answer 2 questions: What is the main structure that prevents the superior translation of the humeral head, the supraspinatus or the superior capsule (SC)? And what mechanism does the principal structure rely on to prevent the superior translation of the humeral head, the spacer effect or the tensional hammock effect?

### **Methods**

Eight shoulder specimens were assessed using a custom biomechanical testing system. Glenohumeral superior translation and subacromial peak pressure were compared using 6 models: the intact joint model, supraspinatus dysfunction model, supraspinatus defect model, SC tear model, SC defect model, and irreparable rotator cuff tear (IRCT) model.

### **Results**

Compared with the intact joint model, the supraspinatus defect model significantly increased the superior translation (by 2.6 mm;  $P < .001$ ) and subacromial peak pressure (by 0.43 MPa;  $P = .013$ ) at  $0^\circ$  glenohumeral abduction, while the SC defect model unremarkably altered the superior translation at  $0^\circ$  (by 0.6 mm;  $P = .582$ ) and  $45^\circ$  (by 0.3 mm;  $P = .867$ ) of glenohumeral abduction and the subacromial peak pressure at  $0^\circ$  (by 0.11 MPa;  $P = .961$ ),  $30^\circ$  (by  $-0.03$  MPa;  $P = .997$ ), and  $45^\circ$  (by  $-0.33$  MPa;  $P = .485$ ) of glenohumeral abduction. The supraspinatus dysfunction model significantly increased the superior translation at  $0^\circ$  (by 1.7 mm;  $P < .001$ ),  $30^\circ$  (by 1.2 mm;  $P = .005$ ), and  $45^\circ$  (by 0.8 mm;  $P = .026$ ) of glenohumeral abduction, but not the subacromial peak pressure compared with the intact joint model. However, no significant differences were found between the supraspinatus defect model and the supraspinatus dysfunction model with respect to the superior translation or subacromial peak pressure (all  $P > .05$ ).

### **Conclusions**

The anatomic SC has a negligible role in preventing the superior translation of the humeral head.

### **Clinical Relevance**

SC reconstruction is not a simple anatomic reconstruction, and its promising clinical outcome may be due to tensional fixation technique and choice of graft.

## **A Comparative Study to Evaluate the Risk Factors for Medium-Sized Rotator Cuff Tear in Patients Younger Than 50 Years of Age**

Seung Bo Shim, M.D., Jeung Yeol Jeong, M.D., Tae Hoon Yum, M.D., Jae Chul Yoo, M.D.

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### **Purpose**

The purpose of this study was to evaluate preoperative and intraoperative factors associated with rotator cuff tears (RCTs) among patients younger than 50 years and to compare arthroscopic rotator cuff repair (RCR) results in patients younger than 50 years (group A) and patients older than 70 years (group B). We also analyzed the results after arthroscopic RCR in these 2 age groups.

### **Methods**

Data were collected from 56 patients allocated to group A and 55 patients allocated to group B who had medium-sized RCTs and had undergone arthroscopic RCR between January 2006 and August 2015. Preoperative variables included demographic data, radiologic data, and surgical procedure. We evaluated fatty degeneration on preoperative magnetic resonance imaging (MRI) and intraoperative variables, including concomitant subscapularis repair, as well as repair technique. Pain visual analog scale, functional visual analog scale, American Shoulder and Elbow Surgeons, and Constant scores were documented to compare functional results in each age group. Postoperative MRI scans were conducted to evaluate the retear rate after RCR after a mean postoperative duration of 5.4 months (range, 2-48 months).

### **Results**

Multivariate regression analysis showed acute-on-chronic injury and a history of hypertension were independent factors for differentiation of the groups. Stepwise regression analysis found sex, hypertension, and fatty infiltration of the supraspinatus and infraspinatus to be comparable factors for each group. All patients showed improved results after arthroscopic RCR, but there was no difference between the 2 groups in functional outcomes. However, cuff retears on postoperative MRI scans were found in only 3.9% of the patients in group A versus 16% of the patients in group B.

### **Conclusions**

The results of this study showed that sex, acute-on-chronic injury, and preoperative fatty infiltration of the rotator cuff were significant factors affecting medium-sized RCTs in patients younger than 50 years. In addition, there were no significant differences in functional outcomes after arthroscopic RCR in both groups at 2 years, but postoperative MRI showed a lower retear rate in group A.

### **Level of Evidence**

Level III, retrospective comparative study.

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## **Biomechanical Analysis of Single-, Double-, and Triple-Bundle Configurations for Coracoclavicular Ligament Reconstruction Using Cortical Fixation Buttons With Suture Tapes: A Cadaveric Study**

In Park, M.D., Ph.D., Yasuo Itami, M.D., Bobak Hedayati, B.S., Benjamin Bitner, B.S., Michelle H. McGarry, M.S., Thay Q. Lee, Ph.D., Sang-Jin Shin, M.D., Ph.D.

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### **Purpose**

To compare the acromioclavicular (AC) joint stability of single-bundle (SB), double-bundle with an anterolateral limb (DBa), double-bundle with a posterolateral limb (DBp), and triple-bundle (TB) coracoclavicular (CC) ligament reconstructions using cortical fixation buttons with suture tapes.

### **Methods**

Eight cadaveric shoulders were used. AC joint translation and rotational stability were tested for intact and following 4 different CC reconstruction techniques: SB, DBa, DBp, and TB configurations using cortical fixation buttons with suture tapes. For each reconstruction and native AC joint as control, anteroposterior (AP) and superoinferior translations were quantified using 10- and 15-N translational loads and anterior and posterior rotations were measured using 0.16- and 0.32-Nm rotational torque.

### **Results**

DBp reconstruction showed significantly better AP stability compared with SB and DBa reconstruction at 10 and 15 N (DBp:  $4.1 \pm 0.6$  mm, SB:  $7.8 \pm 1.1$  mm,  $P < .001$ ; DBa:  $6.5 \pm 0.7$  mm,  $P = .02$  at 10 N; DBp:  $5.5 \pm 0.8$  mm, SB:  $10.1 \pm 1.0$  mm,  $P = .003$ ; DBa:  $9.1 \pm 0.7$  mm,  $P = .02$  at 15 N). The degree of total rotation showed tendency to decrease according to increasing number of bundles; however, there were no significant differences (SB:  $43.1 \pm 9.2^\circ$ , DBa:  $37.9 \pm 7.3^\circ$ , DBp:  $33.9 \pm 6.8^\circ$ , TB:  $32.2 \pm 6.6^\circ$ ,  $P = .37$  at 0.32 Nm).

### **Conclusions**

An additional posterolateral clavicular hole for CC ligament reconstruction using cortical fixation buttons with suture tapes resulted in better AP stability compared with SB reconstruction, whereas use of additional anterolateral clavicular hole did not show any improvement compared with SB reconstruction. Reconstruction using both anterolateral and posterolateral clavicular holes did not guarantee better stability compared with SB reconstruction. There was an increasing tendency of rotational stability with number of bundle increases, although they did not reach statistical difference.

### **Clinical Relevance**

When surgeons consider double-bundle CC ligament reconstruction using cortical fixation buttons with suture tapes, it is better to position the lateral clavicular hole posteriorly to restore AP stability.



## **Prognostic Factors of Arthroscopic Debridement for Central Triangular Fibrocartilage Complex Tears in Adults Younger Than 45 Years: A Retrospective Case Series Analysis**

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### **Purpose**

The purpose of this study was to analyze factors that affect the treatment outcomes of arthroscopic debridement for central triangular fibrocartilage complex (TFCC) lesions in adults <45 years of age.

### **Methods**

A total of 71 patients (mean age, 39 years; range, 20-44 years) who had been arthroscopically diagnosed with central TFCC tears were treated with arthroscopic debridement. Demographic, clinical, and arthroscopic findings were examined and analyzed. The response to treatment, including pain numeric rating scale on an ulnar provocation test; Disability of the Arm, Shoulder, and Hand score; and satisfaction with treatment, was assessed at 12-month follow-up.

### **Results**

The mean pain numeric rating scale ( $6.6 \pm 3.6$  to  $2.4 \pm 2.0$ ,  $P < .01$ ) and Disability of the Arm, Shoulder, and Hand ( $59.3 \pm 15.0$  to  $33.7 \pm 14.1$ ,  $P < .01$ ) scores exhibited significant clinical improvement at 12-month follow-up. In terms of satisfaction, 43 patients (70.5%) were satisfied (enthusiastic or satisfied) and 18 (29.5%) were dissatisfied (noncommittal or disappointed). In the satisfied group, there were 24 flap and 19 wearing tears, whereas in the dissatisfied group, there were 4 flap and 14 wearing tears ( $P = .02$ ). The extent of ulnar plus variance on preoperative radiographs also differed between the 2 groups ( $0.5 \pm 1.2$  vs  $1.7 \pm 1.1$ ,  $P < .01$ ). There were no significant differences in age, gender, hand dominance, or work level between the groups. After controlling for confounding variables, the wearing type tears (odds ratio, 3.4) and greater ulnar plus variance (odds ratio, 2.0) were associated with a higher likelihood of dissatisfaction after arthroscopic TFCC debridement.

### **Conclusions**

Although clinical outcome scores showed significant improvement after arthroscopic debridement for central TFCC tears, wearing type tears and greater ulnar plus variance were associated with dissatisfaction and poorer postoperative outcomes after the procedure.

### **Level of Evidence**

Level IV, case series.

## **Outcomes After Arthroscopic Rotator Interval Closure for Shoulder Instability: A Systematic Review**

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### **Purpose**

(1) To systematically assess the clinical outcomes of arthroscopic rotator interval closure (RIC) procedures for shoulder instability and (2) to report the different technical descriptions and surgical indications for this procedure.

### **Methods**

Two independent reviewers searched 4 databases (PubMed, Embase, Web of Science, and Cochrane) from database inception until October 15, 2017. The inclusion criteria were studies that reported outcomes of shoulder stabilization using arthroscopic RIC as an isolated or adjunctive surgical procedure. The methodologic quality of studies was assessed with the Methodological Index for Non-Randomized Studies tool and Grading of Recommendations Assessment, Development and Evaluation system for randomized controlled trials.

### **Results**

Fifteen studies met our search criteria (524 patients). Of the studies, 12 were graded Level IV evidence; 2, Level III; and 1, Level II. Six different RIC technique descriptions were reported, with 2 studies not defining the details of the procedure. The most common method of RIC was arthroscopic plication of the superior glenohumeral ligament to the middle glenohumeral ligament (8 of 15 studies). The most commonly used patient-reported outcome measure was the Rowe score, with all studies reporting a minimum postoperative score of 80 points. The rate of return to preinjury level of sport ranged from 22% to 100%, and the postoperative redislocation rate ranged from 0% to 16%.

### **Conclusions**

The indications for RIC were poorly reported, and the surgical techniques were inconsistent. Although most studies reported positive clinical results, the heterogeneity of outcome measures limited our ability to make definitive statements about which types of rotator interval capsular closure are warranted for select subgroups undergoing arthroscopic shoulder stabilization.

### **Level of Evidence**

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

**Evaluation of risk factors for irreparable rotator cuff tear in patients older than age 70 including evaluation of radiologic factors of the shoulder**

Seung Bo Shim, MD, Jeung Yeol Jeong, MD, Jae Soo Kim, MD, Jae Chul Yoo, MD

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**Background**

Rotator cuff tears (RCTs) are generally considered to occur at the age of 40 to 50, but some becomes massive tears at the age of 60 to 70 if neglected. This study evaluated preoperative factors affecting tear size and reparability of rotator cuffs based on magnetic resonance imaging findings among patients older than age 70.

**Methods**

We identified 270 patients with full-thickness RCTs (175 reparable tears, group A; 95 irreparable tears, group B) that were confirmed with magnetic resonance imaging findings from January 2009 to March 2016. Irreparable tear was identified if all of the following criteria were met: (1) a large to massive RCT based on the DeOrio and Cofield classification, (2) sum of preoperative global fatty degeneration index of the supraspinatus and infraspinatus  $\geq 6$ , and (3) positive tangent sign. Preoperative variables included demographic data, medical history, and radiologic data. Acromial index, critical shoulder angle, and acromiohumeral interval (AHI) were evaluated to investigate the relationship between anatomic factors and reparability of RCT.

**Results**

Stepwise multivariate regression analysis revealed older age, longer symptom duration, longer duration of overhead sports activity, lower preoperative forward elevation of the shoulder joint, and shorter AHI as risk factors for irreparable RCTs.

**Conclusions**

This study suggests that older age at surgery, longer duration of symptoms, longer duration of overhead sports activity, lower preoperative forward elevation of the shoulder joint, and shorter AHI are independent risk factors for irreparable RCT.

## **Tenodesis renders better results than tenotomy in repairs of isolated supraspinatus tears with pathologic biceps**

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### **Background**

Many authors recommend systematic biceps tenotomy or tenodesis when repairing rotator cuff tears, regardless of whether the biceps is normal or pathologic. The purpose of this study was to determine whether 10-year outcomes of repairs of isolated supraspinatus tears are influenced by adjuvant biceps tenodesis or tenotomy.

### **Methods**

Patients who underwent repair of isolated supraspinatus tears were recalled for evaluation at a minimum follow-up of 10 years. A total of 249 patients (51% men) aged  $56.7 \pm 6.3$  years were evaluated clinically (Constant score), of whom 182 were also evaluated using magnetic resonance imaging (Sugaya classification). The biceps was intraoperatively found to be pathologic in 52% of shoulders, of which 39% had a tenotomy and 54% had a tenodesis; it was found to be normal in 48% of shoulders, of which 88% were left intact.

### **Results**

There were no significant differences in Constant scores for patients who had normal biceps without adjuvant procedures ( $77.1 \pm 11.7$ ) compared with patients who had pathologic biceps with either tenodesis ( $79.8 \pm 11.5$ ,  $P = .104$ ) or tenotomy ( $75.3 \pm 10.7$ ,  $P = .420$ ). However, for patients who had pathologic biceps, Constant scores were significantly better for those with tenodesis compared with those with tenotomy ( $P = .025$ ). Multivariable regression revealed Constant scores to be significantly lower for women, as well as patients with fatty infiltration of stages 1 and 2, but significantly higher for patients who underwent tenodesis.

### **Conclusion**

Adjuvant biceps procedures are not required when repairing isolated supraspinatus tears, unless biceps pathology is observed intraoperatively, for which tenodesis grants better function and strength than tenotomy.

## **Clinical outcomes and repair integrity after arthroscopic full-thickness rotator cuff repair: suture-bridge versus double-row modified Mason-Allen technique**

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### **Background**

This retrospective study compared the clinical and radiologic outcomes of patients who underwent arthroscopic rotator cuff repairs by the suture-bridge and double-row modified Mason-Allen techniques.

### **Methods**

From January 2012 to May 2013, 76 consecutive cases of full-thickness rotator cuff tear, 1 to 4 cm in the sagittal plane, for which arthroscopic rotator cuff repair was performed, were included. The suture-bridge technique was used in 37 consecutive shoulders; and the double-row modified Mason-Allen technique, in 39 consecutive shoulders. Clinical outcomes at a minimum of 2 years (mean, 35.7 months) were evaluated postoperatively using the visual analog scale; University of California, Los Angeles Shoulder Scale; American Shoulder and Elbow Surgeons Subjective Shoulder Scale; and Constant score. Postoperative cuff integrity was evaluated at a mean of 17.7 months by magnetic resonance imaging.

### **Results**

At the final follow-up, the clinical outcomes improved in both groups (all  $P < .001$ ) but with no significant differences between the 2 groups (all  $P > .05$ ). The retear rate was 18.9% in the shoulders subjected to suture-bridge repair and 12.8% in the double-row modified Mason-Allen group; the difference was not significant ( $P = .361$ ).

### **Conclusions**

Despite the presence of fewer suture anchors, the patients who underwent double-row modified Mason-Allen repair had comparable shoulder functional outcomes and a comparable retear rate with those who underwent suture-bridge repair. Therefore, the double-row modified Mason-Allen repair technique can be considered an effective treatment for patients with medium- to large-sized full-thickness rotator cuff tears.

## **Is augmentation with the long head of the biceps tendon helpful in arthroscopic treatment of irreparable rotator cuff tears?**

Sung-Ryeoll Park, MD, Dong-Hyuk Sun, MD, Jinhong Kim, MD, Hyo-Jin Lee, MD, Jong-Bin Kim, MD, Yang-Soo Kim, MD, PhD

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### **Background**

Although various surgical techniques have been used to treat irreparable rotator cuff tears (RCTs), debate remains regarding which treatment is most effective. The purpose of our study was to compare the outcomes of partial rotator cuff repair versus repair with augmentation of the tenotomized long head of the biceps tendon (LHBT).

### **Methods**

This study included 76 patients with large to massive RCTs. Arthroscopic rotator cuff repair with LHBT augmentation was performed in 39 patients (group I), while partial repair was performed in 37 patients (group II). Clinical and functional outcomes were compared with a visual analog scale for pain and the American Shoulder and Elbow Surgeons score, Constant score, and Korean Shoulder Score. Magnetic resonance imaging was performed 12 months after surgery.

### **Results**

The mean follow-up period was  $29.6 \pm 7.8$  months (range, 24-51 months). Significant improvements in pain and clinical scores were observed in both groups at the last follow-up. However, there were no significant differences in pain, clinical scores, or range of motion between the 2 groups at any time point. Retears were observed in 16 patients in group I (41.0%) and 14 in group II (37.8%,  $P = .78$ ). Augmented LHBT pathology was observed in 10 patients (25.6%).

### **Conclusions**

Both partial repair and repair with LHBT augmentation were effective in improving clinical and radiologic outcomes. No significant differences in clinical outcomes or repaired cuff integrity were observed between the groups. The investment of operation time and effort in augmenting the LHBT in the treatment of irreparable RCTs is not recommended.

## **Rotator cuff repair with all-suture anchors: a midterm magnetic resonance imaging evaluation of repair integrity and cyst formation**

Hans Van der Bracht, MD, PhD, Tom Van den Langenbergh, MD, Marc Pouillon, MD, Skrallan Verhasselt, MD, Philippe Verniers, MD, Danny Stoffelen, MD, PhD

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### **Background**

This study investigated the feasibility and safety of all-suture anchors in arthroscopic rotator cuff repair.

### **Methods**

All patients were diagnosed with a rotator cuff tear by ultrasound or magnetic resonance imaging (MRI). Patients with partial tears, massive tears, subscapularis tears, or previous shoulder surgery, were excluded. MRI and clinical outcome were investigated in all patients at 1.58 years (range, 1.0-2.0 years) after rotator cuff repair with all-suture anchors (prospective case series). Integrity of the cuff repair, cyst formation (encapsulated fluid signal around the anchor), ingrowth of the bone into the anchor, and integrity of the bone tunnel border were evaluated for 47 anchors. Clinical results were evaluated using the Constant-Murley score.

### **Results**

An MRI evaluation was performed in 20 patients at 1.58 years (range, 1.0-2.0 years) after rotator cuff repair with all-suture anchors. MRI evaluation showed a very small rim of fluid around 10% of the anchors. None of the anchors showed cyst formation with fluid diameter more than twice the anchor diameter. In approximately 90% of the anchors, no fluid could be detected between the anchors and the edge of the bony tunnel. Full rotator cuff integrity was seen in 19 patients. Only 1 patient sustained a re-rupture. Clinical results comparable with an arthroscopic rotator cuff repair using classic anchors were seen.

### **Conclusions**

This prospective clinical cohort study shows promising early radiographic and clinical results after arthroscopic rotator cuff repair using all-suture anchors.

## **Analysis of technical feasibility and neurovascular safety of endoscopic distal biceps repair: a cadaveric study**

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### **Background**

This cadaveric study was designed to analyze the safety of endoscopic repair of distal biceps tendon (DBT) tears using 2 reattachment techniques. We evaluated the proximity of neurovascular structures to endoscopy portals; iatrogenic injury to neurovascular, musculotendinous, and osseous structures; and changes in compartment pressures. We hypothesized that an all-endoscopic repair of the ruptured DBT would be technically safe and the risk of iatrogenic injury would be low.

### **Methods**

A 2-portal endoscopic tendon repair was performed in 28 fresh-frozen cadaveric elbows with button devices (with or without interference screws) ( $n = 17$ ) and suture anchors ( $n = 11$ ). Dissection was performed, and neurovascular, musculotendinous, and osseous structures were assessed for iatrogenic injury. The repair construct (tendon-tuberosity contact area and implant placement site) was evaluated, and compartment pressures were measured. Statistical analysis was performed to determine significant differences in iatrogenic injury, compartment pressure changes, and tendon-bone contact area between different devices.

### **Results**

The lateral cutaneous nerve, cephalic vein, and radial artery were in close proximity to the portals. The button group showed a significantly higher number of iatrogenic injuries than the anchor group ( $P = .036$ ). All-suture anchor repair showed a significantly higher contact area (mean, 85 mm<sup>2</sup>) than repairs with all other devices ( $P < .001$ ). Compartment pressures increased by 2-4 mm in each of the 3 compartments tested ( $P < .001$ ).

### **Conclusion**

Endoscopic DBT repair was technically feasible with both fixation techniques. Button devices were associated with a significantly higher number of iatrogenic injuries. Endoscopic repair with dual suture anchors was safe in cadavers; however, further clinical results are necessary to establish the clinical safety of this technique.



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## Lower Extremity

Arthroscopy, Volume 34, Issue 11

### **Hip Arthroscopy in Patients Ages 50 Years or Older: Minimum 5-Year Outcomes, Survivorship, and Risk Factors for Conversion to Total Hip Replacement**

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#### **Purpose**

To report minimum 5-year outcomes and risk factors for conversion to total hip arthroplasty (THA) in patients  $\geq 50$  years old undergoing hip arthroscopy to treat labral tears and femoroacetabular impingement (FAI).

#### **Methods**

Data were prospectively collected on patients who underwent hip arthroscopy to treat labral tears and FAI between February 2008 and January 2012. The inclusion criteria were  $\geq 50$  years old at surgery, arthroscopic treatment for both labral tears and FAI, and preoperative patient-reported outcome (PRO) scores for modified Harris Hip Score (mHHS), Nonarthritic Hip Score (NAHS), Hip Outcome Score-Sports Specific Subscale (HOS-SSS), and Visual Analog Scale (VAS). The exclusion criteria were Tönnis grade  $> 1$  and previous hip conditions or surgeries.

#### **Results**

Of 103 eligible cases, 94 hips (91.3%) had minimum 5-year follow-up at a mean of 70.1 months (range, 60.0-95.1 months). All PROs and VASs demonstrated significant improvement at latest follow-up ( $P = .0001$ ). Mean patient satisfaction was 8.4. All mean scores demonstrated durability from 2 years to latest follow-up, and NAHS ( $P = .009$ ), HOS-SSS ( $P = .02$ ), and VAS ( $P = .04$ ) continued to significantly improve. Fifty-one (54.3%) of cases reached patient acceptable symptomatic state for mHHS, and 49 cases (52.1%) achieved minimal clinically important difference for this outcome measure. Four cases (4.3%) required secondary arthroscopy, and survivorship was 72.3%. Compared with survivors, the subgroup requiring THA demonstrated higher body mass indexes ( $P = .01$ ), had larger alpha angles ( $P = .0200$ ) and smaller lateral center-edge angles ( $P = .0200$ ), and had higher proportions of Tönnis grade 1 ( $P = .0012$ ), acetabular Outerbridge grade  $\geq 2$  ( $P = .0500$ ), and femoral head Outerbridge grade  $\geq 2$  ( $P = .0001$ ).

#### **Conclusions**

Hip arthroscopy for the treatment of labral tears and FAI in patients  $\geq 50$  years old demonstrates statistically significant PRO improvements at minimum 5-year follow-up. However, due to potential for subsequent need for THA in a subset of this population, surgeons should use rigorous selection criteria and counsel patients appropriately.

#### **Level of Evidence**

Level IV, case series.

[BACK](#)

## **Acetabular Chondral Lesions Associated With Femoroacetabular Impingement Treated by Autologous Matrix-Induced Chondrogenesis or Microfracture: A Comparative Study at 8-Year Follow-Up**

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### **Purpose**

The aim of this retrospective study was to investigate, at 8 years, the clinical follow-up and failure rate (revision rate/conversion to arthroplasty) of patients with hip chondral lesions associated with femoroacetabular impingement and to compare over time the treatment by microfracture (MFx) and autologous matrix-induced chondrogenesis (AMIC).

### **Methods**

Patients aged between 18 and 55 years, with acetabular grade III and IV chondral lesions (Outerbridge), measuring 2 to 8 cm<sup>2</sup> operated on at least 8 years before enrollment. Exclusion criteria were rheumatoid arthritis, dysplasia, or axial deviation of the femoral head. There were no arthritic lesions, Tonnis < 2, or joint space of at least 2 mm. MFx was performed with an awl, and the Chondro-Gide membrane used for the AMIC procedure was placed without glue. Outcomes used modified Harris hip score (mHHS) at 6 months and yearly for 8 years and patient acceptable symptomatic state.

### **Results**

Among 130 patients, 109 fulfilled inclusion criteria. Fifty were treated by MFx and 59 by AMIC. The mHHS significantly improved in both groups from  $46 \pm 6.0$  to  $78 \pm 8.8$  for mHHS at 6-12 months, even for lesions > 4 cm<sup>2</sup>. From 2 to 8 years, mHHS in the AMIC group was better than in the MFx group ( $P < .005$ ). This mHHS improvement in the AMIC group was maintained through the 8-year follow-up period, whereas it deteriorated after 1 year in the MFx group ( $P < .005$ ). Eleven patients (22%) in the MFx group required total hip arthroplasty (THA); none in the AMIC group did. Patient acceptable symptomatic state analysis confirmed similar short-term improvement, but a significant ( $P < .007$ ) degradation after 2-8 years in MFx patients.

### **Conclusions**

MFx and AMIC techniques led to marked clinical short-term improvement in patients with chondral defects resulting from femoroacetabular impingement in the first 2 years. However, AMIC gave significantly better results as measured by mHHS, which were maintained after 8 years, the results of MFx in the hip deteriorated over time with 22% of patients undergoing conversion to THA. No patient in the AMIC group was converted to THA; the results of AMIC appeared stable over time and independent of lesion size.

### **Level of Evidence**

III, retrospective patient group study.

## Identification of a Patient Acceptable Symptomatic State Score for the International Hip Outcome Tool in People Undergoing Hip Arthroscopy

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### Purpose

To determine a Patient Acceptable Symptomatic State (PASS) score for the 33-item International Hip Outcome Tool (iHOT-33) in people undergoing hip arthroscopy for primary diagnoses of femoroacetabular impingement syndrome, acetabular labral tears, and/or ligamentum teres pathology.

### Methods

Consecutive participants underwent hip arthroscopy by a single surgeon between August 2011 and May 2016. Participants were included if they were between ages 18 and 60 years and underwent hip arthroscopy for femoroacetabular impingement syndrome, acetabular labral tears, or ligamentum teres pathology. Participants were excluded if they did not speak sufficient English to complete the iHOT-33, had evidence of hip dysplasia, had less than 2 mm of joint space on anteroposterior radiograph, or underwent subsequent total hip replacement surgery. Participants completed the iHOT-33 preoperatively and at a minimum of 1 to a maximum of 5 years postoperatively. Participants were also asked to answer yes or no to the external anchor question of "Taking into account all the activities you do during your daily life, your level of pain and also your functional impairment, are you satisfied with your current state following your surgery?" A receiver operating characteristic (ROC) curve was used to identify the PASS score. Multiple logistic regression was performed to determine if patient factors, primary preoperative diagnosis, or intraoperative findings predicted achievement of the PASS score.

### Results

A total of 117 participants undergoing hip arthroscopy were included: 72 women (61.1%) and 45 men (38.5%) with mean age of 36.81 years (18-59). Forty-two (35.9%) had cam morphology, 18 (15.4%) had pincer morphology, 78 (67.2%) had labral tears, and 97 (82.9%) had ligamentum teres tears. Mean time to final follow-up was 2.25 years (range, 1-5). The PASS score at a mean of 2.25 years postoperatively was 58 as determined by the cutoff threshold on the ROC curve with the lowest difference between sensitivity and specificity (area under the ROC curve 0.88;  $P < .01$ ; 95% confidence interval [CI], 0.81-0.95). No factors were predictors of achievement of the PASS score in this study ( $P > .05$ ), including age (odds ratio [OR], 0.71; 95% CI, 0.32-1.56), sex (OR, 1.02; 95% CI, 0.98-1.06), preoperative iHOT-33 score (OR, 1.002; 95% CI, 0.98-1.03), primary preoperative diagnosis (OR, 0.86; 95% CI, 0.53-1.40), cam morphology (OR, 1.19; 95% CI, 0.54-2.64), Pincer morphology (OR, 0.50; 95% CI, 0.18-1.38), acetabular labral tears (OR, 1.93; 95% CI, 0.88-4.26), Outerbridge grade 3-4 chondral damage (OR, 0.97; 95% CI, 0.42-2.25), and ligamentum teres pathology (OR, 0.95; 95% CI, 0.35-2.61).

### Conclusions

This study reports a PASS score of 58 for the iHOT-33 at 2 years following hip arthroscopy. The PASS score will assist in assessing response to hip arthroscopy in research and clinical settings.

### Level of Evidence

Level II, retrospective prognostic study.

[BACK](#)

## **Topographic Matching of Osteochondral Allograft Transplantation Using Lateral Femoral Condyle for the Treatment of Medial Femoral Condyle Lesions: A Computer-Simulated Model Study**

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### **Purpose**

The purpose of this study was to determine whether lateral femoral condyle (LFC) osteochondral allografts (OCAs) would have a similar articular cartilage contour and resulting subchondral bone contour when compared with medial femoral condyle (MFC) allografts for the treatment of MFC chondral defects.

### **Methods**

In this controlled laboratory study, human femoral hemi-condyles (10 MFCs and 8 LFCs) were divided into 4 groups: MFC recipient, MFC donor, ipsilateral LFC donor, and contralateral LFC donor. Computed tomography (CT) images were obtained for each, and 3D CT models were created and exported into point-cloud models. Three circular defect and graft models were created on each condyle at 3 locations (0°, 45° posterior, and 90° posterior regions). The graft model in each donor group was virtually placed on the MFC recipient defect model. The least distances of the articular cartilage surface between the graft and the defect models and the resulting mean least distance of the subchondral bone surface were calculated.

### **Results**

The mean least distance of the articular cartilage surface was less than 0.5 mm in all donor–recipients, and there was no significant difference among donor groups. Although the mean least distance of the subchondral bone surface was significantly greater than the articular cartilage surface in all donor groups ( $P < .001$ ), there was no significant difference among donor groups.

### **Conclusion**

Ipsilateral and contralateral LFC grafts provided similar articular cartilage surface and resulting subchondral bone surface matching with that of MFC grafts, suggesting that LFCs could be a potential source of OCA for the treatment of MFC lesions.

### **Clinical Relevance**

Ipsilateral and contralateral LFCs can be suitable donor sites for the treatment of MFC lesions with OCAs.

## **Bacterial Deoxyribonucleic Acid Is Often Present in Failed Revision Anterior Cruciate Ligament Reconstructions**

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### **Purpose**

To determine whether bacterial DNA will be detectable by polymerase chain reaction (PCR) in torn graft tissue at the time of revision anterior cruciate ligament reconstruction (ACLR).

### **Methods**

A total of 31 consecutive revision ACLR cases from 1 center from 2014-2016 were recruited. No patients had clinical signs of infection on presentation. Torn graft tissue was obtained in revision cases and subjected to clinical culture and PCR analysis with a universal bacterial primer. Fluorescence microscopy was used to confirm the presence of a biofilm. We obtained negative control samples of water open to air on the field and excess primary ACLR graft tissue, as well as torn native ligament, to evaluate for PCR positivity due to environmental contamination.

### **Results**

Clinical cultures were positive (coagulase-negative Staphylococcus) in 1 revision case (3%, 1 of 31). Bacterial DNA was detectable in most revision ACLR cases (87.0%, 27 of 31), and there was a low rate of PCR positivity in negative control samples of water open to air (0%, 0 of 3), excess primary ACLR graft tissue after passage (20%, 1 of 5), or native torn ligament (20%, 1 of 5). Bacterial biofilm presence on failed graft tissue as well as monofilament suture was visually confirmed with fluorescence microscopy.

### **Conclusions**

Bacterial DNA is frequently present in failed ACLR grafts, with high rates of DNA detection by PCR but low culture positivity.

### **Level of Evidence**

Level IV, case series.

## **Primary Anterolateral Ligament Rupture in Patients Requiring Revision Anterior Cruciate Ligament Reconstruction: A Retrospective Case-Control Magnetic Resonance Imaging Review**

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### **Purpose**

To compare the initial rate of anterolateral ligament (ALL) injury at the time of anterior cruciate ligament (ACL) rupture in patients who subsequently experienced ACL reconstruction graft failure versus patients who did not experience subsequent ACL reconstruction graft failure.

### **Methods**

Our institution's electronic medical record database was queried for patients who underwent primary ACL reconstruction with subsequent ACL graft rupture. Exclusion criteria included unavailable MRI scan, chronic ACL injury, multi-ligamentous injury, previous ACL reconstruction, and age younger than 13 or older than 50 years. Each patient was paired with an age-, gender-, and graft-matched control who underwent ACL reconstruction without subsequent graft rupture. Each patient was diagnosed with an intact, partially injured, or fully ruptured ALL on initial MRI. The location of ALL injury was also noted. The incidence and location of ALL rupture were compared using  $\chi^2$  analysis.

### **Results**

1,967 patients underwent primary ACL reconstruction. 128 patients experienced ACL graft rupture, and 55 patients (43%) had MRI scans available for review. 39 of these patients fulfilled inclusion criteria and were matched with a control patient. In the revision group, the ALL was diagnosed as intact, partially torn, and completely torn in 17, 14, and 8 patients, respectively, compared to 18, 13, and 8 patients, respectively in the control group. No difference was found in frequency of ALL rupture (Pearson  $\chi^2 = 0.066$ ;  $P = .968$ ) or rupture location (Pearson  $\chi^2 = 4.00$ ,  $P = 0.135$ ).

### **Conclusions**

The incidence of initial ALL injury as documented on MRI was not different in patients who experienced subsequent ACL graft rupture compared with patients who did not experience ACL graft rupture after primary ACL reconstruction. The ALL was more commonly injured on the tibial side in patients with ACL graft rupture and femoral-sided lesions were more common in control patients.

### **Level of Evidence**

Level III, prognostic case-control study.

[BACK](#)

## **Loop Length Change of an Adjustable-Length Femoral Cortical Suspension Device in Anatomic Rectangular Tunnel Anterior Cruciate Ligament Reconstruction With a Bone–Patellar Tendon–Bone Graft and Associated Clinical Outcomes**

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### **Purpose**

To evaluate loop length changes of an adjustable femoral cortical suspensory fixation device and assess the clinical results after anatomic rectangular tunnel anterior cruciate ligament (ART-ACL) reconstruction with a bone–tendon–bone (BTB) graft.

### **Methods**

The study included 50 patients who underwent ART-ACL reconstruction with a BTB graft fixed using the adjustable-length device BTB TightRope for femoral fixation between July 2013 and December 2014. Computed tomography examinations were performed at 1 and 12 weeks after the surgery. Loop length was measured in the reconstructed plane just parallel to the femoral tunnel, including the bone plug and the button. Measurement was performed thrice, and the mean value was used. Loop length change was defined as the difference in loop length between 1 and 12 weeks after the surgery. A paired t test was conducted with the effect size for statistical analysis. At 2 years postoperatively, clinical evaluations, including subjective and objective assessments, were performed.

### **Results**

The mean loop lengths at 1 and 12 weeks were  $25.77 \pm 3.88$  mm and  $25.81 \pm 3.89$  mm, respectively, with a significant difference ( $P = .01$ ). However, the effect size was 0.01, suggesting that the difference was not meaningful. The mean individual loop length change was  $0.04 \pm 0.13$  mm. All individual loop length changes were within the measurement error range. At 2 years postoperatively, 49 patients (98%) were graded as normal or nearly normal according to the International Knee Documentation Committee form. The mean side-to-side difference in anterior laxity at manual maximum force was  $0.2 \pm 0.5$  mm.

### **Conclusions**

The loop length change of an adjustable-length femoral cortical suspension device was negligible after ART-ACL reconstruction with a BTB graft. This ART-ACL reconstruction with a BTB graft using an adjustable-length device could safely provide sufficient stability to the operated knee.

### **Level of Evidence**

Level IV, therapeutic case series.

## **Which Technique Is Better for Treating Patellar Dislocation? A Systematic Review and Meta-analysis**

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### **Purpose**

To clarify the discrepancy in surgical options and present evidence to treat patellar dislocation by evaluating which of the techniques yields better improvement in stability and functional recovery for patellar dislocation.

### **Methods**

The MEDLINE, Embase, Cochrane Central Register of Controlled Trials, Web of Science, and Scopus electronic databases were searched for relevant articles comparing the outcomes of medial patellofemoral ligament (MPFL) treatment published up until August 2017. Data searching, extraction, analysis, and quality assessment were performed based on The Cochrane Collaboration guidelines. Clinical outcomes were evaluated using various outcome values in various techniques. For results with high heterogeneity, 95% prediction intervals (PIs) were also investigated.

### **Results**

Eleven clinical studies were investigated. In patients with primary patellar dislocation, there were no significant differences in all evaluated outcomes between the conservative and surgical treatment groups. For patients with recurrent patellar dislocation, MPFL reconstruction was associated with a favorable Kujala score (mean difference,  $-8.91$ ; 95% confidence interval,  $-14.05$  to  $-3.77$ ;  $I^2 = 94\%$ ; 95% PI,  $-9.64$  to  $-8.1$ ) and Lysholm score (mean difference,  $-13.51$ ; 95% confidence interval,  $-21.35$  to  $-5.68$ ;  $I^2 = 96\%$ ; 95% PI,  $-14.86$  to  $-12.16$ ) when compared with soft tissue realignment surgery.

### **Conclusions**

Although surgical treatment of the MPFL for primary patellar dislocation is not superior to conservative treatment in restoring knee function and clinical outcomes, MPFL reconstruction is associated with more favorable clinical outcomes compared with medial soft tissue realignment surgery in patients with recurrent patellar dislocation. Double-bundle MPFL reconstruction seems to provide more favorable outcomes than single-bundle MPFL reconstruction, but this finding should be interpreted with caution because the evidence levels were low and were from only a few studies.

### **Level of Evidence**

Level III, meta-analysis.



## **Clinical and Radiographic Predictors of Acetabular Cartilage Lesions in Adolescents Undergoing Hip Arthroscopy**

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### **Background**

Acetabular cartilage lesions are a known cause of poor outcomes after hip arthroscopy and are seen regularly among adolescents. However, studies identifying preoperative factors predictive of acetabular cartilage lesions have been limited to adult populations.

### **Purpose**

To assess clinical and radiographic predictors of acetabular cartilage lesions in a large cohort of adolescents undergoing hip arthroscopy.

**Study Design** Cohort study (Diagnosis); Level of evidence, 3.

### **Methods**

Patients undergoing hip arthroscopy for idiopathic femoroacetabular impingement or acetabular labral tears at a children's hospital were reviewed. Demographic predictors were analyzed by use of univariate logistic regression with generalized estimating equations. A matched case-control analysis was subsequently performed to identify radiographic predictors of acetabular cartilage lesions through use of univariate and multivariable conditional logistic regression.

### **Results**

Four hundred two patients (446 hips) undergoing hip arthroscopy between 2010 and 2015 were analyzed. Median age was 16.7 years (range, 13.6-19.0) and 72% of patients were female. Ninety-five hips (21%) were found to have an acetabular cartilage lesion at the time of arthroscopic surgery. Age (odds ratio [OR], 1.7; 95% CI, 1.4-2.1), male sex (OR, 2.5; 95% CI, 1.7-5.0), and body mass index (OR, 1.07; 95% CI, 1.01-1.14) were found to be predictive of intraoperative acetabular cartilage lesions. In the matched case-control analysis, femoral alpha angle as calculated on a Dunn lateral radiograph was independently predictive of an intraoperative acetabular cartilage lesion (OR, 1.8; 95% CI, 1.2-2.6). Additionally, the presence of a crossover sign was independently associated with a decreased odds of an acetabular cartilage lesion (OR, 0.3; 95% CI, 0.1-0.7). On multivariate analysis, alpha angle (Dunn lateral) (OR, 2.0; 95% CI, 1.3-3.1) and crossover sign (OR, 0.2; 95% CI, 0.1-0.7) remained independently associated with the presence of an acetabular cartilage lesion. The presence of an acetabular labral tear was not predictive of an associated cartilage lesion (OR, 1.17; 95% CI, 0.39-3.47;  $P = .78$ ).

**Conclusion** In an adolescent population undergoing hip arthroscopy, older age, male sex, and higher body mass index were predictive of acetabular cartilage lesions. From an imaging standpoint, increased alpha angle increased the likelihood of an acetabular cartilage lesion whereas the presence of a crossover sign decreased this likelihood. Predicting the presence of an acetabular cartilage lesion is important when considering a hip arthroscopy procedure to facilitate preoperative planning and to more accurately set patient expectations.

## **Femoroacetabular Impingement in Professional Basketball Players: Return to Play, Career Length, and Performance After Hip Arthroscopy**

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### **Background**

Previous studies have demonstrated that hip arthroscopy is an effective treatment for symptomatic femoroacetabular impingement (FAI) in professional athletes across a variety of sports. However, the return-to-play rates and postoperative performance of elite basketball players after hip arthroscopy are currently unknown.

### **Purpose**

To determine return-to-play rates and postoperative performance among professional basketball athletes after hip arthroscopy.

### **Study Design**

Case series; Level of evidence, 3.

### **Methods**

Eighteen professional basketball players underwent hip arthroscopy (24 hips) for symptomatic FAI between 2001 and 2016 by a single surgeon. Return to play was defined as competing in a single professional game of equal level after surgery. Data were retrospectively obtained for each player from basketball-reference.com, ESPN.com, eurobasket.com, and individual team websites. Matched controls were selected from the websites to compare performances.

### **Results**

The mean age at the time of surgery was 25.6 years, and the mean body mass index was 24.4 kg/m<sup>2</sup>. All players returned to their previous levels of competition, with a mean number of 4 seasons played after surgery (median, 3; range, 1-12). The mean  $\pm$  SD time between the date of surgery and return to a professional game was 7.1  $\pm$  4.4 months. There was no change in player efficiency rating when pre- and postinjury performance were compared. When compared with controls, players undergoing surgery also had no significant decline in player efficiency rating.

### **Conclusion**

Elite basketball athletes who undergo hip arthroscopy for the treatment of FAI return to their presurgical levels of competition at a high rate. These athletes demonstrate no significant overall decrease in performance upon their return to play.

## **When Do Patients Improve After Hip Arthroscopy for Femoroacetabular Impingement? A Prospective Cohort Analysis**

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### **Background**

Hip arthroscopy for femoroacetabular impingement (FAI) has been shown to improve patient outcomes, especially for returning to sport. Although previous studies often evaluated outcomes 2 years after hip arthroscopy, there has been no analysis of the progression of patient improvement over time or with respect to achieving the minimal clinically important difference (MCID).

### **Hypothesis/Purpose**

The purpose was to prospectively evaluate changes in patient-reported outcome (PRO) scores during the first 2 years after hip arthroscopy for FAI and to analyze when the MCID is achieved. It was hypothesized that clinically significant changes will be reached by 1 year after surgery.

### **Study Design**

Case series; Level of evidence, 4.

### **Methods**

Patients undergoing hip arthroscopy for FAI were prospectively enrolled, and they completed the 12-Item Short Form Health survey (SF-12), modified Harris Hip Score, and Hip disability and Osteoarthritis Outcome Score (HOOS) at preoperative baseline and 3 months, 6 months, 1 year, and 2 years after surgery. Mean scores and the percentage of patients reaching the MCID at each time point were analyzed via analysis of variance and Cochrane-Armitage trend tests.

### **Results**

A total of 129 hips from 122 patients were evaluated, revealing significant improvements after hip arthroscopy for FAI (PRO scores increased 19 to 45 points) with 95.8%, 93.6%, and 84.8% of patients achieving the MCID for HOOS-Sports, HOOS–Quality of Life (QoL), and HOOS-Pain, respectively, at 2-year follow-up. Analysis of PRO change showed that for all scores, the greatest improvement occurred from presurgery to postoperative 3 months, with lesser improvements at subsequent 6-month, 1-year, and 2-year time points ( $P < .001$ ). The SF-12 physical component score, HOOS-Sports, and HOOS-QoL continued to show statistically significant improvements through 2 years, while other scores plateaued after 3 months. The percentage of patients achieving the MCID for HOOS-Sports, HOOS-QoL, and HOOS-Pain continued to increase over 2 years, but the percentage achieving the MCID did not increase after 3 months for all other scores.

### **Conclusion**

Hip arthroscopy for FAI yields significant improvements in patient outcomes within 2 years of surgery. The majority of improvement occurs within 3 months after surgery, but certain outcomes, such as returning to sport, QoL, and pain, can continue to improve through 2 years.

## Acetabular Labral Reconstruction: Development of a Tool to Predict Outcomes

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**Background** Acetabular labral reconstruction has demonstrated good results for labral lesions not amenable to labral repair.

**Purpose** To determine the predictors of outcomes at a minimum 2 years after labral reconstruction.

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

### Methods

Patients included in the study underwent labral reconstruction with a minimum 2-year follow-up. The primary outcome variable was the Hip Outcome Score–Activities of Daily Living (HOS-ADL). Secondary outcome measures included the 12-item Short Form Health Survey physical component summary (SF-12 PCS) and patient satisfaction with surgical outcomes. Preoperative and intraoperative variables assessed included demographics, prior surgery, chronicity of symptoms, radiographic measurements, preoperative outcome scores, and findings at arthroscopic surgery. Predictors were assessed using logistic regression with restricted cubic splines. Bivariate statistics assessed risk factors for reoperation including revision arthroscopic surgery and total hip arthroplasty (THA).

### Results

Three hundred seventeen of 368 labral reconstructions were available for follow-up (86.1%). Of these, 42 were converted to THA (13.2%) and 35 required revision arthroscopic surgery after labral reconstruction (11.0%). Factors associated with THA included older age,  $\geq 2$  previous surgeries,  $\leq 2$  mm of joint space, and lateral center edge angle (LCEA)  $< 25^\circ$ . Factors associated with revision included female sex,  $\geq 2$  previous surgeries, and LCEA  $< 25^\circ$ . Six patients refused to participate (1.9%), leaving 234 with a minimum follow-up of 2 years (mean, 3.7 years [range, 2.0–11.3 years]). These patients had significant improvement in HOS-ADL (71 to 90;  $P < .001$ ), HOS-Sport (47 to 75;  $P < .001$ ), Western Ontario and McMaster Universities Osteoarthritis Index (27 to 9;  $P < .001$ ), modified Harris Hip Score (65 to 85;  $P < .001$ ), and SF-12 PCS scores (41.6 to 53.1;  $P < .001$ ). Median postoperative satisfaction was 9. Predictors of improvement for the HOS-ADL included higher preoperative HOS-ADL scores ( $P < .001$ ), joint space  $> 2$  mm ( $P = .004$ ), and no prior surgery ( $P = .039$ ). Predictors of improvement for the SF-12 PCS included higher preoperative SF-12 PCS scores ( $P < .001$ ), subacute chronicity (3 months to 1 year) of symptoms ( $P = .013$ ), and joint space  $> 2$  mm ( $P = .046$ ). Joint space  $> 2$  mm ( $P < .001$ ) and higher preoperative SF-12 scores (PCS:  $P = .034$ ; mental component summary:  $P = .039$ ) predicted higher satisfaction.

### Conclusion

At a minimum 2 years' follow-up, patients who did not undergo conversion to THA (13.2%) or require revision (11.0%), reported significant improvement in outcome scores and high satisfaction with outcomes. Predictors of revision or THA included  $\geq 2$  previous surgeries, low LCEA, female sex for revision, and narrowed joint space for THA. Higher preoperative outcome scores were the most significant predictors of improvement after labral reconstruction. Lower preoperative scores, joint space narrowing, and history of surgery were predictive of an inferior result and decreased postoperative satisfaction.

[BACK](#)

## Vertical Extension of the T-Capsulotomy Incision in Hip Arthroscopic Surgery Does Not Affect the Force Required for Hip Distraction: Effect of Capsulotomy Size, Type, and Subsequent Repair

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**Background** Interportal and T-capsulotomies are popular techniques for exposing femoroacetabular impingement deformities. The difference between techniques with regard to the force required to distract the hip is currently unknown.

**Purpose** To quantify how increasing interportal capsulotomy size, conversion to T-capsulotomy, and subsequent repair affect the force required to distract the hip.

**Study Design** Controlled laboratory study.

**Methods** Eight fresh-frozen cadaveric hip specimens were dissected and fixed in a materials testing system, such that pure axial distraction of the iliofemoral ligament could be achieved. The primary outcome measure was the load required to distract the hip to a distance of 6 mm at a rate of 0.5 mm/s. Each hip was tested in the intact state and then sequentially under varying capsulotomy conditions: 2-cm interportal, 4-cm interportal, half-T (4-cm interportal and 2-cm T-capsulotomy), and full-T (4-cm interportal and 4-cm T-capsulotomy). After serial testing, isolated T-limb repair and then subsequent complete repair were performed. Repaired specimens underwent distraction testing as previously stated to assess the ability to restore hip stability to the native profile. Distraction force as well as the relative distraction force (percentage normalized to the intact capsule) were compared between all capsulotomy and repair conditions.

**Results** Increasing interportal capsulotomy size from 2 to 4 cm resulted in significantly less force required to distract the hip ( $P < .001$ ). The largest relative decrease in force was seen between the intact state ( $274.6 \pm 71.2$  N; 100%) and 2-cm interportal ( $209.7 \pm 73.2$  N;  $76.4\% \pm 15.6\%$ ;  $P = .0008$ ). There was no significant mean difference in distraction force when 4-cm interportal ( $160.4 \pm 79.8$  N) was converted to half-T ( $140.7 \pm 73.5$  N;  $P = .270$ ) and then full-T ( $112.0 \pm 70.2$  N;  $P = .204$ ). When compared with the intact state, isolated T-limb repair partially restored stability ( $177.3 \pm 86.3$  N;  $63.5\% \pm 19.8\%$ ;  $P < .0001$ ), while complete repair exceeded native values ( $331.7 \pm 103.7$  N;  $122.7\% \pm 15.1\%$ ;  $P = .0008$ ).

**Conclusion** The conversion of interportal capsulotomy to T-capsulotomy did not significantly affect the force required to distract the hip in a cadaveric model. However, larger interportal capsulotomies resulted in significant stepwise decreases in distraction force. When performing interportal or T-capsulotomy, the iliofemoral ligament strength is significantly decreased, but complete capsular repair demonstrated the ability to restore joint stability to the native, intact hip.

**Clinical Relevance** Increasing interportal capsulotomy size decreases the force required to distract the hip. In an effort to maximize visualization and minimize the magnitude of iliofemoral ligament fibers cut, many surgeons have moved from extended interportal capsulotomy to T-capsulotomy. Interportal and T-capsulotomies result in equivalent hip distraction, partial capsular repair marginally improves hip stability, and only complete repair has the ability to restore the hip to its native biomechanical profile.

[BACK](#)

## **Pain Management After Hip Arthroscopy: Systematic Review of Randomized Controlled Trials and Cohort Studies**

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### **Background**

Hip arthroscopy is often associated with significant postoperative pain and opioid-associated side effects. Effective pain management after hip arthroscopy improves patient recovery and satisfaction and decreases opioid-related complications.

### **Purpose**

To collect, examine, and provide a comprehensive review of the available evidence from randomized controlled trials and comparative studies on pain control after hip arthroscopy.

### **Study Design**

Systematic review.

### **Methods**

Using the Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines, a systematic review of the literature for postoperative pain control after hip arthroscopy was performed using electronic databases. Only comparative clinical studies with level 1 to 3 evidence comparing a method of postoperative pain control with other modalities or placebo were included in this review. Case series and studies without a comparative cohort were excluded.

### **Results**

Several methods of pain management have been described for hip arthroscopy. A total of 14 studies met our inclusion criteria: 3 on femoral nerve block, 3 on lumbar plexus block, 3 on fascia iliaca block, 4 on intra-articular injections, 2 on soft tissue surrounding surgical site injection, and 2 on celecoxib (4 studies compared 2 or more methods of analgesia). The heterogeneity of the studies did not allow for pooling of data. Single-injection femoral nerve blocks and lumbar plexus blocks provided improved analgesia, but increased fall rates were observed. Fascia iliaca blocks do not provide adequate pain relief when compared with surgical site infiltration with local anesthetic and are associated with increased risk of cutaneous nerve deficits. Patients receiving lumbar plexus block experienced significantly decreased pain compared with fascia iliaca block. Portal site and periacetabular injections provide superior analgesia compared with intra-articular injections alone. Preoperative oral celecoxib, compared with placebo, resulted in earlier time to discharge and provided significant pain relief up to 24 hours.

### **Conclusion**

Perioperative nerve blocks provide effective pain management after hip arthroscopy but must be used with caution to decrease risk of falls. Intra-articular and portal site injections with local anesthetics and preoperative celecoxib can decrease opioid consumption. There is a lack of high-quality evidence on this topic, and further research is needed to determine the best approach to manage postoperative pain and optimize patient satisfaction.

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