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**Contact** [4@erasmusmc.nl](mailto:4@erasmusmc.nl)

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Arthroscopy

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## Upper extremity

Arthroscopy, Volume 35, Issue 3

### Long-Term Outcomes After In Situ Arthroscopic Repair of Partial Rotator Cuff Tears

Luciano A. Rossi, M.D., Nicolas A. Atala, M.D., Agustin Bertona, M.D., Santiago Bongiovanni, M.D., Ignacio Tanoira, M.D., Gaston Maignon, M.D., Maximiliano Ranalletta, M.D.

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#### Purpose

To analyze clinical outcomes, return to sports, and complications in a series of patients with painful partial-thickness rotator cuff tears treated with arthroscopic in situ repair with suture anchors who had a minimum of 8 years of follow-up.

#### Methods

Sixty-two patients who had undergone an arthroscopic in situ repair for partial-thickness rotator cuff tears were evaluated. All injuries involved the supraspinatus tendon. Clinical assessment consisted of glenohumeral range-of-motion measurement and the American Shoulder and Elbow Surgeons score. Pain was rated by using a visual analog scale. We assessed return to sports and the level of performance achieved after surgery. Postoperative complications were also assessed.

#### Results

Mean age was 52.4 years (range, 32 to 67 years), and mean duration of follow-up was 10.4 years (range, 8 to 12 years). All active range-of-motion parameters improved significantly ( $P < .0001$ ). The American Shoulder and Elbow Surgeons score improved from 45.6 to 85.1; and the visual analog scale scores improved from 6.4 to 1.6 ( $P < .0001$ ). Thirty patients participated in sports before injury: 21 were recreational athletes and 9 were competitive athletes. Twenty-six (87%) were able to return to sports, and 24 (80%) returned to the same level they had achieved before injury. No significant difference regarding functional outcomes or return to sports was found between patients with articular-sided tears and those with bursal-sided tears. No revision surgeries were performed. Three patients had postoperative adhesive capsulitis that responded favorably to physical therapy.

#### Conclusions

During long-term follow-up, arthroscopic in situ repair of partial-thickness rotator cuff tears produces excellent functional outcomes in more than 80% of patients, and revision rates are low. Most patients return to their chosen sport at the same level they had achieved before injury. The results are equally favorable for articular-sided and bursal-sided tears.

#### Level of Evidence

IV, therapeutic case series.

## **Preoperative Shoulder Injections Are Associated With Increased Risk of Revision Rotator Cuff Repair**

Sophia A. Traven, M.D., Daniel Brinton, M.H.A., M.A.R.b, Kit N. Simpson, Dr.P.H.b, Zachary Adkins, M.D.a, Alyssa Althoff, B.S.a, John Palsis, M.D.a, Harris S. Slone, M.D.a

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### **Purpose**

The goal of this study was to determine whether the timing of preoperative shoulder injections is associated with an increased risk of revision rotator cuff repair following primary rotator cuff repair (RCR).

### **Methods**

A retrospective analysis of claims data of privately insured subjects from the MarketScan database for the years 2010 to 2014 was conducted. Multivariable logistic regression models were used to compare the odds of reoperation between groups. Laterality for the injection, index procedure, and subsequent surgery were verified for all subjects.

### **Results**

A total of 4,959 subjects with an arthroscopic RCR were identified, 392 of whom required revision RCR within the following 3 years. Patients who had an injection within 6 months preceding the index surgery were at a much higher risk of undergoing reoperation for revision RCR: 0 to 3 months prior, adjusted odds ratio (AOR) 1.375 (95% confidence interval [CI], 1.027-1.840); 3 to 6 months prior, AOR 1.822 (95% CI, 1.290-2.573); and 6 to 12 months prior, AOR 1.237 (95% CI, 0.787-1.943).

### **Conclusions**

Patients who had received an injection within 6 months prior to RCR were much more likely to undergo a revision cuff repair within the following 3 years. The risk of reoperation significantly declines if there is more than 6 months between injection and RCR. Consideration should be given to minimizing preoperative injections in patients requiring RCR or delaying primary RCR for 6 months following injection.

### **Level of Evidence**

Level III, therapeutic study.

## **Injections Prior to Rotator Cuff Repair Are Associated With Increased Rotator Cuff Revision Rates**

Alexander E. Weber, M.D, Nicholas A. Trasolini, M.D., Erik N. Mayer, B.S., Anthony Essilfie, M.D., C. Thomas Vangsness Jr., M.D., Seth C. Gamradt, M.D., James E. Tibone, M.D., Hyunwoo Paco Kang, M.D.

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### **Purpose**

To determine whether shoulder injections prior to rotator cuff repair (RCR) are associated with deleterious surgical outcomes.

### **Methods**

Two large national insurance databases were used to identify a total of 22,156 patients who received ipsilateral shoulder injections prior to RCR. They were age, sex, obesity, smoking status, and comorbidity matched to a control group of patients who underwent RCR without prior injections. The 2 groups were compared regarding RCR revision rates.

### **Results**

Patients who received injections prior to RCR were more likely to undergo RCR revision than matched controls (odds ratio [OR], 1.52; 95% confidence interval [CI], 1.38-1.68;  $P < .0001$ ). Patients who received injections closer to the time of index RCR were more likely to undergo revision ( $P < .0001$ ). Patients who received a single injection prior to RCR had a higher likelihood of revision (OR, 1.25; 95% CI, 1.10-1.43;  $P = .001$ ). Patients who received 2 or more injections prior to RCR had a greater than 2-fold odds of revision (combined OR, 2.12; 95% CI, 1.82-2.47;  $P < .0001$ ) versus the control group.

### **Conclusions**

This study strongly suggests a correlation between preoperative shoulder injections and revision RCR. There is also a frequency dependence and time dependence to this finding, with more frequent injections and with administration of injections closer to the time of surgery both independently associated with higher revision RCR rates. Presently, on the basis of this retrospective database study, orthopaedic surgeons should exercise due caution regarding shoulder injections in patients whom they are considering to be surgical candidates for RCR.

### **Level of Evidence**

Level III, therapeutic study.

## **Risk Factors for Cerebral Desaturation Events During Shoulder Surgery in the Beach Chair Position**

Mohit N. Gilotra, M.D., Ashley Klein, M.A., Nabil Elkassabany, M.D., M.S.C.E., Andrew F. Kuntz, M.D., G. Russell Huffman, M.D., M.P.H., David L. Glaser, M.D.

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### **Purpose**

The goals of this study were 2-fold: (1) to determine the risk factors for cerebral desaturation events (CDEs) after implementation of a comprehensive surgical and anesthetic protocol consisting of patient risk stratification, maintenance of normotensive anesthesia, and patient positioning in a staged fashion, and (2) to assess for subclinical neurologic decline associated with intraoperative ischemic events through cognitive testing.

### **Methods**

One hundred patients undergoing shoulder surgery in the beach chair position were stratified for risk of CDE based on Framingham stroke criteria, body mass index (BMI), and history of cerebrovascular accidents. Cerebral oxygen saturation was monitored with near-infrared spectroscopy. As per a standardized protocol, mean arterial pressure was maintained between 70 and 90 mm Hg. The head was raised in 2 stages separated by 3 minutes. CDE were defined as >20% drop from baseline or <55% O<sub>2</sub> absolute threshold. Patients completed a Mini-Mental State Examination during preoperative examination and at the first postoperative visit.

### **Results**

The CDE rate was 4% overall and 4.3% in patients undergoing general anesthesia. Forty-five patients were in the higher risk category, and all CDEs occurred in that group. Patients with a Framingham score  $\geq 10$  or BMI  $\geq 35$  who underwent general anesthesia had an increased risk of CDE ( $P = .04$ ). No significant change was noted in Mini-Mental State Examination scores between pre- and postoperative visits. No correlation was shown between CDE and history of diabetes, smoking, cardiovascular disease, or left ventricular hypertrophy.

### **Conclusions**

Our observed CDE rate was lower than previously reported rates, likely because of risk stratification, staged positioning, and normotensive anesthesia. Framingham score  $\geq 10$  and BMI  $\geq 35$  are risk factors for CDE in the beach chair position.

### **Level of Evidence**

Level II, prospective observational study with >80% follow-up.



## **Automated 3-Dimensional Magnetic Resonance Imaging Allows for Accurate Evaluation of Glenoid Bone Loss Compared With 3-Dimensional Computed Tomography**

Drew A. Lansdown, M.D, Gregory L. Cvetanovich, M.D., Nikhil N. Verma, M.D., Brian J. Cole, M.D., M.B.A., Bernard R. Bach, M.D., Gregory Nicholson, M.D., Anthony Romeo, M.D., Robert Dawe, Ph.D., Adam B. Yanke, M.D.

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### **Purpose**

To evaluate clinical measurements of glenoid bone loss based on 3-dimensional (3D) computed tomography (CT) and automatically segmented 3D reconstructions from Dixon fat-water magnetic resonance (MR) imaging.

### **Methods**

Available CT and MR studies from 16 patients with recurrent anterior shoulder instability were retrospectively reviewed. Three-dimensional reconstructions were formed independently by 2 observers using freely available software and a simple threshold-based segmentation (3D Slicer, version 4.8.0; <http://www.slicer.org>). Bone loss was estimated with the perfect-circle method. Intra-user and interuser reproducibility was determined with intraclass correlation coefficients. Bland-Altman plots were used to evaluate the similarity between imaging modalities.

### **Results**

Differences between MR and CT estimates of bone loss ranged from 0% to 6%. The individual intraclass correlation coefficients showed good to excellent reliability, with intraobserver comparisons between MR- and CT-based bone loss estimates ranging from 0.94 to 0.99. Bland-Altman plots showed 95% confidence intervals from -5% to 6% for differences between MR and CT estimates, with 88% of all measurements (42 of 48) showing a less than 2% difference between MR and CT estimates.

### **Conclusions**

The described methodology for obtaining an MR-based 3D reconstruction of the glenoid can evaluate glenoid bone loss similarly to the performance of a 3D CT reconstruction. The results may allow surgeons to simplify the preoperative imaging protocol for patients with recurrent shoulder stabilization and limit the number of shoulder CT scans.

### **Level of Evidence**

Level III, retrospective therapeutic trial.

## **The Impact of Body Mass Index on Complications After Shoulder Arthroscopy: Should Surgery Eligibility Be Determined by Body Mass Index Cutoffs?**

William J. Rubenstein, M.D, Drew A. Lansdown, M.D., Brian T. Feeley, M.D., C. Benjamin Ma, M.D., Alan L. Zhang, M.D.

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### **Purpose**

The goal of this study is to analyze postoperative complications after shoulder arthroscopy stratified by body mass index (BMI) and to quantify the trade-off in postsurgical complications and access to care that occurs with BMI eligibility cutoffs.

### **Methods**

Patients who underwent shoulder arthroscopy in the National Surgical Quality Improvement Program database from 2015 to 2016 were identified. Patients were categorized on the basis of their BMI.  $\chi^2$  tests were used to identify differences in complication rates between different BMI categories. Logistic regression was used to calculate the odds ratio of having a major complication by BMI category. The positive predictive value (PPV) was calculated at different BMI cutoffs.

### **Results**

There were 26,509 shoulder arthroscopy cases identified in the National Surgical Quality Improvement Program database with 383 major complications, for an overall rate of 1.4%. Patients with a BMI >40 had a higher overall complication rate (2.3% vs 1.4%,  $P = .001$ ), as well as higher rates of readmission ( $P = .012$ ), pneumonia ( $P = .030$ ), progressive renal insufficiency ( $P = .006$ ), and cardiac arrest ( $P = .008$ ). BMI >40 was associated with an increased risk of major complications (odds ratio, 1.84; confidence interval, 1.29-2.61). A BMI cutoff of 40 would avoid 12% of major complications while excluding 8% of complication-free surgeries. At a BMI cutoff of 40, the PPV was 2.3% where 43 surgeries would be denied for every complication avoided.

### **Conclusion**

Patients with a BMI >40 have a statistically significant but only slightly increased risk of 30-day complications after shoulder arthroscopy. Instituting a BMI eligibility cutoff at 40 has a low PPV and would prevent 43 complication-free surgeries from proceeding for every complication prevented. Patients should be counseled individually about their risk factors, but denial of shoulder arthroscopy on the basis of BMI alone may not be an appropriate strategy for risk reduction.

### **Level of Evidence**

Level III, comparative prognostic trial.

## Early Active Motion Versus Sling Immobilization After Arthroscopic Rotator Cuff Repair: A Randomized Controlled Trial

David M. Sheps, M.D., M.Sc., M.B.A., F.R.C.S.C., Anelise Silveira, P.T., M.R., Lauren Beaupre, P.T., Ph.D., Fiona Styles-Tripp, B.Sc.P.T., Robert Balyk, M.D., F.R.C.S.C., Aleem Lalani, M.D., F.R.C.S.C., Robert Glasgow, M.D., F.R.C.S.C., Joseph Bergman, M.D., F.R.C.S.C., Martin Bouliane, M.D., F.R.C.S.C.

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### Purpose

To compare the effect of early mobilization (EM) with standard rehabilitation (SR) over the initial 24 months following arthroscopic rotator cuff (RC) repair.

### Methods

A total of 206 patients with full-thickness RC tears undergoing arthroscopic repair were randomized following preoperative assessment of shoulder range of motion (ROM), pain, strength, and health-related quality of life (HRQOL) to either EM (n = 103; self-weaned from sling and performed pain-free active ROM during the first 6 weeks) or SR (n = 103; wore a sling for 6 weeks with no active ROM). Shoulder ROM, pain, and HRQOL were reassessed at 6 weeks and 3, 6, 12, and 24 months postoperatively by a blinded assessor. At 6, 12, and 24 months, strength was reassessed. At 12 months, ultrasound verified RC integrity. Independent t tests assessed 6-week group differences and 2-way repeated measures analysis of variance assessed changes over time between groups.

### Results

The groups were similar preoperatively ( $P > .12$ ). The mean age of participants was 55.9 (minimum, 26; maximum, 79) years, and 131 (64%) were men. A total of 171 (83%) patients were followed to 24 months. At 6 weeks postoperatively, EM participants had significantly better forward flexion and abduction ( $P < .03$ ) than the SR participants; no other group differences were noted. Over 24 months, there were no group differences in ROM after 6 weeks ( $P > .08$ ), and pain ( $P > .06$ ), strength ( $P = .35$ ), or HRQOL ( $P > .20$ ) at any time. Fifty-two (25%) subjects (30% EM; 33% SR) had a full-thickness tear present at 12-month postoperative ultrasound testing ( $P > .8$ ).

### Conclusions

EM did not show significant clinical benefits, but there was no compromise of postoperative ROM, pain, strength, or HRQOL. Repair integrity was similar at 12 months postoperatively between groups. Consideration should be given to allow pain-free active ROM within the first 6 weeks following arthroscopic RC repair.

### Level of Evidence

Level I, high-quality randomized controlled trial.

## **Perioperative Serum 25-Hydroxyvitamin D Levels Affect Revision Surgery Rates After Arthroscopic Rotator Cuff Repair**

Jourdan M. Cancienne, M.D., Stephen F. Brockmeier, M.D., Michelle E. Kew, M.D., Brian C. Werner, M.D.

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### **Purpose**

To examine any association between perioperative serum 25-hydroxyvitamin D levels and failure of arthroscopic rotator cuff repair (RCR) requiring revision surgery.

### **Methods**

Using a private-payer national insurance database, patients who underwent arthroscopic RCR with perioperative serum 25-hydroxyvitamin D levels recorded were included. Patients were stratified into groups of (1) serum 25-hydroxyvitamin D deficiency (<20 ng/mL), (2) insufficiency (20-30 ng/mL), or (3) sufficient (>30-<150 ng/mL). The primary outcome measure was ipsilateral revision rotator cuff surgery, including revision repair, debridement, or reverse shoulder arthroplasty. A multivariable logistic regression analysis was used to control for patient demographics and comorbidities during comparisons.

### **Results**

A total of 982 patients were included in the study. The rate of revision rotator cuff surgery was significantly higher in patients in the serum 25-hydroxyvitamin D–deficient group (5.88%) compared with the serum 25-hydroxyvitamin D–sufficient control group (3.7%) (odds ratio [OR], 3.1; 95% confidence interval [CI], 1.6-5.8;  $P = .007$ ). Patients with serum 25-hydroxyvitamin D deficiency (5.88%) also had a significantly higher incidence of revision surgery compared with patients with serum 25-hydroxyvitamin D insufficiency (OR, 2.4; 95% CI, 1.5-3.9;  $P = .011$ ). There was no significant difference in the incidence of revision surgery in the serum 25-hydroxyvitamin D–insufficient group (4.97%) compared with the serum 25-hydroxyvitamin D–sufficient control group (3.7%) (OR, 1.4; 95% CI, 0.8-2.3;  $P = .250$ ). The absolute risk reduction of revision surgery for 25-hydroxyvitamin D–deficient patients compared with controls was 2.2%, corresponding to a number needed to treat to avoid 1 revision surgery of 46 patients, relative risk reduction = 0.59.

### **Conclusions**

Although the present study found a significant statistical association between serum 25-hydroxyvitamin D deficiency and insufficiency and the rate of revision rotator cuff surgery after primary arthroscopic RCR, the absolute differences of these revision rates are minimal and are accompanied with overlapping confidence intervals limiting the clinical significance of these findings.

### **Level of Evidence**

Level III, retrospective cohort study.

## **Performance of PROMIS Global-10 to Legacy Instruments in Patients With Lateral Epicondylitis**

Joseph B. Kahan, M.D., M.P.H., Hafiz F. Kassam, M.D., Allen D. Nicholson, M.D., Maarouf A. Saad, B.S., David Kovacevic, M.D.

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### **Purpose**

To validate the Patient-Reported Outcomes Measurement Information System (PROMIS) Global-10 for patients who have lateral epicondylitis requiring surgical treatment in comparison with other gold standard patient-reported outcomes.

### **Methods**

Sixty-two patients with lateral epicondylitis of the elbow were prospectively enrolled before arthroscopic treatment. Inclusion criteria were patients 18 years of age or older with a diagnosis of lateral epicondylitis. Each patient completed the PROMIS Global-10, EuroQol 5 Dimension (EQ-5D), American Shoulder and Elbow Surgeons (ASES) assessment form, Mayo Elbow Performance Score (MEPS), and Quick Disabilities of the Arm, Shoulder and Hand Score (QuickDASH). Spearman correlations were calculated. Bland-Altman agreement tests were conducted between estimated EQ-5D scores from the PROMIS-10 and actual EQ-5D scores.

### **Results**

Correlation between the PROMIS-10 and the EQ-5D was excellent (0.72,  $P < .0001$ ). Bland-Altman 95% limits of agreement for estimated EQ-5D scores ranged from 0.33 below to 0.21 above actual EQ-5D scores. Correlation of the PROMIS-10 physical score was good to excellent with MEPS (0.61,  $P < .0001$ ) and QuickDASH scores (0.64,  $P < .0001$ ) and good with the ASES (0.58,  $P < .0001$ ). Correlation of the PROMIS mental scores was good with QuickDASH (0.50,  $P < .0001$ ) and poor with ASES (0.26,  $P = .0492$ ) and MEPS (0.37,  $P = .0038$ ).

### **Conclusions**

The PROMIS Global-10 physical scores showed good to excellent correlation with gold standard patient-reported outcome instruments, demonstrating it is a reliable tool for outcome assessment in populations with lateral epicondylitis. Despite the excellent correlation with the EQ-5D, the 95% limit of agreement and high variability among the estimated EQ-5D scores derived from the PROMIS-10 suggests that the PROMIS-10 cannot be used as a substitute for actual EQ-5D scores to derive quality-adjusted life years for economic evaluations and cost-effectiveness research.

### **Level of Evidence**

Level II, development of diagnostic criteria on the basis of consecutive patients.

# Management of Concomitant Preoperative Rotator Cuff Pathology and Adhesive Capsulitis: A Systematic Review of Indications, Treatment Approaches, and Outcomes

Kailai Zhang, B.H.Sc., Darren de SA, M.D., F.R.C.S.C., Ajay Kanakamedala, M.D., Andrew J. Sheehan, M.D., Dharmesh Vyas, M.D., Ph.D.

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## Purpose

Concomitant preoperative adhesive capsulitis (AC) and rotator cuff (RC) pathology pose therapeutic challenges in light of contrasting interventional and rehabilitative goals. The purposes of this systematic review were to assess the literature regarding the management and rehabilitation of patients with concomitant RC tears and preoperative AC and to compare overall clinical outcomes between strategies for this common scenario.

## Methods

In accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, 3 databases (MEDLINE, Embase, and PubMed) were searched and screened in duplicate using predetermined criteria for studies on the aforementioned patient population. Descriptive statistics are presented.

## Results

Of 952 studies, 17 involving 662 shoulders, with a mean age of  $59.6 \pm 3.5$  years, 57.9% female patients, and a mean follow-up period of 18.6 months, were included. Capsular release (CR) (86.1%) and manipulation under anesthesia (MUA) (33.1%) were the most common co-interventions with RC repair. Across studies, mean preoperative American Shoulder and Elbow Surgeons scores ranged from 29.0 to 61.3, visual analog scale scores (pain) ranged from 5.3 to 8.0, and Constant scores ranged from 18.0 to 48.0. Mean postoperative American Shoulder and Elbow Surgeons scores ranged from 76.9 to 92.0, visual analog scale scores (pain) ranged from 0.3 to 2.5, and Constant scores ranged from 72.6 to 93.2. Postoperative rehabilitation comprised abduction braces and passive range of motion immediately postoperatively for mean durations of 5.0 weeks and 5.3 weeks, respectively, followed by active range of motion at a mean of 5.3 weeks and strengthening at 10.9 weeks. Postoperative complications included stiffness, RC retear, instability, glenoid fracture, and superficial infection.

## Conclusions

The results of this systematic review support treatment of patients with degenerative RC tears and concomitant AC with a combination of RC repair and MUA, CR, or both MUA and CR. Regardless of the treatment modality, accelerated postoperative rehabilitative protocols are beneficial in preventing postoperative persistence of AC and can be safely used in this scenario without a substantial increase in complication rates compared with patients undergoing RC repair alone with conservative rehabilitation.

## Level of Evidence

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

**Outcomes of arthroscopic rotator cuff repair with muscle advancement for massive rotator cuff tears**

Shin Yokoya, Shin Yokoya, Shin Yokoya, Yoshihiro Nakamura, Yohei Harada, Mitsuo Ochi, Nobuo Adachi

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**Background**

We performed arthroscopic rotator cuff repair (ARCR) combined with miniopen supraspinatus and infraspinatus muscle advancement for massive rotator cuff tears (RCTs) to decrease tension at the repair site with the goal of reduction of the failure rate. We evaluated the clinical outcomes and failure rate after this procedure.

**Methods**

This study included 47 patients diagnosed with chronic massive RCTs between October 2010 and March 2015. Of these patients, 21 underwent transosseous equivalent (TOE) ARCR only (control group), and 26 underwent TOE ARCR with muscle advancement (study group). We evaluated shoulder clinical outcomes at preoperative and postoperative assessments and also measured muscle strength and the acromiohumeral interval (AHI) at the same time in both groups. Failure rates were calculated in both groups by evaluating the cuff integrity with postoperative magnetic resonance imaging.

**Results**

Although there was statistically significant improvement for the mean clinical scores in the both groups, there were no significant differences between the 2 groups. The postoperative abduction muscle strength and AHI were significantly higher in the study group ( $46.3 \pm 20.6$  N and  $9.4 \pm 2.9$  mm;  $P = .04$ ) than in the control group ( $34.6 \pm 20.0$  N and  $7.7 \pm 3.0$  mm;  $P = .04$ ). The failure rates were significantly lower in the study group than in the control group (23.1% and 52.4%;  $P = .03$ ).

**Conclusion**

The TOE ARCR with muscle advancement can achieve significantly better abduction muscle strength, wider AHI, and lower failure rates for massive RCTs than the normal TOE ARCR.

**Level of evidence**

Level III, Retrospective Cohort Design, Treatment Study

## **Influence of preoperative opioid use on postoperative outcomes and opioid use after arthroscopic rotator cuff repair**

Brady T. Williams, Nathan J. Redlich, Dara J. Mickschl, Steven I. Grindel

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### **Background**

Recent orthopedic research has questioned the effect of opioid use on surgical outcomes. This study investigated this in the context of arthroscopic rotator cuff repair. We hypothesized that preoperative opioid use would be associated with inferior outcomes and greater postoperative opioid requirements.

### **Methods**

A database query identified adult patients with full-thickness or partial-thickness supraspinatus tears surgically treated between 2011 and 2015. Preoperative and postoperative outcomes scores (active range of motion [AROM], American Shoulder and Elbow Surgeons [ASES], Constant scores, Simple Shoulder Test [SST], and visual analog scale [VAS] for pain) and postoperative opioid use were retrospectively recorded. Patients with less than 2 years of follow-up data at the time of the retrospective review were contacted for prospective ASES, SST, and VAS data collection.

### **Results**

A total of 200 patients, 44 of whom received opioids preoperatively, were identified for inclusion. Patients prescribed preoperative opioids had consistently inferior preoperative and postoperative outcomes scores; however, the magnitudes of improvement were not significantly different between groups. Postoperatively, patients in the preoperative opioid group received 1.91 (95% confidence interval, 1.31-2.78) times more opioids over a postoperative course of treatment that was 2.73 (95% confidence interval, 1.62-4.59) times longer. In addition to having a greater proportion of women, this group also had significantly higher rates of certain comorbidities, including back pain, depression, degenerative joint disease, and chronic pain conditions.

### **Conclusions**

All patients demonstrated significant improvements in outcomes scores after surgical repair that were not significantly different between groups. However, patients taking opioids preoperatively did not ultimately reach the same level of functionality and had substantially greater opioid requirements postoperatively.

### **Level of evidence**

Level III, Retrospective Cohort Comparison, Treatment Study



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## Lower Extremity

Arthroscopy, Volume 35, Issue 3

### Early Outcomes After Arthroscopic Hip Capsular Reconstruction Using Iliotibial Band Allograft Versus Dermal Allograft

Lorenzo Fagotti, M.D., Eduardo Soares, M.D., Ioanna K. Bolia, M.D., M.S., Karen K. Briggs, M.P.H., M.B.A., Marc J. Philippon, M.D.

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#### Purpose

To compare the clinical outcomes between 2 groups of patients who underwent arthroscopic hip capsular reconstruction with the same surgical technique with an iliotibial band (ITB) allograft versus dermal allograft tissue.

#### Methods

From March 2013 to October 2015, patients who were 18 years of age or older and who underwent revision arthroscopic hip surgery with capsular reconstruction by the senior author were identified. Patients who were younger than 18 years old, had a lateral center-edge angle  $<20^\circ$  or Tonnis osteoarthritis grade 2 or 3, or refused to participate were excluded. Patients were assigned to 2 groups based on whether an ITB (ITB group) or a dermal allograft (dermal group) was used to reconstruct the capsule. The ITB graft was used initially, then the dermal graft was used when it was available. The dimensions were based on the intraoperative measurement of the capsular defect, and the thickness was 3 mm. Other treatments included labral debridement, repair, or reconstruction; treatment of residual femoroacetabular impingement; and treatment of cartilage damage. Clinical outcome scores including the Hip Outcome Score (HOS)–Activity of Daily Living scale (primary outcome measure), modified Harris Hip Score, HOS–Sports scale, SF-12, and Western Ontario & McMaster Universities Osteoarthritis Index were compared between the groups in addition to the failure rate (conversion to total hip arthroplasty, revision hip arthroscopy) and patient satisfaction rate with the outcome (range, 1-10).

#### Results

Thirty-six patients (9 men and 27 women) met the inclusion criteria. Each group consisted of 18 patients (18 hips) with a mean age of  $30.9 \pm 9.4$  years in the ITB group and a mean age of  $29.8 \pm 9.4$  years in the dermal group ( $P = .718$ ). There were no differences in patient demographics, physical examination findings, or imaging characteristics. The procedure failed for 8 patients (4 in the ITB group and 4 in the dermal group), and another surgery was required ( $P = 1.0$ ). Additional surgeries included 3 total hip arthroplasties, 1 periarticular osteotomy, and 4 revision arthroscopies. The mean follow-up time was 25 months (range, 18-38 months) in both groups ( $P = .881$ ). At follow-up, the HOS–Activity of Daily Living scale, SF-12, modified Harris Hip Score, and HOS–Sports scale measures were significantly higher in the ITB group than in the dermal group ( $P < .05$ ). A greater percentage of patients reached minimum clinically important difference in the ITB group for Western Ontario & McMaster Universities Osteoarthritis Index and HOS scales with the minimum clinically important difference for HOS–Sports scale being significantly higher in the ITB group ( $P = .04$ ). Patient satisfaction scores were 8 and 6 in the ITB and dermal groups, respectively.

#### Conclusions

At a mean follow-up time of 25 months, hip capsular reconstruction with an ITB allograft results in improved clinical outcomes compared with the dermal allograft. A similar failure rate was noted in both groups, but a greater percentage of patients in the ITB group achieved clinical improvement.

## Validation of a Virtual Reality–Based Hip Arthroscopy Simulator

David E. Bauer, M.D, Karl Wieser, M.D., Alexander Aichmair, M.D., M.P.H., Patrick O. Zingg, M.D., Claudio Dora, M.D., Stefan Rahm, M.D.

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### Purpose

To assess construct and face validity of a novel virtual reality–based hip arthroscopy simulator using the previously validated Arthroscopic Surgery Skills Evaluation Tool (ASSET), metric parameters, and a questionnaire.

### Methods

Metric parameters including task completion time, camera path, and grasper path were recorded, and the ASSET score was used to assess construct validity. Face validity was evaluated using a questionnaire.

### Results

Nine hip arthroscopy experts, of whom the majority performed more than 200 procedures (age,  $48 \pm 7.3$ ; range, 38-61 years; 8 men, 1 woman), and 33 nonexperts (age,  $33 \pm 7.9$ ; range, 26-62 years; 25 men, 8 women) performed 3 individual tasks on a virtual reality–based arthroscopy simulator of a left hip. The ASSET global rating scale showed a statistically significant difference between the hip arthroscopy expert and the nonexpert group, indicating strong construct validity (25.0 in the expert group, range, 17-34, versus 15.30 in the nonexpert group, range, 8-30 [ $P < .001$ ], respectively). This also applied to most metric parameters recorded by the simulator. The simulator also demonstrated high face validity. The overall impression in terms of realism was graded “completely realistic” by 17% and “close to realistic” by 62% of participants.

### Conclusions

The tested simulator demonstrated high construct and face validity.

### Clinical Relevance

This study demonstrates the construct and face validity of a novel hip arthroscopy simulator. The device proved to be an adequate model for the simulation of some arthroscopic procedures of the hip.

## Combined Lateral Osseolabral Coverage Is Normal in Hips With Acetabular Dysplasia

Matthew J. Kraeutler, M.D., Jesse A. Goodrich, B.A., Zachary R. Ashwell, M.D., Tigran Garabekyan, M.D., Mary K. Jesse, M.D., Omer Mei-Dan, M.D.

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### Purpose

To compare the lateral osseolabral coverage between groups of patients with different degrees of acetabular bony coverage using a magnetic resonance imaging parameter known as the combined lateral center-edge angle (cLCEA).

### Methods

The cLCEA was measured among a consecutive series of patients presenting to a dedicated hip preservation surgeon with a magnetic resonance imaging scan. The cLCEA was measured using a coronal T1 or proton density image and was defined as the angle subtended by (1) a line through the center of the femoral head and orthogonal to the transverse line passing through the teardrops of both hips and (2) an oblique line drawn from the center of the femoral head to the free edge of the lateral acetabular labrum. The average difference between the lateral center-edge angle (LCEA) and the cLCEA was calculated and compared between groups based on acetabular bony coverage: dysplasia (LCEA <20°), borderline dysplasia (LCEA 20°-24.9°), normal coverage (LCEA 25°-39.9°), and overcoverage (LCEA ≥40°).

### Results

In total, 341 patients (386 hips) were included. There were no significant differences in cLCEA between hips with normal acetabular coverage and dysplasia ( $P = .10$ ) or borderline dysplasia ( $P = .46$ ). Despite the large difference in mean LCEA between dysplasia ( $14.8^\circ \pm 3.9^\circ$ ) and acetabular overcoverage ( $43.1^\circ \pm 2.8^\circ$ ), the mean cLCEA values exhibited only a modest difference ( $44.7^\circ \pm 4.9^\circ$  vs  $52.7^\circ \pm 4.5^\circ$ , respectively). Concordantly, hips with dysplasia exhibited the largest difference between mean LCEA and cLCEA ( $\Delta = 29.9^\circ \pm 4.7^\circ$ ) and hips with acetabular overcoverage had the smallest difference between measures ( $9.6^\circ \pm 5.2^\circ$ ).

### Conclusions

With decreasing acetabular bony coverage, there is increasing labral size such that the total osseolabral coverage, measured by the combined LCEA, remains equivalent between hips with normal acetabular coverage versus dysplasia.

### Level of Evidence

Level III, retrospective comparative study.

## **Location and Correlation of Acetabular Labral Tears and Paralabral Cysts Using Magnetic Resonance Imaging or Magnetic Resonance Arthrography in Patients With Femoroacetabular Impingement**

Young-Kyun Lee, M.D., Jong-Min Kim, M.D.a, Byung-Il Yoon, M.D., Jae-Yoon Kim, M.D., Guen Young Lee, M.D., Sujin Kim, M.D., Yong-Chan Ha, M.D.

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### **Purpose**

To evaluate the prevalence and location of paralabral cysts and the correlation between the type of femoroacetabular impingement (FAI) and acetabular labral tears, as well as the location of the paralabral cysts.

### **Methods**

Patients who received a diagnosis of FAI syndrome using plain radiography, magnetic resonance imaging or magnetic resonance arthrography, or computed tomographic arthrography from 2010 to 2015 were included in this study. The exclusion criteria were patients with arthritis (Tönnis grade 2 or greater) or dysplasia. We identified paralabral cysts and their location, size, configuration. Correlations between the type of FAI and labral tears and paralabral cysts were analyzed using the  $\chi$ -square test.

### **Results**

Among 506 patients with FAI, paralabral cysts were found in 51 patients (55 hips) and were located anterosuperiorly in 40% of cases, posterosuperiorly in 36%, anteroinferiorly in 17%, and posteroinferiorly in 8%. We identified multilocular cysts in 60% of hips and unilocular cysts in 40%. Labral tears were radiographically found in 44 of 55 hips with paralabral cysts (80%); they were located anterosuperiorly in 59% and posterosuperiorly in 41%. Although paralabral cysts were found in the anteroinferior and posteroinferior areas, acetabular labral tears were not identified in the anteroinferior and posteroinferior areas. Classification of the type of FAI showed cam type in 14 of 55 hips (25.5%), pincer type in 16 (29%), mixed type in 7 (13%), labral tears in 15 (27%), and normal findings in 3 (5.5%). No correlation was found between the type of FAI and labral tears ( $P = .739$ ) or the location of paralabral cysts ( $P = .228$ ).

### **Conclusions**

Paralabral cysts in patients with FAI most commonly are found in the anterosuperior area and are of the multilocular type. Although paralabral cysts in the anterosuperior and posterosuperior portions are related to labral tears, those in the anteroinferior and posteroinferior portions are not.

### **Level of Evidence**

Level IV, diagnostic case series.

## Single- Versus Double-Row Repair of Hip Abductor Tears: A Biomechanical Matched Cadaver Study

Cynthia A. Kahlenberg, M.D., Benedict U. Nwachukwu, M.D., M.B.A., Hamidreza Jahandar, M.S., Kathleen N. Meyers, M.S., Amar S. Ranawat, M.D., Anil S. Ranawat, M.D

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### Purpose

The purposes of this study were (1) to evaluate the percentage of gluteus medius and minimus tendon footprint restoration that can be achieved with fixation using single-row repair versus double-row repair and (2) to evaluate the yield load of a repair of the gluteus medius and minimus tendon using single-row versus double-row repair techniques.

### Methods

Twelve human fresh-frozen cadaveric hip specimens (6 matched pairs, 4 female, mean age  $47.5 \pm 14.5$  years) were tested. Specimens were excluded if they had any prior hip surgery or injury, if any abnormality of the tendon was noted on dissection, or if they had a body mass index  $<20$  or  $>35$  or a T-score  $<2.0$  on dual-energy x-ray absorptiometry scanning. Matched pairs were randomized to receive either double-row repair with 2 standard suture anchors and 2 knotless anchor devices or a single-row repair with suture anchors only. The percentage of the footprint area covered after repair was determined using a computer-assisted digitization algorithm. With a mechanical testing system, each repaired specimen was tested for mechanical strength first with cyclic loading and then load to failure testing.

### Results

Footprint coverage of the lateral facet was significantly greater for double-row repair (mean 76.6%) compared with single-row repair (mean 50.3%) ( $P = .03$ ). There was no significant difference between single- and double-row repair for posterior-superior or anterior facet coverage. Mechanical testing showed a higher mean yield load for double-row anchor repair ( $197.6 \pm 61.7$  N vs  $163.5 \pm 35.4$  N for single-row repair), but this did not reach statistical significance ( $P = .15$ ). The predominant mode of failure was suture pullout through the musculotendinous unit (9/12 specimens: 5 double-row and 4 single-row).

### Conclusions

For hip abductor tears, double-row suture repair yields improved footprint coverage compared with single-row repair. Although it did not reach statistical significance, there was a higher mean yield load in the double-row group.

### Clinical Relevance

Double-row suture fixation technique for hip abductor tears maximizes strength and footprint coverage of the repair.

## Outcomes of Hip Arthroscopy With Concomitant Periacetabular Osteotomy, Minimum 5-Year Follow-Up

David R. Maldonado, M.D., Justin M. LaReau, M.D., Itay Perets, M.D., Victor Ortiz-Declet, M.D., Joseph R. Laseter, B.A., Ajay C. Lall, M.D., Benjamin G. Domb, M.D.

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### Purpose

To report minimum 5-year follow-up results of concomitant hip arthroscopy followed by periacetabular osteotomy (PAO) to treat acetabular dysplasia and intra-articular pathology, such as femoroacetabular impingement syndrome and labral tears.

### Methods

Data were prospectively collected from October 2010 to December 2012. Patients were included in this study if they underwent concomitant hip arthroscopy and PAO and if they had preoperative scores documented for the following measures: modified Harris Hip Score (mHHS), Nonarthritic Hip Score (NAHS), Hip Outcome Score—Sports-Specific Subscale (HOS-SSS), and pain on a visual analog scale (VAS). Patients who underwent reverse PAO to address acetabular retroversion were excluded. Follow-up was considered complete with these outcomes collected after surgery, as well as the abbreviated International Hip Outcome Tool and patient satisfaction on a 0-10 scale. Significance was set at  $P = .05$ .

### Results

Sixteen patients were eligible, all of whom had complete follow-up at a minimum of 5 years after surgery. There were 13 female subjects. The average age of the patients was  $23.5 \pm 6.8$  years (range, 12.3-35.3 years), and the average body mass index was  $24.3 \pm 5.6$  (range, 14.8-34.2). The mean lateral center-edge angle increased from  $14.2^\circ$  to  $31.8^\circ$  ( $P < .0001$ ), and the anterior center-edge angle increased from  $11.9^\circ$  to  $28.6^\circ$  ( $P < .0001$ ). The Tönnis angle of acetabular inclination decreased from  $19.3^\circ$  to  $2.6^\circ$  ( $P < .0001$ ). The alpha angle decreased from  $55.7^\circ$  to  $41.0^\circ$  ( $P < .0001$ ). All preoperative radiographs were Tönnis  $\leq 1$ , and there was no progression of arthritis in radiographs taken at the latest clinical visit. All patient-reported outcomes scores demonstrated significant improvement from preoperative baseline to the minimum 5-year follow-up scores (mHHS,  $P < .001$ ; NAHS,  $P < .001$ ; HOS-SSS,  $P = .001$ ). The VAS score decreased from a preoperative mean of 5.8 to 3.1 at the latest follow-up ( $P = .007$ ). No conversion to total hip arthroplasty was reported.

### Conclusions

Concomitant hip arthroscopy and PAO appears to be a safe and effective procedure with favorable mid-term outcomes that are durable compared to the short-term.

### Level of Evidence

Level IV, case series.

## **Prognosis Following Hip Arthroscopy Varies in Professional Athletes Based on Sport**

Robert A. Christian, M.D, Ryan J. Lubbe, B.S., Danielle S. Chun, M.D., Ryan S. Selley, M.D., Michael A. Terry, M.D., Wellington K. Hsu, M.D.

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### **Purpose**

To evaluate return to play (RTP) and performance-based outcomes in professional athletes across 4 major North American team sports following hip arthroscopy.

### **Methods**

Professional athletes of the National Football League, Major League Baseball (MLB), National Basketball Association, and National Hockey League (NHL) who underwent hip arthroscopy were identified using an established protocol of public reports. Sport-specific statistics were collected before and after hip arthroscopy for each athlete, leading to a performance score. RTP was defined as the first regular or postseason game played following surgery.

### **Results**

A total of 151 arthroscopic hip procedures were performed on 131 professional athletes. The overall RTP rate after arthroscopic hip surgery was found to be 88.7% (134 of 151 arthroscopic hip surgeries), with no significant difference between sports. The median number of seasons played after hip arthroscopy were 2.7, 2.3, 1.1, and 0.9 for the National Football League, National Basketball Association, MLB, and NHL cohorts, respectively, with no significant difference between sports. MLB and NHL cohorts experienced a decrease in games played in the first season following hip arthroscopy ( $P = .04$ ,  $P = .01$ ), whereas NHL players also experienced a decrease in games played in seasons 2 and 3 postoperatively ( $P = .001$ ). Performance scores decreased in the NHL cohort for all seasons postoperatively ( $P < .001$ ,  $P = .003$ ). No other statistically significant differences were found when comparing players of different sports.

### **Conclusions**

Although professional athletes demonstrate a high rate of RTP following hip arthroscopy across the 4 major North American team sports, hockey players demonstrate the worst prognosis following hip arthroscopy, with sustained decreases in games played and performance in the first 3 seasons postoperatively.

### **Level of Evidence**

Level III, retrospective comparative therapeutic trial.

# Medial Patellofemoral Ligament Reconstruction: A Comparison of Single-Bundle Transpatellar Tunnel and Double-Anchor Anatomic Techniques for the Treatment of Recurrent Lateral Patellar Dislocation in Adults

Ji Li, Ph.D., Zhongli Li, Ph.D, Li, Ketao Wang, M.D., Chunhui Liu, Ph.D., Yuxing Wang, Ph.D., Haoran Wang, M.D.

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## Purpose

To compare the stability and clinical outcomes of 2 medial patellofemoral ligament reconstruction (MPFLR) techniques for the treatment of recurrent lateral patellar dislocation in adults.

## Methods

Ninety-one patients with recurrent patellar dislocation were randomly divided into 2 groups, undergoing either the traditional single-bundle transpatellar tunnel technique (group A) or the double-anchor anatomic reconstruction technique (group B). Preoperatively and at follow-up, the patellar position and rotation were evaluated by computed tomography with the congruence angle, lateral patellar angle, patellar tilt angle, and lateral patellar translation; the subjective symptoms and functional outcomes were evaluated with Kujala, Lysholm, Tegner, and International Knee Documentation Committee subjective scores. Clinical examinations were also performed, and redislocations or episodes of instability were recorded.

## Results

Patients were followed up for a mean period of  $41.11 \pm 7.40$  months (range, 29-62 months). At the final point, no recurrent patellar dislocations occurred, except in 4 patients with instability symptoms in group A; however, no significant difference between the 2 groups was seen ( $\chi^2 = 2.503$ ,  $P = .114$ ). The measurement results from computed tomography decreased significantly to the normal range, and no significant difference was found between the 2 groups except for the lesser patellar tilt angle in group B ( $t = 2.175$ ,  $P = .030$ ). The clinical examination improved significantly, no patient exhibited a positive apprehension test in either group, and the number of patients with abnormal lateral patellar translation grade and firm end point showed no statistically significant differences between the 2 groups ( $P > .05$ ). All score systems significantly improved with no significant difference between the 2 groups except for the higher Kujala score ( $t = -40.635$ ,  $P = .001$ ) and International Knee Documentation Committee score ( $t = -33.823$ ,  $P = .003$ ) in group B.

## Conclusions

Both MPFLR techniques achieved good results in the treatment of patellar dislocation. Compared with the single-bundle transpatellar tunnel technique, the double-anchor anatomic MPFLR technique may be more effective with a more congruous patellofemoral joint and better knee function.

## Level of Evidence

Level II, prospective comparative study.



## **One-Third of Meniscal Tears Are Repairable: An Epidemiological Study Evaluating Meniscal Tear Patterns in Stable and Unstable Knees**

Alejandro Espejo-Reina, M.D., M., José Aguilera, Sc.D., María Josefa Espejo-Reina, M.D., María Pilar Espejo-Reina, M.D., M.S.c., Alejandro Espejo-Baena, M.D

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### **Purpose**

To analyze, in a long series of patients with knee injuries, the meniscal tear patterns in both stable and unstable knees to ascertain the exact proportion of such injuries that could have been repaired.

### **Methods**

A descriptive cross-sectional study was undertaken by reviewing the clinical reports of arthroscopic knee operations carried out in 1 hospital. A total of 2,066 consecutive patients were included in the study. An analysis of clinical and anatomical data of knee lesions, including the shape of the meniscal tears and the surrounding injuries, was performed.

### **Results**

Out of all meniscal tears, 34.9% were found to be repairable, a figure that rose to 55.6% in those tears accompanied by anterior cruciate ligament injuries; 37% of meniscal tears in male patients were repairable, and 28% in their female counterparts; 38.2% of medial meniscal tears were repairable and 30.6% in their lateral counterparts. The most frequently encountered injury was the complex tear (46.9%).

### **Conclusions**

Our study concludes that, according to current standard indications, 34.9% of all meniscal injuries offer the potential for repair. Where the injury is also accompanied by anterior cruciate ligament damage, the proportion of repairable tears rises to 55.6%. This information should increase the interest for meniscal preservation in the future.

### **Level of Evidence**

Level IV, case series.

## **The Utility of Oral Nonsteroidal Anti-inflammatory Drugs Compared With Standard Opioids Following Arthroscopic Meniscectomy: A Prospective Observational Study**

Hien Pham, M.D., Michael Pickell, M.D., Michelle Yagnatovsky, B.S., Mark Kramarchuk, B.S., Michael J. Alaia, M.D., Eric J. Strauss, M.D., Laith M. Jazrawi, M.D., Kirk A. Campbell, M.D

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### **Purpose**

To evaluate the efficacy of oral nonsteroidal anti-inflammatory drugs (NSAIDs) as the primary postoperative pain medication compared with standard oral opioids following arthroscopic partial meniscectomy.

### **Methods**

This was a single-center, prospective, nonrandomized, comparative observational study. Patients ages 18 to 65 years who were indicated for arthroscopic meniscectomy were included. Postoperatively, patients were prescribed 1 of 2 analgesic regimens: (1) ibuprofen (600 mg every 6-8 hours as needed) and 10 tablets of oxycodone/acetaminophen (5/325 mg as needed for breakthrough pain) or (2) 30 to 40 tablets oxycodone/acetaminophen (5/325 mg every 6 hours as needed). Subjects completed questionnaires at 8 hours, 24 hours, 48 hours, and 1 week after surgery, which included medication usage, visual analog scale pain score, incidence of adverse events, and patient satisfaction.

### **Results**

Sixty-eight patients with mean age 51.2 years ( $\pm 10.4$  years) were enrolled between October 2016 and February 2017. Enrollment in the opioid group continued until 30 patients were enrolled in the NSAID group, and at final analysis there were 28 patients in the NSAID group and 40 in the opioid group. There were no significant differences in sex, visual analog scale pain score, or patient satisfaction between the 2 groups at any time point. Patients in the opioid group had a significantly higher mean opioid consumption on postoperative day 1 (1.1 vs 0.5 tablets,  $P < .03$ ) and postoperative days 3 to 7 (2.6 vs 0.5 tablets,  $P < .02$ ) compared with NSAID group patients. There was a trend toward greater total (1 week) opioid usage (4.7 vs 2.0 tablets) in the opioid group; however, this was not statistically significant ( $P < .08$ ). Fifty-three percent of opioid group patients independently chose to forego their opioid medication for an over-the-counter NSAID and/or acetaminophen instead. No patients requested a medication refill.

### **Conclusions**

We found no significant difference in pain control, satisfaction, and total 1-week opioid use between patients prescribed NSAIDs with opioids and those prescribed opioids alone. All patients used only limited amounts of opioids to control postoperative pain, suggesting we are currently overprescribing opioids after arthroscopic partial meniscectomy.

### **Level of Evidence**

Level II, prospective comparative study.

# Combined Anterior Cruciate and Anterolateral Ligament Reconstruction in the Professional Athlete: Clinical Outcomes From the Scientific Anterior Cruciate Ligament Network International Study Group in a Series of 70 Patients With a Minimum Follow-Up of 2 Years

Nikolaus Rosenstiel, M.D., Cesar Praz, M.D., Hervé Ouanezar, M.D., Adnan Saithna, M.B.Ch.B., Dip.SEM., M.Sc., F.R.C.S.(T&O), Yann Fournier, M.D., Jean-Philippe Hager, M.D., Mathieu Thauinat, M.D., Bertrand Sonnery-Cottet, M.D.

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## Purpose

To evaluate clinical outcomes in professional athletes after combined anterior cruciate ligament (ACL) and anterolateral ligament (ALL) reconstruction at a minimum follow-up of 2 years.

## Methods

A retrospective analysis of prospectively collected data from the Scientific Anterior Cruciate Ligament Network International (SANTI) Study Group database was performed. All professional athletes who underwent primary combined ACL and ALL reconstruction between January 2011 and March 2016 were included. Patient assessment included physical examination, pre- and postoperative subjective and objective International Knee Documentation Committee (IKDC), Tegner activity scale, and Lysholm scores.

## Results

Seventy-two professional athletes underwent primary ACL and ALL reconstruction; 70 (97%) were available, with a mean follow-up of 3.9 years (range, 2-7). The preoperative side-to-side anteroposterior laxity difference was  $7.1 \pm 1.4$  mm, and this decreased significantly after surgery to  $0.4 \pm 0.9$  mm ( $P < .0001$ ). Pivot-shift grade evolved from 16 grade I (22.8%) and 54 grade II or III (77.2%) preoperatively, to 66 absent pivot shift (94.3%) and 4 grade I (5.7%;  $P < .001$ ). By 1-year postoperatively, 60 athletes (85.7%) returned to professional sport, with a mean time interval of 7.9 months (range, 5-12). Preoperatively, the mean subjective IKDC was  $56.1 \pm 12.3$ , the Lysholm score was  $48.4 \pm 12.5$ , and the Tegner score was  $9.3 \pm 1$ . At final follow-up, the mean subjective IKDC was  $90.5 \pm 7.6$  ( $P < .0001$ ), the Lysholm score was  $94.4 \pm 7.5$  ( $P < .0001$ ), and the Tegner score was  $8.8 \pm 1.5$  ( $P < .004$ ). The objective IKDC evolved from 39 grade C (55.7%) and 31 grade D (44.3%) preoperatively to 65 grade A (92.9%) and 5 grade B (7.1%) ( $P < .0001$ ). Eleven Patients (15.7%) underwent a subsequent ipsilateral reoperation including 4 (5.7%) revision ACL reconstructions. The risk of graft rupture was significantly higher in female patients (13.6% vs 2.1% in male patients;  $P = .048$ ).

## Conclusions

Combined ACL and ALL reconstruction is associated with excellent outcomes in professional athletes with respect to graft rupture rates, return to sport, knee stability, and reoperation rates after injury.

## Level of Evidence

Level IV, case series.

## **A Biomechanical Comparison of Single-, Double-, and Triple-Bundle Anterior Cruciate Ligament Reconstructions Using a Hamstring Tendon Graft**

Tomoyuki Suzuki, M.D., Ph.D., Konsei Shino, M.D., Ph.D., Satoshi Yamakawa, Ph.D., Hidenori Otsubo, M.D., Ph.D., Daisuke Suzuki, Ph.D., Takashi Matsumura, M.D., Mineko Fujimiya, M.D., Ph.D., Hiromichi Fujie, Ph.D., Toshihiko Yamashita, M.D., Ph.D.

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### **Purpose**

The first objective of our cadaveric study was to perform a biomechanical comparison of single-bundle (SB), double-bundle (DB), and triple-bundle (TB) anterior cruciate ligament (ACL) reconstructions using a hamstring tendon graft to determine the laxity match pre-tension (LMP) value, which is the tension within the graft required to re-create the same anterior laxity as the ACL-intact knee. The second objective was to determine the anterior laxity and force distribution during the application of both an anterior force and a simulated pivot-shift test.

### **Methods**

Eleven fresh-frozen cadaveric knees were tested using a robotic/universal force-moment sensor system in the intact state, TB-reconstructed knee, DB-reconstructed knee, and SB-reconstructed knee. The LMP in each reconstruction was recorded. Each reconstructed knee was tested with an external load of 100-N anterior drawer and combined rotatory loads of 10-Nm valgus moment and 5-Nm internal rotation. The anterior tibial translation and tensile forces of each graft bundle were measured.

### **Results**

The LMP values for the TB reconstruction were 1.7 N for the anteromedial-medial graft, 1.7 N for the anteromedial-lateral graft, and 3.4 N for the posterolateral graft (PLG). The LMP value was 5.6 N for the anteromedial graft and PLG in the DB reconstruction. The LMP value was 26.3 N for the whole graft in the SB reconstruction. No statistically significant difference in stability was found between TB and DB reconstructions during the anterior load and the combined rotatory load test. For force distribution, the PLG tension in the TB reconstruction was statistically lower than that in the DB reconstruction.

### **Conclusions**

Anatomic TB ACL reconstruction with the lowest initial tension on the graft stabilized the knee equally to DB or SB reconstruction, which required greater initial tension.

### **Clinical Relevance**

Although SB, DB, and TB ACL reconstructions through the anatomic tunnel position could equally restore stability, the initial tension on the graft required to restore stability was less in the latter 2 multi-tunnel reconstructions.

## **Supplemental Fixation of Inner Graft Limbs in All-Inside, Quadrupled, Single-Tendon Anterior Cruciate Ligament Reconstruction Graft Construct Yields Improved Biomechanical Properties**

Carlos M. Barrera, B.S., Hayley Ennis, M.D., Gaëtan J.-R. Delcroix, Ph.D., David Kaimrajh, M.S., Edward Milne, B.Sc., Loren Latta, Ph.D., Michael G. Baraga, M.D.

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### **Purpose**

To compare the time-zero load to failure of a quadrupled, single-tendon, all-inside anterior cruciate ligament (ACL) reconstruction graft construct with (supplemented) and without the incorporation of inner-limb whipstitch sutures (control) into a tibial suspensory fixation button.

### **Methods**

Eight matched pairs of peroneus longus tendons were prepared according to a quadrupled, all-inside ACL soft-tissue graft technique with 1 side serving as a control and the contralateral side supplemented. The constructs were biomechanically tested for strain in the inner and outer limbs during a preconditioning protocol, single-cycle load to failure, and elongation of the whole construct.

### **Results**

Ultimate load to failure was significantly higher in the supplemented group:  $797.5 \pm 49.6$  N (95% confidence interval [CI], 763.13-831.87 N) versus  $719.6 \pm 69.6$  N (95% CI, 671.38-767.82 N;  $P = .044$ ). Less graft elongation at failure was observed in the supplemented group ( $3.1 \pm 1.5$  mm; 95% CI, 2.07-4.17 mm) versus the control group ( $21.0 \pm 21.2$  mm; 95% CI, 6.31-35.69 mm;  $P = .052$ ). The number of grafts undergoing a 5-mm or greater change in length at failure was 1 of 8 in the supplemented group versus 5 of 8 in the control group ( $P = .038$ ).

### **Conclusions**

Inner-limb supplemental tibial fixation results in higher time-zero load to failure and decreased graft elongation in a quadrupled, single-tendon, all-inside ACL reconstruction graft construct.

### **Clinical Relevance**

The weak point of a single-tendon, quadrupled, all-inside ACL graft construct is the tendon-to-tendon suturing to secure the inner limbs of the graft. Adding supplemental fixation by incorporating the sutures from the inner limb to the tibial suspensory fixation button leads to a higher time-zero load to failure and decreased graft elongation.

# **Adductor Canal Nerve Versus Femoral Nerve Blockade for Pain Control and Quadriceps Function Following Anterior Cruciate Ligament Reconstruction With Patellar Tendon Autograft: A Prospective Randomized Trial**

Lane Bailey, P.T., Ph.D., Joshua Griffin, M.D., Mark Elliott, M.D.b, Jennifer Wu, M.D., Thanos Papavasiliou, P.T., D.P.T., Christopher Harner, M.D., Walter Lowe, M.D.

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## **Purpose**

To compare femoral nerve blockade (FNB) versus adductor canal nerve blockade (ACB) for postoperative pain control and quadriceps muscle function in patients undergoing anterior cruciate ligament (ACL) reconstruction with patellar tendon autograft.

## **Methods**

A randomized therapeutic trial of 90 patients undergoing ACL reconstruction with patellar tendon autograft was conducted comparing ACB versus FNB at 24 hours, 2 and 4 weeks, and 6 months postsurgery. Early outcome measures included average pain score and morphine equivalent units (milligrams) consumed, quadriceps surface electromyography, straight leg raise, and ability to ambulate without assistive devices. The 6-month outcome measures included knee range of motion (ROM), isokinetic knee extension peak torque, single-leg squat, and single-leg hop performance. Complications were recorded throughout the study for the development of anterior knee pain, knee extension ROM loss, deep vein thrombosis, and graft failure. Mixed-model analysis of variance and Mann-Whitney U tests were performed using an alpha of .05.

## **Results**

Quadriceps surface electromyography deficits were higher for FNB at 24 hours ( $P < .001$ ) and 2 weeks ( $P < .001$ ) when compared with the ACB group. There were no between-groups difference for subjective pain ( $P = .793$ ) or morphine consumption ( $P = .358$ ) within the first 24 hours of surgery. A higher percentage of patients in the ACB group met the full ambulation criteria at 4 weeks compared with the FNB group (100% vs 84.2%,  $P < .001$ ). No between-group differences were observed at 6 months; however, the rate of knee extension ROM loss was higher for the FNB group versus the ACB group (21.1% vs 5.0%,  $P = .026$ ), respectively.

## **Conclusions**

ACB was as effective as FNB at providing pain control while eliciting fewer quadriceps muscle activation deficits and fewer postoperative complications. Based on previous evidence and the results of this study, we recommend the use of ACB over FNB for the analgesic management of patients undergoing ACL reconstruction with patellar tendon autograft.

## **Level of Evidence**

Level I, prospective randomized controlled trial.

## **The Presence of the Arthroscopic “Floating Meniscus” Sign as an Indicator for Surgical Intervention in Patients With Combined Anterior Cruciate Ligament and Grade II Medial Collateral Ligament Injury**

Luis Fernando Z. Funchal, M.D., Diego Costa Astur, M.D., Ph.D., Rafael Ortiz, M.D.a, Moises Cohen, M.D., Ph.D

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### **Purpose**

To compare the outcomes of patients with an arthroscopic floating meniscus sign at 24-month follow-up when treated with and without medial compartment reconstruction surgery. Another aim of the present study was to compare magnetic resonance imaging and arthroscopic findings directly related to the characterization and localization medial collateral ligament (MCL) injuries.

### **Methods**

A total of 112 patients diagnosed with combined anterior cruciate ligament (ACL)–MCL grade II injuries to be treated with ACL reconstruction surgery were included in the study. During arthroscopy, patients diagnosed with the “floating meniscus” sign were divided into 2 groups: group 1 (n = 58) was treated with ACL and medial compartment reconstruction surgery and group 2 (n = 54) was treated with ACL reconstruction and nonsurgical medial compartment treatment. Return to competitive sports (Tegner score), Lysholm scores, ACL reconstruction failure, and residual MCL laxity were evaluated 6, 12, and 24 months after surgery.

### **Results**

After 24 months, patients from group 1 (n = 58) had an average Tegner score of 8.98 and Lysholm score of 89.67; 2 patients presented with ACL reconstruction failure and none presented with residual MCL laxity. Patients from group 2 (n = 54) had an average Tegner score of 6.7 and Lysholm score of 78.12; 16 patients presented with ACL reconstruction failure and 13 presented with residual MCL laxity.

### **Conclusions**

In the presence of a floating meniscus arthroscopic sign, patients with combined ACL and grade II MCL injuries treated with ACL and MCL reconstruction surgery had significantly lower frequency of ACL reconstruction failure, residual MCL laxity, and better Tegner and Lysholm scores at 24 months' follow-up ( $P < .05$ ). Additionally, magnetic resonance imaging and arthroscopy differed significantly ( $P < .05$ ) in their ability to identify mid-substance and tibial site MCL injuries.

### **Level of Evidence**

Level I, randomized clinical trial.

## **The Impact of Transphyseal Anterior Cruciate Ligament Reconstruction on Lower Extremity Growth and Alignment**

Ahmad F. Bayomy, M.D., Viviana Bompadre, Ph.D., Gregory A. Schmale, M.D.

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### **Purpose**

To evaluate the effect of transphyseal anterior cruciate ligament (ACL) reconstruction on lower extremity radiographic growth and alignment.

### **Methods**

We retrospectively reviewed patients who underwent transphyseal ACL reconstruction and were followed to skeletal maturity or at least 2 years, with the nonoperative limb used as an internal control. Changes in coronal plane alignments and tibial slope of the operative limb were compared with a Wilcoxon test. Associations among sex, tunnel, and graft characteristics and failure; changes in coronal plane measures and tunnel size; and tunnel angles and the development of deformity were examined by  $\chi$ -square and correlation coefficients.

### **Results**

Fifty-nine patients (41 boys and 18 girls) underwent surgery at a mean age of 12.5 years (range, 6.8-16.0 years). There were differences in changes in the mechanical lateral distal femoral angle comparing operative and nonoperative limbs (decreased 1.1° in girls and 1.9° in boys  $\leq$ 13 years of age,  $P = .0008$  and  $.025$ , respectively) and in changes in tibial slope of the operative limb (decreased 2.1° in male patients  $>13$  years,  $P = .012$ ). No patient developed a new limb length difference  $>1$  cm. Two boys were treated for deformities. Eight additional patients developed  $>5^\circ$  difference in alignment for a rate of radiologic deformity of 10 of 59 or 17%. Neither graft failure nor the presence of deformity was associated with sex, tunnel size, mode of femoral tunnel positioning, inclination of tunnels, or the use of allograft.

### **Conclusions**

Radiographically evident limb deformities following transphyseal ACL reconstruction occurred at a rate of 17%, although these deformities were clinically evident in only 5% of patients. Tunnels intersecting physes near cortical margins may increase the risk of developing deformity. Regular follow-up should include alignment radiographs to detect deformities despite the clinical appearance of neutral limb alignment.

### **Level of Evidence**

Level III, case-control study.



## **Presence of Subfibular Ossicle Does Not Affect the Outcome of Arthroscopic Modified Broström Procedure for Chronic Lateral Ankle Instability**

Woo Jong Kim, M.D., Hong Seop Lee, M.D.b, Sang Il Moon, M.D., Hak Soo Kim, M.D., Eui Dong Yeo, M.D., Young Hwan Kim, M.D., Eun Seok Park, M.D., Young Koo Lee, M.D., Ph.D.

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### **Purpose**

To evaluate the clinical and radiological outcomes of the all-inside, arthroscopic, modified Broström procedure (MBP) used to treat chronic lateral ankle instability (CLAI) according to subfibular ossicle (SFO) status.

### **Methods**

Between January 2013 and September 2016, we retrospectively analyzed CLAI patients who underwent the arthroscopic MBP. When performing the arthroscopic MBP, SFO was removed with all inside technique regardless of size. Patients who were not followed for more than a minimum of 12 months after surgery were excluded. The patients were divided into 2 groups: ankles with SFOs were assigned to the SFO group and the others to the non-SFO (NSFO) group. The evaluation tools used included the American Orthopedic Foot and Ankle Society (AOFAS) ankle-hind foot score, a pain visual analog scale, and the talar tilt angle.

### **Results**

Following the inclusion criteria, we included 125 patients (125 ankles) in this study. The SFO group consisted of 26 patients and the NSFO group consisted of 99 patients. The preoperative scores in the 2 groups shows no significant difference except for AOFAS scores. The final AOFAS scores in both groups improved compared with the preoperative scores ( $18.4 \pm 16.3$  and  $22.1 \pm 21.6$  for the SFO and NSFO groups, respectively). The final follow-up visual analog scale scores also improved in both groups ( $5.0 \pm 1.7$  and  $5.2 \pm 1.4$ , respectively). The mean  $\pm$  standard deviation talar tilt improved from  $8.7 \pm 5.0^\circ$  preoperatively to  $4.6 \pm 3.6^\circ$  at the final follow-up in the SFO group, and from  $7.3 \pm 4.4^\circ$  preoperatively to  $3.2 \pm 3.0^\circ$  at the final follow-up in the NSFO group. Neither the preoperative nor final talar tilt angle differed between the 2 groups ( $P = .300$  and  $P = .072$ , respectively).

### **Conclusions**

All-inside arthroscopic MBP after SFO resection was as successful as the same surgery without SFO resection. The clinical outcomes of the SFO and NSFO groups did not differ. Both groups achieved successful radiological outcomes at the last follow-up. All-inside arthroscopic MBP is a reliable treatment for CLAI patients regardless of SFO status.

### **Level of Evidence**

Level III, retrospective comparative study.

# **Knee Osteoarthritis After Single-Bundle Versus Double-Bundle Anterior Cruciate Ligament Reconstruction: A Systematic Review of Randomized Controlled Trials**

John W. Belka, Matthew J. Kraeutler, M.D., Darby A. Houck, B.A., Eric C. McCarty, M.D

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## **Purpose**

To systematically review high-quality studies in the literature to compare the postoperative radiographic incidence of knee osteoarthritis (OA) after anterior cruciate ligament reconstruction (ACLR) with a single-bundle (SB) versus double-bundle (DB) graft.

## **Methods**

A systematic review was performed by searching PubMed, the Cochrane Library, and Embase to locate randomized controlled trials that compared the postoperative progression of knee OA in SB versus DB ACLR patients. The search terms used were "anterior cruciate ligament reconstruction," "single-bundle," "double-bundle," "randomized," and "osteoarthritis." Patients were assessed based on radiographic evaluation (Kellgren-Lawrence [K-L] and objective International Knee Documentation Committee scales) and graft failure.

## **Results**

A total of 7 studies (5 Level I and 2 Level II) met the inclusion criteria, including 375 SB and 477 DB ACLR patients with a mean follow-up period of 5.3 years. Graft failure occurred in 3.2% of patients overall (27 of 852), with no significant difference between groups ( $P = .10$ ). No significant difference in overall K-L grade distribution was found between groups ( $P = .90$ ). Overall, 15.1% of patients (58 of 383) were given a K-L grade of 2 or greater, including 14.4% in the SB group (31 of 215) and 16.1% in the DB group (27 of 168) ( $P = .65$ ). Using other, unconventional grading schemes, 2 studies found DB ACLR patients to have significantly fewer signs of radiographic knee OA at follow-up compared with SB ACLR patients ( $P < .05$ ).

## **Conclusions**

Patients undergoing ACLR with either an SB or DB graft can be expected to experience a similar incidence of postoperative knee OA at midterm follow-up according to the K-L grading system.

## **Level of Evidence**

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

**Greater magnitude tibiofemoral contact forces are associated with reduced prevalence of osteochondral pathologies 2–3 years following anterior cruciate ligament reconstruction**

David John Saxby, Adam L. Bryant, Ans Van Ginckel, Yuanyuan Wang, Xinyang Wang, Luca Modenese, Pauline Gerus, Jason M. Konrath, Karine Fortin, Tim V. Wrigley, Kim L. Bennell, Flavia M. Cicuttini, Christopher Vertullo, Julian A. Feller, Tim Whitehead, Price Gallie, David G. Lloyd

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**Purpose**

External loading of osteoarthritic and healthy knees correlates with current and future osteochondral tissue state. These relationships have not been examined following anterior cruciate ligament reconstruction. We hypothesised greater magnitude tibiofemoral contact forces were related to increased prevalence of osteochondral pathologies, and these relationships were exacerbated by concomitant meniscal injury.

**Methods**

This was a cross-sectional study of 100 individuals ( $29.7 \pm 6.5$  years,  $78.1 \pm 14.4$  kg) examined 2–3 years following hamstring tendon anterior cruciate ligament reconstruction. Thirty-eight participants had concurrent meniscal pathology ( $30.6 \pm 6.6$  years,  $83.3 \pm 14.3$  kg), which included treated and untreated meniscal injury, and 62 participants ( $29.8 \pm 6.4$  years,  $74.9 \pm 13.3$  kg) were free of meniscal pathology. Magnetic resonance imaging of reconstructed knees was used to assess prevalence of tibiofemoral osteochondral pathologies (i.e., cartilage defects and bone marrow lesions). A calibrated electromyogram-driven neuromusculoskeletal model was used to predict medial and lateral tibiofemoral compartment contact forces from gait analysis data. Relationships between contact forces and osteochondral pathology prevalence were assessed using logistic regression models.

**Results**

In patients with reconstructed knees free from meniscal pathology, greater medial contact forces were related to reduced prevalence of medial cartilage defects (odds ratio (OR) = 0.7, Wald  $\chi^2(2) = 7.9$ , 95% confidence interval (CI) = 0.50–95,  $p = 0.02$ ) and medial bone marrow lesions (OR = 0.8, Wald  $\chi^2(2) = 4.2$ , 95% CI = 0.7–0.99,  $p = 0.04$ ). No significant relationships were found in lateral compartments. In reconstructed knees with concurrent meniscal pathology, no relationships were found between contact forces and osteochondral pathologies.

**Conclusions**

In patients with reconstructed knees free from meniscal pathology, increased contact forces were associated with fewer cartilage defects and bone marrow lesions in medial, but not, lateral tibiofemoral compartments. No significant relationships were found between contact forces and osteochondral pathologies in reconstructed knees with meniscal pathology for any tibiofemoral compartment. Future studies should focus on determining longitudinal effects of contact forces and changes in osteochondral pathologies.

**Level of evidence**

IV.

## **All-arthroscopic release for treating severe knee extension contractures could improve the knee range of motion and the mid-term functional outcomes**

Ziming Liu, Yuwan Li, Pengpeng Sun, Peng Sang, ChengHao Zhang, Youliang Ren, Jibin Yang, Xizhong Zhu, Wei Huang

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<https://doi.org/10.1007/s00167-018-5022-3>

### **Purpose**

To evaluate the safety, feasibility, and effectiveness of an all-arthroscopic technique for the intra- and extraarticular release of severe knee extension contractures.

### **Methods**

From 2012 to 2016, 25 patients with severe knee extension contractures (less than 45° range of flexion) were treated with an all-arthroscopic release technique. The patients underwent intra- and extraarticular arthroscopic release and arthroscopic-assisted mini-incision quadriceps plasty. The post-operative rehabilitation was initiated the first day after the procedures. Comprehensive clinical follow-up evaluations including the range-of-motion (ROM) assessment, the Lysholm score, and the International Knee Documentation Committee (IKDC) score were performed on all patients.

### **Results**

The median follow-up time was 28 months (range 12–65 months). The ROM improved from  $23.9^\circ \pm 7.5^\circ$  pre-operatively to  $105.9^\circ \pm 6.5^\circ$  at the final follow-up ( $P < 0.001$ ). In addition, the Lysholm score increased from  $59.9 \pm 5.2$  pre-operatively to  $89.7 \pm 3.3$  ( $P < 0.001$ ). The IKDC score increased from  $47.6 \pm 3.4$  pre-operatively to  $91.7 \pm 2.4$  ( $P < 0.001$ ). All patients were satisfied with their final ROM and functional outcomes.

### **Conclusion**

The all-arthroscopic release technique was a safe, feasible and effective method for treating severe knee extension contractures. The severe knee extension contractures may be successfully addressed by the all-arthroscopic release technique during our clinical practice.

### **Level of evidence**

IV.

## **Neither significant osteoarthritic changes nor deteriorating subjective outcomes occur after hybrid fixation of osteochondritis dissecans in the young adult**

L. Chadli, C. Steltzlen, P. Beaufils, C. Toanen, N. Pujol

March 2019, Volume 27, [Issue 3](#), pp 740–744

<https://doi.org/10.1007/s00167-018-5025-0>

### **Purpose**

The goal of the fixation of painful osteochondritis dissecans of the femoral condyles in adults is to integrate the osteochondral fragment and thus achieve a normal hyaline cartilaginous coverage. The addition of a biological process to primary fixation may result in improved fragment integration (hybrid fixation). Osteochondral plugs may fulfil this role. The aim of this study was to evaluate long-term clinical and radiological results after hybrid fixation of unstable osteochondritis dissecans. The hypothesis was that the rate of secondary osteoarthritis would be low.

### **Methods**

Nine patients treated by hybrid fixation were retrospectively reviewed at a median follow-up of 10.1 years (range 7–14). The median age at surgery was 21 (range 17–28). Six of them were evaluated as ICRS grade II and three, as ICRS grade III. The mean surface of the lesion was 4.5 cm<sup>2</sup>. All patients were followed up clinically (IKDC, KOOS, Lysholm) and radiologically [Kellgren–Lawrence score (KL)].

### **Results**

During arthroscopic assessment at the time of screw removal (3 months after surgery), the fragments were stable, and autograft plugs were all well integrated. At the most recent follow-up visit, the median IKDC score was 85.8 (range 51.72–100), the KOOS score was 87.7 (52.4–100), and the Lysholm scale score was 89.8 (77–100). In 7 out of 9 patients, radiographs showed a joint space KL grade of 0 or 1.

### **Conclusion**

Hybrid fixation for treating osteochondritis dissecans lesions of the femoral condyles using mechanical and biological fixation provides healing of the osteochondral fragments with good long-term outcomes. No significant osteoarthritic change was seen with this technique at a mid-term follow-up.

### **Level of evidence**

IV—case series.

[BACK](#)

## **The presence of patellar tendinopathy in the bone–patellar tendon–bone autograft may increase the risk of anterior cruciate ligament graft failure**

Eduard Alentorn-Geli, Dhaval Gotecha, Gilbert Steinbacher, Pedro Álvarez-Díaz, David Barastegui, Roberto Seijas, Xavier Cuscó, Kristian Samuelsson, Alexander L. Lazarides, Ramón Cugat Bertome

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### **Purpose**

The purpose of this study was to evaluate the influence of patellar tendinopathy on primary anterior cruciate ligament (ACL) reconstruction graft failure when using bone–patellar tendon–bone (BPTB) autograft.

### **Methods**

All patients undergoing primary ACL reconstruction using ipsilateral BPTB with preoperative magnetic resonance imaging (MRI) available for review were approached for eligibility. The medical charts of included patients were reviewed to obtain demographic information, anatomical characteristics, injury characteristics, treatment characteristics, length of follow-up, and presence of graft failure. A single, fellowship-trained, knee-specialist and blinded researcher performed preoperative MRI interpretation of patellar tendinopathy. The presence/absence of patellar tendinopathy (none, mild, moderate, or severe changes) was compared between patients with (cases) and without (controls) failure of ACL reconstruction. There were 559 cases with a median (range) clinical follow-up was 8 (4–30) months and an average age of 21.5 years (82% males).

### **Results**

Of the 559 cases, there were 182 (32.6%) with and 377 (67.4%) without patellar tendinopathy. A total of 32 (5.7%) graft failures occurred. There were a significantly higher failure rate in patients with compared to without patellar tendinopathy ( $p < 0.001$ ), and in patients with compared to without partial tendon tear ( $p < 0.001$ ). The odds ratio (95% confidence interval) for graft failure was 5.9 (2.7–13.1), 20.8 (6.8–63.9) and 54.4 (5.5–539.4) in patients with patellar tendinopathy (compared to absence of patellar tendinopathy), moderate or severe patellar tendinopathy (compared to none or mild patellar tendinopathy), or partial tendon tear (compared to absence of tendon tear), respectively.

### **Conclusion**

The presence of patellar tendinopathy increases the risk of BPTB graft failure when used for ACL reconstruction. The use of BPTB autograft is not recommended if patellar tendinopathy is obvious or there are suspicious of partial tendon tear on MRI. In such cases, the surgeon should consider using a different graft.

### **Level of evidence**

Retrospective cohort analysis, Level III.

[BACK](#)

## **Subgroups of patients with osteoarthritis and medial meniscus tear or crystal arthropathy benefit from arthroscopic treatment**

Katrin Karpinski, Ralf Müller-Rath, Phillipp Niemeyer, Peter Angele, Wolf Petersen

March 2019, Volume 27, Issue 3, pp 782–796

<https://doi.org/10.1007/s00167-018-5086-0>

### **Purpose**

The purpose of this study was to perform a systematic review of prospective randomized controlled trials comparing arthroscopic treatment for knee osteoarthritis (OA) with either other therapeutic interventions or sham treatment.

### **Methods**

A systematic search for randomized controlled trials (RCT) about arthroscopic treatment (AT) for knee OA was performed according to the PRISMA guidelines. Arthroscopic treatment included procedures such as lavage, debridement and partial meniscectomy of the knee. Data source was PubMed central.

### **Results**

Fourteen articles could be included. Five studies compared interventional AT with either sham surgery, lavage or diagnostic arthroscopy. Nine trials compared AT with another active intervention (exercise, steroid injection, hyaluronic acid injection). In ten trials, the clinical scores improved after arthroscopic treatment of knee OA in comparison to the baseline. In seven trials, there was a significant difference in the final clinical outcome with higher scores for patients after arthroscopic OA treatment in comparison to a control group. In four trials, the intention to treat analysis revealed no significant difference between arthroscopic OA treatment and the control group. In one of those trials, which compared arthroscopic partial meniscectomy (APM) with exercise, the cross over rate from exercise to AT was 34.9%. The clinical scores of cross-over patients improved after APM. In one study, the subgroup analysis revealed that patients with tears of the anterior two-thirds of the medial meniscus or any lateral meniscus tear had a higher probability of improvement after arthroscopic surgery than did patients with other intraarticular pathology. There was no difference in the side effects between patients with AT and the control group. Despite acceptable scores in the methodological quality assessment, significant flaws could be found in all studies. These flaws include bad description of the exact surgical technique or poor control of postoperative use of non-steroidal anti-inflammatory drugs (NSAID).

### **Conclusion**

Results of RCTs comparing AT with other treatment options were heterogeneous. AT in OA patients is not useless because there is evidence that a subgroup of patients with non-traumatic flap tears of the medial meniscus or patients with crystal arthropathy benefit from arthroscopy. This topic has a high relevance because several health insurances do not reimburse arthroscopy for patients with OA anymore. The results of these randomized studies, however, should be interpreted with care because in many studies, the use of other therapeutic variables such as pain killers or NSAIDs was not controlled or reported.

### **Level of evidence**

I.

[BACK](#)

## **Temporary postoperative treatment with compartment-unloading knee braces or wedge insoles does not improve clinical outcome after partial meniscectomy**

Dietmar Dammerer, Florian Fischer, Raul Mayr, Johannes Giesinger, Rene El Attal, Michael C. Liebensteiner

March 2019, Volume 27, Issue 3, pp 814–821

<https://doi.org/10.1007/s00167-018-5106-0>

### **Purpose**

To investigate whether temporary postoperative compartment-unloading therapy after arthroscopic partial meniscectomy (APM)—with either knee braces or wedge insoles—leads to superior clinical outcome as compared to controls. This difference in clinical outcome was tested in the form of two knee scores, physical activity and general health outcome over the first postoperative year.

### **Methods**

Sixty-three patients who underwent arthroscopic partial meniscectomy (APM) were randomized to one of the following three groups: 12 weeks postoperative knee compartment-unloading therapy with either a knee brace (brace group) or wedge insoles (insole group) or no specific postoperative therapy (control group). Patient-reported outcome was assessed with the International Knee Documentation Committee Subjective Knee Evaluation Form (IKDC Score), the Knee Injury and Osteoarthritis Outcome Score (KOOS), the MARX score (physical activity) and the SF-12 (general health).

### **Results**

Sixty-three patients were available for analysis. Except for the SF-12 mental score, all other scores showed significant improvement over time. With regard to the hypotheses proposed, no significant group \* time interactions were observed for any of the outcome parameters. This means that the group (i.e. the type of postoperative treatment) was not related to the degree of improvement of any of the scores.

### **Conclusions**

It was concluded that 12 weeks of compartment-unloading therapy—with either a knee brace or wedge insoles—is ineffective with regard to clinical outcome after APM. This applies to the knee score outcome, physical activity and general health outcome over the first year following APM.

### **Level of evidence**

Randomized controlled trial, Level I.

[BACK](#)



## **Posterior capsule injection of local anesthetic for post-operative pain control after ACL reconstruction: a prospective, randomized trial**

Robert A. Keller, Michael E. Birns, Adam C. Cady, Orr Limpisvasti, Michael B. Banffy

March 2019, Volume 27, Issue 3, pp 822–826

<https://doi.org/10.1007/s00167-018-5111-3>

### **Purpose**

Alternative modalities to optimize pain control after anterior cruciate ligament reconstruction (ACLR) are continually being explored. The purpose of this study was to compare femoral nerve block (FNB) only vs FNB with posterior capsule injection (PCI) of the knee for pain control in patients undergoing ACLR.

### **Methods**

Patients undergoing primary ACLR were randomized to receive either FNB only or FNB with PCI. Following surgery, patient's pain was evaluated in the postoperative care unit (PACU) and at home for 4 days. Pain levels were measured via visual analog scale (VAS) and calculating opioid consumption. Outcomes of interest included postoperative pain levels and opioid consumption.

### **Results**

A total of 42 patients were evaluated, with 21 patients randomized to each study arm. Outcomes showed significant pain reduction in both anterior and posterior knee VAS scores in the PACU in those that received PCI (anterior VAS: 39.6 vs 21.3 (SD = 12.9),  $p < 0.01$ ; posterior VAS: 25.4 vs 15.3 (SD = 8.05),  $p = 0.01$ ). Moreover, the PCI group also showed significantly less opioid consumption compared to FNB only (23.5 vs 17.4 pills,  $p = 0.03$ ). There were no differences found in pain scores between groups in home VAS scores.

### **Conclusions**

These findings suggest the use of arthroscopically assisted injection of local anesthetic to the posterior capsule of the knee significantly reduces early post-operative pain and dramatically reduces the number of opioid medication taken after ACLR.

### **Level of evidence**

Prospective, randomized, control trial, Level I.

[BACK](#)

## **Knee hyperextension and a small lateral condyle are associated with greater quantified antero-lateral rotatory instability in the patients with a complete anterior cruciate ligament (ACL) rupture**

Yoshitomo Saita, Herbert Schoenhuber, Gabriele Thiébat, Giovanni Ravasio, Roberto Pozzoni, Andrea Panzeri, Marco Galli, Masashi Nagao, Yuji Takazawa, Hiroshi Ikeda, Kazuo Kaneko

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<https://doi.org/10.1007/s00167-018-5143-8>

### **Purpose**

To identify factors associated with quantified rotatory stability (pivot-shift phenomenon) in the anterior cruciate ligament (ACL)-injured knee joint.

### **Methods**

A consecutive sample of 54 patients who were diagnosed with an ACL injury and admitted to our hospital to undergo ACL reconstruction were enrolled in this study. Antero-lateral rotatory laxity of the knee joint was quantified using a Kinematic Rapid Assessment device (KiRA; Orthokey LTD) under spinal block before initiating reconstruction of the ACL. Univariate and multivariate regressions were performed assuming relationships between patient characteristics (independent variables) and quantified antero-lateral rotatory stability (a dependent variable).

### **Results**

It was observed that a low BMI ( $t = -1.659$ , n.s.), greater passive knee extension angle ( $t = 2.374$ ,  $P = 0.023$ ), and a narrower lateral femoral condyle width index ( $t = -1.712$ , n.s.) could be candidates associated with the antero-lateral rotatory instability, using univariate analysis. Employing multivariate analysis controlling for these three variables, that the range of passive knee extension was found to be significantly associated with antero-lateral rotatory instability in the ACL-injured knee joint ( $t = 2.21$ ,  $P = 0.035$ ). Patients were then divided into two groups (pivot-shift negative versus positive groups) based on the KiRA-documented quantified pivot-shift test. Interestingly, 23.3% of patients were pivot-shift negative, even though their ACL was confirmed as a complete rupture by arthroscopic observations. The degree of passive knee extension was  $2.3 \pm 4.5$  (mean  $\pm$  SD) in the pivot-shift negative group, while it was  $6.8 \pm 6.6$  in the pivot-shift positive group (n.s.). The lateral femoral condyle width index was  $36.6 \pm 2.0\%$  in the pivot-shift negative group, and it was significantly wider than in the pivot-shift positive group ( $33.8 \pm 2.6\%$ ,  $P = 0.0046$ ). Finally, we estimated that the risk of positive pivot-shift depends on the degree of knee extension. The logistic regression analysis revealed that genu recurvatum significantly increased the odds ratio for positive pivot-shift (OR = 3.08,  $P = 0.047$ , 95% CI = 1.017–9.350).

### **Conclusions**

This study revealed that greater antero-lateral rotatory instability in patients with a complete ACL rupture was associated with genu recurvatum and small lateral femoral condyle. These factors should be considered as predictors of a poor outcome from an ACL reconstruction due to a higher load on the ACL graft, and therefore, the attending physicians should modify the treatment strategies accordingly. This study indicates that joint hyperlaxity and bone morphology contribute to the rotational stability of the knee joint, in addition to the ACL and antero-lateral complex (ALC).

### **Level of evidence**

IV.

[BACK](#)

## **The presence of concomitant intra-articular injuries and bone bruise does not affect pre-operative knee pain and symptoms in patients undergoing anterior cruciate ligament reconstruction**

Taufiq Panjwani, Ying Ren Mok, Keng Lin Wong, Chloe Xiaoyun Chan, Shi Jie Toh, Lingaraj Krishna

March 2019, Volume 27, Issue 3, pp 893–897

<https://doi.org/10.1007/s00167-018-5168-z>

### **Purpose**

Increased knee pain at the time of anterior cruciate ligament (ACL) reconstruction may predict increased pain post-operatively, a prolonged recovery and a more difficult rehabilitation. The main objective of our study was to identify preoperative factors, such as concomitant intra-articular injuries and bone bruises, that may be associated with increased knee pain and symptoms in patients undergoing ACL reconstruction.

### **Methods**

Patient data was queried from our institution's prospectively maintained ACL reconstruction registry. Two-hundred and seventy patients who underwent primary ACL reconstruction within 3 months of injury were included in the study. Predictors such as demographic characteristics (age, body mass index and gender) and injury characteristics (mechanism of injury, meniscal injury, chondral injury and bone bruise) were recorded. The association between the pre-operative knee injury and Osteoarthritis Outcome Score (KOOS) pain and symptom subscales and the Short Form-36 (SF-36) bodily pain subscale, and the predictors were assessed using logistic regression for categorical variables and linear regression for continuous variables.

### **Results**

The mean age of our patient group was 25.4 years with 211 out of 270 (78%) being males. Bone bruise was present in 243 patients (90%), meniscal injury in 165 (61%) patients and chondral injury in 40 (15%) patients. The presence of bone bruise, meniscal injury or chondral injury was not significantly associated with worse preoperative KOOS pain and symptom and SF-36 bodily pain scores. Other factors that were not associated were demographic characteristics (age, BMI and gender) and mechanism of injury.

### **Conclusion**

The presence of bone bruise and concomitant intra-articular injuries does not affect pre-operative knee pain and symptoms in patients undergoing ACL reconstruction within 3 months of injury. This knowledge would aid the surgeon in pre-operative counselling, and prognostication of post-operative pain and rehabilitation after ACL reconstruction.

[BACK](#)

## **Delayed reconstruction and high BMI z score increase the risk of meniscal tear in paediatric and adolescent anterior cruciate ligament injury**

Maroun Raad, Camille Thevenin Lemoine, Emilie Bérard, Pierre Laumonerie, Jerome Sales de Gauzy, Franck Accadbled

March 2019, Volume 27, Issue 3, pp 905–911

<https://doi.org/10.1007/s00167-018-5201-2>

### **Purpose**

The purpose of this study was to identify epidemiologic risk factors for secondary meniscal tears in paediatric and adolescent patients who sustain an anterior cruciate ligament (ACL) tear. The hypothesis was that delayed reconstruction and elevated BMI z score, increase the risk for secondary meniscal tears.

### **Methods**

A prospective, descriptive and analytical study of consecutively accrued children and adolescents with an ACL tear was performed. One hundred and sixty subjects (114 males and 46 females) were identified between 2006 and 2015 at one institution. The age range was between 7 and 19 years. Fifteen parameters were recorded and analysed: age at initial trauma, initial trauma circumstance, sex, BMI z score, affected side, type of sport, Tegner score, athletic level, time to MRI, time to first referral, time to surgery, age at surgery, attempted non-operative treatment, operative report and associated meniscal tear. These meniscal lesions could be diagnosed by an MRI and / or during surgery.

### **Results**

Out of the 160 cases, 143 were treated surgically and 17 cases non-operatively. Median corrected BMI z score was 0.5 (range – 1.8 to 4.7). 41.9% had one or more meniscal lesions. 55 patients were initially treated non-operatively, of which 39 patients were secondarily operated. There was a positive relationship between meniscal lesion and: BMI z score ( $p = 0.0364$ ), attempted non-operative treatment ( $p = 0.001$ ) and time to surgery ( $p = 0.002$ ). The median time to ACL reconstruction was 229 days for patients with secondary meniscal lesions.

### **Conclusions**

Patients with ACL tears treated non-operatively developed secondary meniscal lesions requiring delayed surgical management. There was a positive correlation between BMI z score and secondary meniscal lesions. Thus, early ACL reconstruction is advocated in young athletes.

### **Level of evidence**

Retrospective comparative study, Level III.

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## **Partial meniscectomy adversely affects return-to-sport outcome after anatomical double-bundle anterior cruciate ligament reconstruction**

Takanori Akada, Ichiro Yamaura, Ashish Gupta, Hiroki Sakai, Kenji Takahashi, Akihiro Tsuchiya

March 2019, Volume 27, Issue 3, pp 912–920

<https://doi.org/10.1007/s00167-018-5213-y>

### **Purpose**

The purposes of this study were to determine whether the partial meniscectomy combined with ACL reconstruction affect the postoperative return-to-sport and to identify if partial meniscectomy has an influence on the graft failure following an anatomical double-bundle ACL reconstruction case.

### **Methods**

A retrospective cohort study including 426 primary double bundle ACL reconstruction cases. There were 206 males and 220 females, median age of 28.4 years, median BMI of 23.0, median preinjury Tegner score of 7.0 and median follow-up period after surgery of 24.0 months. Patients with less than 12 months of follow-up, revision surgery, multi-ligaments injury, previous contralateral knee ligaments injury and postoperative infection cases were excluded. Furthermore, patients who had meniscal repair were excluded in order to compare the outcomes between patients who had intact menisci and those who underwent partial meniscectomy. There were 227 patients with intact menisci (group A) and 199 patients with partial meniscectomy (group B). The median age was younger and the preoperative Tegner score was higher in group A. The patients in group B were subcategorized as the site of partial meniscectomy, including medial (group C), lateral (group D) and bicompartamental (group E) meniscectomy. There were 74, 94, and 31 patients in group C, D, and E, respectively. Return-to-sport (running and sport phase) and graft failure were included in our primary outcomes, and functional outcome as Lysholm knee scores was included in secondary outcome.

### **Results**

The rate of return to running phase and sport phase were 91% (387/426) and 76% (303/399), the mean time taken to return to running and sport phase were 5.7 months and 11.1 months, respectively. There was significant difference in the returning to sport phase between group A and B ( $p = 0.01$ ), and between group A and D/E subgroups ( $p = 0.007$ ). There were fourteen graft failures (3.5%) in total. In addition, 9 and 5 graft failures in group A and B, respectively. Of the 5 graft failures in group B, 2 and 3 graft failures in group C and D, respectively. There was no significant difference of the graft failure ratio among the groups.

### **Conclusion**

Our study demonstrates that partial meniscectomy has an adverse effect on the return to sport phase following the anatomical double-bundle ACL reconstruction. Therefore, greater postoperative care would be needed to return to sport with partial meniscectomy in ACL reconstruction cases. On the contrary, partial meniscectomy is not considered to be the risk factor for graft failure at short-term follow-up.

### **Level of evidence**

Case–control study, Level III.

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## **Demographic and surgical factors affect quadriceps strength after ACL reconstruction**

Christopher Kuenze, Brian Pietrosimone, Caroline Lisee, Margaret Rutherford, Tom Birchmeier, Adam Lepley, Joseph Hart

March 2019, Volume 27, Issue 3, pp 921–930

<https://doi.org/10.1007/s00167-018-5215-9>

### **Purpose**

To investigate the effects of graft source, time since surgery, age, and sex on unilateral and symmetry-based measures of knee extension strength among individuals with ACL reconstruction (ACLR).

### **Methods**

Three hundred and eight individuals aged 13–40 years old with primary, unilateral ACLR in the last 60 months were enrolled in this multi-site clinical measurement study. Participants completed bilateral knee extension maximal voluntary isometric contraction (MVIC) torque assessments which were normalized to body mass (Nm/kg) and limb symmetry indices (LSI) were calculated. The effects of graft source (patellar tendon autograft; hamstring tendon autograft), time since surgery ( $\leq 12$  months;  $>12$  mo.), age ( $\leq 18$  years;  $>18$  years), and sex were evaluated using separate ANCOVAs.

### **Results**

A significant interaction was present between time since surgery and graft source for LSI ( $P = 0.01$ ) as participants with patellar tendon autografts  $\leq 12$  months post-ACLR experienced the greatest asymmetry (LSI =  $69.2 \pm 24.5\%$ ). Significant interactions were present between time since surgery and sex for involved limb ( $P = 0.01$ ) and uninvolved limb MVIC torque ( $P = 0.05$ ) with females  $\leq 12$  months post-ACLR being weakest (involved MVIC =  $1.81 \pm 0.70$  N m/kg; uninvolved MVIC =  $2.40 \pm 0.68$  N m/kg). Participants  $\leq 18$ -year-old displayed weaker involved limb ( $P < 0.001$ ) and contralateral limb ( $P < 0.001$ ) MVIC torque as compared to participants  $> 18$ -year-old during the first year after ACLR.

### **Conclusions**

Graft source, sex, age, and time since surgery effect quadriceps strength and symmetry after ACLR. Surgical and demographic factors should be considered when developing treatment approaches to optimize quadriceps function prior to re-integration into pre-injury levels of physical activity.

### **Level of evidence**

IV.

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**Predictors of Persistent Postoperative Pain at Minimum 2 Years After Arthroscopic Treatment of Femoroacetabular Impingement**

Austin V. Stone, MD, PhD, Philip Malloy, PT, PhD, Edward C. Beck, MPH, William H. Neal, BS, Brian R. Waterman, MD, Charles A. Bush-Joseph, MD, Shane J. Nho, MD, MS

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**Background**

Hip arthroscopy for femoroacetabular impingement syndrome (FAIS) is a rapidly expanding field, and preoperative factors predictive of persistent postoperative pain are currently unknown.

**Purpose**

To identify predictors for persistent postoperative pain at the site of surgery after hip arthroscopy for FAIS.

**Study Design**

Case-control study; Level of evidence, 3.

**Methods**

Patients who underwent hip arthroscopy for FAIS and had a minimum 2-year follow-up with patient-reported outcomes (PROs) were included in this study. Patients with previous open hip surgery and diagnoses other than FAIS were excluded. Patients were grouped by visual analog scale scores for pain as limited (<30) and persistent (≥30). Patient factors and outcomes were analyzed with univariate and correlation analyses to build a logistic regression model to identify predictors of persistent postoperative pain.

**Results**

The limited pain (n = 514) and persistent pain (n = 174) groups totaled 688 patients (449 females). There was a statistically significant difference in age between groups, with the persistent pain group being older than the low pain group (35.9 ± 12.2 vs 32.4 ± 12.6, respectively; P = .002). Patients with persistent postoperative pain demonstrated significantly lower preoperative PRO scores in the Hip Outcome Score–Activities of Daily Living (57.6 ± 21.2 vs 67.7 ± 16.8), Hip Outcome Score–Sport Specific (35.9 ± 23.9 vs 44.1 ± 22.7), modified Harris Hip Score (51.6 ± 16.2 vs 59.6 ± 12.9), and International Hip Outcome Tool (32.0 ± 16.8 vs 40.0 ± 17.82) but no significant differences in preoperative visual analog scale scores for pain (7.3 ± 1.8 vs 7.2 ± 1.7). Mean postoperative PRO differences between pain groups were all statistically significant. Bivariate logistic regression analysis demonstrated that history of anxiety or depression (odds ratio, 1.8; 95% CI, 1.02-3.32; P = .042), revision hip arthroscopy (odds ratio, 8.6; 95% CI, 1.79-40.88; P = .007), and a low preoperative modified Harris Hip Score (odds ratio, 0.97; 95% CI, 0.95-0.99; P = .30) were predictors of persistent postoperative pain.

**Conclusion**

Independent predictors for persistent postoperative pain include revision hip arthroscopy and

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mental health history positive for anxiety and depression. Our analysis demonstrated significant improvements in pain and functional PROs in the limited pain and persistent pain groups; however, those with persistent pain demonstrated significantly lower PRO scores.

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## **The Addition of Hip Arthroscopy to Periacetabular Osteotomy Does Not Increase Complication Rates: A Prospective Case Series**

Casey M. Sabbag, MD, Jeffrey J. Nepple, MD, Cecilia Pascual-Garrido, MD, Gopal R. Lalchandani, MD, John C. Clohisy, MD, Rafael J. Sierra, MD

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### **Background**

Previous studies on periacetabular osteotomy (PAO) reported complication and reoperation rates of 5.9% and 10%, respectively. Hip arthroscopy is increasingly utilized as an adjunct procedure to PAO to precisely treat associated intra-articular pathology. The addition of this procedure has the potential of further increasing complication rates.

### **Purpose**

To determine the rates of complication and reoperation of combined hip arthroscopy and PAO for the treatment of acetabular deformities and associated intra-articular lesions.

### **Study Design**

Case series; Level of evidence, 4.

### **Methods**

Using a prospective database, the authors retrospectively reviewed 248 hips (240 patients) that underwent combined hip arthroscopy and PAO between 2007 and 2016. Data were collected at scheduled follow-up visits at approximately 1 month, 3 to 4 months, and 1 and 2 years after surgery. Mean follow-up from surgery was 3 years (range, 1-8 years). A total of 220 PAOs were done for symptomatic acetabular dysplasia, 18 for symptomatic acetabular retroversion, and 10 for combined acetabular dysplasia and acetabular retroversion. Central compartment arthroscopy was performed for treatment of intra-articular chondrolabral pathology in all cases. Select cases underwent femoral head-neck junction osteochondroplasty either arthroscopically before the PAO or through an open approach after it. Complications were graded according to the modified Dindo-Clavien complication scheme, which was validated for hip preservation procedures. Reoperations (excluding hardware removal) were recorded.

### **Results**

Grade III complications occurred among 7 patients (3%) while there were no grade IV complications. Grade III complications included deep infection (n = 3), wound dehiscence (n = 1), hematoma requiring exploration (n = 1), symptomatic heterotopic ossification requiring excision (n = 1), and deep venous thrombosis (n = 1). There were 13 reoperations (5%), and 3 were repeat hip arthroscopy. Univariate Cox hazard models were used to estimate the relative risk factors for complication and reoperation. Increased age (per decade) showed over twice the increased likelihood for complications (hazard ratio, 2.5; 95% CI, 1.67-3.74). Also, preoperative diagnosis of acetabular retroversion, not acetabular dysplasia, showed >3 times the increased risk of reoperation (hazard ratio, 3.05; 95% CI, 1.41-6.61).

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**Conclusion**

The rate of complications reported is comparable (3%) with previously published complication rates of PAO without hip arthroscopy. In this cohort, increasing age and diagnosis of acetabular retroversion were associated with higher complication and reoperation rates.

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## Miscellaneous

Arthroscopy, Volume 35, Issue 3

### **Body Mass Index as a Risk Factor for 30-Day Postoperative Complications in Knee, Hip, and Shoulder Arthroscopy**

Richard W. Nicolay, M.D, Ryan S. Selley, M.D., Michael A. Terry, M.D., Vehniah K. Tjong, M.D.

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#### **Purpose**

To use the American College of Surgeons National Surgical Quality Improvement Program database to determine whether body mass index (BMI) is associated with 30-day postoperative complications following arthroscopic surgery.

#### **Methods**

Cases of elective knee, hip, and shoulder arthroscopy were identified. A retrospective comparative analysis was conducted, and the overall rates of morbidity, mortality, readmission, reoperation, and venothromboembolism (VTE) were compared using univariate analyses and binary logistic regressions to ascertain the adjusted effect of BMI, with and without diabetes, on morbidity, readmission, reoperation, and VTE.

#### **Results**

There were 141,335 patients who met the criteria. The most common complications were deep vein thrombosis (0.27%), superficial surgical site infection (0.17%), urinary tract infection (0.13%), and pulmonary embolism (0.11%). Obesity class III with diabetes was a risk factor for morbidity (odds ratio [OR] = 1.522; 95% confidence interval [CI], 1.101-2.103) and readmission (OR = 2.342; 95% CI, 1.998-2.745) following all procedures, while obesity class I was protective toward reoperation (OR = 0.687, 95% CI, 0.485-0.973). Underweight patients were at higher risk for morbidity following shoulder arthroscopy (OR = 3.776; 95% CI, 1.605-8.883), as were the class I obese (OR = 1.421; 95% CI, 1.010-1.998) and class II obese (OR = 1.726, 95% CI, 1.159-2.569). BMI did not significantly affect morbidity following knee arthroscopy. VTE risk factors included being overweight (OR = 1.474; 95% CI, 1.088-1.996) or diabetic with class I obesity (OR = 1.469; 95% CI, 1.027-2.101).

#### **Conclusions**

Arthroscopic procedures are safe with very low complication rates. However, underweight and class I and class II obese patients are at higher risk for morbidity following shoulder arthroscopy, and diabetic patients with class III obesity are at higher risk for morbidity and readmission following all arthroscopy. Because BMI is a modifiable risk factor, these patients should be evaluated carefully before being considered for outpatient arthroscopic surgery.

#### **Level of Evidence**

Level III, retrospective comparative study.

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