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#### Lower extremity

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## Upper extremity

Journal of Arthroscopy, Volume 38, Issue 10, pages 2771-2942

### **Preoperative Opioid Use Is Associated With Inferior Patient-Reported Outcomes Measurement Information System Scores Following Rotator Cuff Repair**

F.Meta, L.S. Khalil, et al.

DOI: <https://doi.org/10.1016/j.arthro.2022.03.032>

#### Purpose

To determine the influence of preoperative opioid use on Patient-Reported Outcomes Measurement Information System (PROMIS) scores pre- and postoperatively in patients undergoing arthroscopic rotator cuff repair (RCR).

#### Methods

A retrospective review of all RCR patients aged >18 years old was performed. PROMIS pain interference (“PROMIS PI”), upper extremity function (“PROMIS UE”), and depression (“PROMIS D”) scores, were reviewed. These measures were collected at preoperative, 6-month, and 1-year postoperative time points. A prescription drug–monitoring program was queried to track opioid prescriptions. Patients were categorized as chronic users, acute users, and nonusers based on prescriptions filled. Comparison of means were carried out using analysis of variance and least squares means. Effect sizes and 95% confidence intervals were calculated.

#### Results

In total, 184 patients who underwent RCR were included. Preoperatively, nonusers (n = 92) had superior PROMIS UE (30.6 vs 28.9 vs 26.1;  $P < .05$ ) and PI scores (61.5 vs 64.9 vs 65.3;  $P < .001$ ) compared with acute users (n = 65) and chronic users (n = 27), respectively. At 6 months postoperatively; nonusers demonstrated significantly greater PROMIS UE (41.7 vs 35.6 vs. 33.5;  $P < .001$ ), lower PROMIS D (41.6 vs 45.8 vs 51.1;  $P < .001$ ), and lower PROMIS PI scores (50.7 vs 56.3 vs 58.1;  $P < .01$ ) when compared with acute and chronic users, respectively. Nonusers had lower PROMIS PI (47.9 vs 54.3 vs 57.4;  $P < .0001$ ) and PROMIS D (41.6 vs 48.3 vs 49.2;  $P = .0002$ ) scores compared with acute and chronic users at 1-year postoperatively. Nonusers experienced a significantly greater magnitude of improvement in PROMIS D 6 months postoperatively compared with chronic opioid users (–5.9 vs 0.0;  $P < .01$ ).

#### Conclusions

Patients undergoing RCR demonstrated superior PROMIS scores pre- and postoperatively if they did not use opioids within 3 months before surgery.

#### Level of Evidence

III, retrospective comparative trial.

## **Remplissage Yields Similar 2-Year Outcomes, Fewer Complications, and Low Recurrence Compared to Latarjet Across a Wide Range of Preoperative Glenoid Bone Loss**

J.L. Horinek, M.E. Menedez, et al.

DOI: <https://doi.org/10.1016/j.arthro.2022.03.031>

### **Purpose**

The purpose of this study was to compare functional outcome, return to sport, satisfaction, postoperative recurrence, and complications in patients undergoing primary arthroscopic Bankart repair with remplissage (ABR) to primary Latarjet.

### **Methods**

A multicenter retrospective study was performed on patients undergoing primary ABR or open Latarjet between 2013 and 2019 who had a minimum 2-year follow-up. Baseline and two-year range of motion (ROM), patient-reported outcomes (PROs: Western Ontario Shoulder Instability Index [WOSI], Single Assessment Numeric Evaluation [SANE], and visual analog scale [VAS] for pain) recurrence, return to sport, satisfaction, and complications were reviewed.

### **Results**

This study included 258 patients, including 70 ABRs and 188 Latarjet procedures. Baseline demographics, ROM, and PROs were similar. Mean preop glenoid bone loss (GBL) ( $12.3\% \pm 10.9\%$  vs  $7.6\% \pm 9\%$ ;  $P < .001$ ) and off-track lesions ( $23\%$  vs  $13\%$ ;  $P = .046$ ) were higher in the ABR group, while preoperative GBL range was similar ( $0-42\%$  vs  $0-47\%$ ). Changes in the VAS ( $1.9$  vs  $0.9$ ;  $P = .019$ ) and WOSI ( $1096$  vs  $805$ ;  $P < .001$ ) were improved in ABR. The percentage of patients who achieved a minimal clinically important difference was improved in WOSI for ABR and PASS for ABR in SANE, VAS, and WOSI scores. The ABR cohort reported worse changes in external rotation (ER) ( $-4^\circ$  vs  $+19^\circ$ ;  $P < .001$ ). Return to sport among overhead and contact athletes favored ABR ( $91.5\%$  vs  $72.7\%$ ;  $P = .007$ ). Satisfaction and recurrent dislocation were similar. Surgical complications were observed in  $0\%$  of ABR cases, compared to  $5.9\%$  in the Latarjet group.

### **Conclusion**

Primary ABR resulted in 2-year functional outcomes that were as good or superior to primary Latarjet, with higher return to sport for overhead and contact activities, fewer complications, and comparably low recurrence rates, even despite greater bipolar bone loss in the ABR cohort. However, this comes at the expense of decreased external rotation, which may be considered in individual patients.

### **Level of Evidence**

III, retrospective comparative study.

## **Arthroscopic Latarjet for Primary Shoulder Instability With Off-Track Lesions or Revision Surgery Yields Satisfactory Clinical Results and Reliable Return to Sport and Work at Minimum 3-Year Follow-Up**

R.Castricini, D. Castioni, et al.

DOI: <https://doi.org/10.1016/j.arthro.2022.04.004>

### **Purpose**

To retrospectively evaluate clinical and radiologic outcomes and return to sport and to work of patients after arthroscopic Latarjet stabilization for primary instability or revision surgery; factors influencing and determining results and potential predictors for clinical outcomes also were evaluated.

### **Methods**

This is a retrospective study including patients older than 18 years old who underwent arthroscopic Latarjet stabilization for recurrent anterior glenohumeral instability with off-track lesions, or for cases of recurrence after previous surgery, from 2011 to 2017. Patients were assessed preoperatively and at a minimum 3 years of follow-up using the Rowe score, the University of California at Los Angeles Shoulder Score and Simple Shoulder Test score; the range of motion, satisfaction rate, return to work and sport, perception of discomfort during sporting and daily activities, and complications and recurrence after surgery were also evaluated. The integration of the coracoid graft and the position of the screws were examined by computed tomography scan.

### **Results**

At a mean follow-up time of  $6 \pm 2$  years, 93 patients (95 shoulders) showed significant improvement of all scale scores ( $P < .001$ ), 97.8% of the patients had returned to the same working condition as before surgery, and all the patients who practiced sports preoperatively (85; 91.4%) returned to sport after surgery; 97.9% of patients were satisfied with surgery. The complication rate was 5.4%, and 2 cases (2.1%) of recurrence occurred, both after high-energy trauma. At an average of  $17 \pm 13$  months postoperatively, computed tomography scans showed 4 (6.6%) stable nonunions, 9 (14.8%) superior, and 1 (1.6%) inferior lyses of the graft; a correct positioning of the graft was observed in 86.9% of the cases. Greater satisfaction, fewer complications, less pain during daily activities, and a lower number of reoperations were associated with a shorter time between the first dislocation episode and surgery ( $P = .019$ ,  $P < .001$ ,  $P = .014$ , and  $P = .005$ , respectively). Complications were directly associated with older patient age at operation ( $P = .001$ ). A greater number of nonunions was found in patients with increased angle between the line linking the posterior and anterior glenoid rim and the screw axis ( $P = .040$ ) and a medial axial position or a lower coronal position of the graft (both  $P = .010$ ). A lower age at the time of surgery predicted better Rowe scores at follow-up ( $P < .001$ ), and a lower age at the time of the first episode of dislocation predicted better postoperative Simple Shoulder Test scores ( $P = .026$ ).

### **Conclusions**

At a mean 6-year follow-up time, excellent clinical outcomes, and radiological results, with few complications, high rates of satisfaction and return to work and sport and low sports anxiety can be expected after arthroscopic Latarjet procedure. A shorter time between the first dislocation episode and surgery was associated with higher satisfaction, fewer complications, less pain during daily activities and lower reoperations; a lower age at the operation was associated with lower complications.



## **Biceps Tenodesis Has Greater Expected Value Than Repair for Isolated Type II SLAP Tears: A Meta-analysis and Expected-Value Decision Analysis**

A.J. Recker, T.L. Waters, et al.

DOI: <https://doi.org/10.1016/j.arthro.2022.05.005>

### **Purpose**

To use an expected-value decision analysis to determine the optimal treatment decision between repair and biceps tenodesis (BT) for an isolated type II SLAP injury.

### **Methods**

An expected-value decision analysis with sensitivity analysis was performed to systematically quantify the clinical decision. To determine outcome probabilities, a decision tree was constructed (repair vs BT) and a meta-analysis was conducted. To determine outcome utilities, we evaluated 70 patients with a chief complaint of shoulder pain regarding age, sex, Shoulder Activity Level, and visual analog scale score in terms of potential outcome preferences. Statistical fold-back analysis was performed to determine the optimal treatment. One-way sensitivity analysis determined the effect of changing the reinjury rate on the expected value of BT.

### **Results**

The overall expected value was 8.66 for BT versus 7.19 for SLAP repair. One-way sensitivity analysis showed that BT was the superior choice if reinjury rates were expected to be lower than 28%. Meta-analysis of 23 studies and 908 patients revealed that the probability of a “well” outcome was significantly greater for BT (87.8%; 95% confidence interval [CI], 74.9%-94.6%; I<sup>2</sup> = 0.0%) than for SLAP repair (62.9%; 95% CI, 55.9%-69.3%; I<sup>2</sup> = 65.9%; P = .0023). The rate of reinjury was 1.5% for BT (95% CI, 0.05%-33.8%; I<sup>2</sup> = 0.0%) and 6.4% for repair (95% CI, 4.2%-9.6%; I<sup>2</sup> = 24%), which was not statistically significantly different (P = .411). A total of 50 participants (mean age, 25.4 years [standard deviation, 8.9 years]; 76% male patients; 50% overhead athletes) met the inclusion criteria. Forty-six percent of participants had a high Shoulder Activity Level score.

### **Conclusions**

Decision analysis showed that BT is preferred over repair for an isolated type II SLAP tear based on greater expected value of BT versus repair. Meta-analysis showed more frequent favorable outcomes with BT. Surgeons can use this information to tailor discussions with patients.

### **Level of Evidence**

Level IV, meta-analysis of Level I-IV studies.

## **Moderate Return to Play and Previous Performance After SLAP Repairs in Competitive Overhead Athletes: A Systematic Review**

S.F. DeFroda, A.S. Vadhera, et al.

DOI: <https://doi.org/10.1016/j.arthro.2022.03.026>

### **Purpose**

To perform a systematic review of return to play (RTP) and return to previous level of performance (RPP) in competitive overhead athletes after SLAP repair to identify factors associated with failure to RTP.

### **Methods**

Systematic review was conducted according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. Review was registered with PROSPERO International prospective register of systematic reviews (CRD42020215488). Inclusion criteria were literature reporting RTP or RPP following SLAP repair in overhead athletes were run in the following databases: PubMed/MEDLINE, Scopus, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, and Google Scholar. Categories for data collection for each full article included (1) article information; (2) patient demographics; (3) surgical techniques; (4) level of competition; (5) rotator cuff treatment; (6) player position; (7) patient-reported outcome measures; and (8) RTP and RPP rates. The Methodological Index for Non-randomized Studies checklist was used to evaluate quality of all included studies.

### **Results**

Eight studies with 333 subjects were identified. Overall RTP and RPP rates were 50% to 83.6% and 35.3% to 64%, respectively. Patients with surgically treated rotator cuff pathology had lower RTP (12.5%-64.7%) rates compared with those without (80.0%-83.6%). Professional athletes had similar RTP rates (62.5%-81.5%) compared with high-school (75.0%-90.0%) and college athletes (12.5%-83.3%). However, professional athletes demonstrated the lowest relative range of reported RPP rates (27.7%-55.6%). Pitchers had lower RTP (62.5%-80.0%) and RPP (52.0%-58.9%) compared with position players (91.3% RTP, 76.3%-78.2% RPP).

### **Conclusions**

Studies reviewed reported moderate RTP and RPP rates following SLAP repairs in competitive overhead athletes. Those with associated rotator cuff tear requiring treatment, and baseball pitchers were less likely to RTP and RPP. Professional athletes had similar RTP to an amateur; however, they were less likely to RPP.

### **Level of Evidence**

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

Knee Surgery, Sports Traumatology, Arthroscopy, October 2022, volume 30, issue 10, pages: 3499 - 3507

**Transosseous repair with a cortical implant for greater tubercle cyst-related rotator cuff tear results in good clinical outcomes, but significant implant migration**

Aydin, M., Veizi, E. et al.

DOI: <https://doi.org/10.1007/s00167-022-06958-9>

**Purpose**

To evaluate whether an arthroscopic transosseous technique (ATO) with cortical implants is effective for rotator cuff tear (RCT) repair in patients with cysts of the greater tuberosity (GTC).

**Methods**

Patients treated with the ATO technique between January 2013 and October 2017 were evaluated. Inclusion criteria were patients treated for both cyst-related and non-cyst-related RCTs and patients with a moderate-sized tear (1–3 cm) according to the DeOrto and Cofield classification. A total of 39 patients were separated into two groups: Group 1 (n = 16) patients with cyst-associated RCT, and Group 2 (n = 23) patients with no cyst. Implant pull-out and migration were evaluated radiologically on standard antero-posterior shoulder radiographs and rotator cuff re-tear was assessed on magnetic resonance images at the final follow-up examination. Group 1 patients were separated into two subgroups according to cyst size (cyst < 5 mm and cyst ≥ 5 mm) and subgroup analysis was performed. Clinical assessment was performed using a visual analog scale, the Constant score and Oxford shoulder score.

**Results**

The mean follow-up time was  $33.7 \pm 11.7$  months. The mean cyst size was  $5.4 \pm 1.5$  mm. There was no significant difference in re-tear rates between the cystic and non-cystic groups. The mean implant migration distance was  $3.0 \pm 2.2$  mm in patients with a RCT -related cyst and  $0.7 \pm 0.8$  mm in those without a cyst. A statistically significant difference was found between the groups ( $p = 0.002$ ). There was no statistically significant difference between the groups in respect of clinical scores. No implant failure was observed.

**Conclusion**

The ATO method performed with a cortical implant in RCTs resulted in satisfactory recovery and clinical outcomes in the short to medium term with low failure rates. While no implant failures were observed, implant migration was associated with cyst presence. Therefore, judicious use is advocated in the choice of transosseous fixation for cyst-related RCTs and patients should be informed of the possibility of implant migration.

**Level of evidence**

III.

**Arthroscopic Posterior Articular Coverage and Shift (PACS) Procedure for Treatment of Preosteoarthritic Constitutional Static Posterior Shoulder Instability (Type C1)**

Philipp Moroder MD, Henry Gebauer, Alp Paksoy, Paul Siegert MD, Christian Festbaum MD, Katja Rüttershoff, Lucca Lacheta MD, Kathi Thiele MD, Doruk Akgün MD

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**Background:** Different joint-preserving techniques for treatment of preosteoarthritic, constitutional static (type C1) posterior shoulder instability (PSI) have been proposed, including posterior glenoid open wedge osteotomy and bone graft augmentation. However, the techniques are demanding, the reported complication and reoperation rates are high, and posterior decentering cannot reliably be reversed.

**Purpose:** To assess the clinical and radiological longitudinal outcomes of patients with type C1 PSI after arthroscopic posterior articular coverage and shift (PACS) surgery.

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

**Methods:** We performed a retrospective analysis of a prospective database with longitudinal follow-up including 14 shoulders in 13 patients who underwent an arthroscopic PACS procedure for symptomatic preosteoarthritic constitutional static posterior instability (type C1) with previous failed nonoperative treatment. Patients were clinically evaluated before surgery and at 3, 6, 12, and 24 months postoperatively in terms of satisfaction and pain levels as well as standardized physical examination, Subjective Shoulder Value (SSV), Western Ontario Shoulder Instability Index (WOSI) score, Constant score, and Rowe score. Preoperative, postoperative, and follow-up magnetic resonance imaging scans were obtained in all patients. A paired 2-sample t test was used to compare changes in continuous variable parameters over time. Correlation analyses were performed using the Pearson correlation coefficient.

**Results:** All outcome scores and the pain level improved significantly from preoperatively to postoperatively, and the improvement was sustained over the follow-up period of 2 years (pain level, 6.4 preoperatively vs 3.3 at 2 years,  $P < .001$ ; SSV, 40 vs 70,  $P = .001$ ; WOSI, 33 vs 56,  $P = .001$ ; Constant, 70 vs 79,  $P = .049$ ; Rowe, 52 vs 76,  $P < .001$ ). The mean glenohumeral and scapulohumeral subluxation indices were significantly lower in the early postoperative period compared with preoperative measurements (glenohumeral,  $52\% \pm 6\%$  vs  $58\% \pm 10\%$ ,  $P = .02$ ; scapulohumeral,  $70\% \pm 8\%$ ; vs  $77\% \pm 9\%$ ,  $P = .002$ , respectively); however, they returned to baseline values at follow-up ( $57\% \pm 7\%$  vs  $58\% \pm 10\%$ ,  $P = .7$ ;  $75\% \pm 6\%$  vs  $77\% \pm 9\%$ ,  $P = .4$ , respectively). A high scapulohumeral subluxation index, excessive glenoid retroversion, and increased posterior positioning of the humeral head in relation to scapular blade axis and older age were correlated with worse clinical outcomes.

**Conclusion:** Over the follow-up period of 2 years, the PACS procedure significantly improved outcome scores in patients who had preosteoarthritic constitutional static posterior shoulder instability, especially in younger patients with less severe glenoid retroversion and posterior decentering of the humeral head. However, similar to other techniques, the PACS procedure needs to be considered a symptomatic therapy that does not reverse the underlying cause or stop the progressive pathology.

## **Inconsistencies in Controlling for Risk Factors for Recurrent Shoulder Instability After Primary Arthroscopic Bankart Repair: A Systematic Review**

Nicholas A. Trasolini MD Navya Dandu BS, Eric N. Azua BS, Grant E. Garrigues MD, Nikhil N. Verma MD, Adam B. Yanke MD, PhD

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**Background:** Failure rates after arthroscopic shoulder stabilization are highly variable in the current orthopaedic literature. Predictive factors for risk of failure have been studied to improve patient selection, refine surgical techniques, and define the role of bony procedures. However, significant heterogeneity in the analysis and controlling of risk factors makes evidence-based management decisions challenging.

**Purpose:** The goals of this systematic review were (1) to critically assess the consistency of reported risk factors for recurrent instability after arthroscopic Bankart repair, (2) to identify the existing studies with the most comprehensive inclusion of confounding factors in their analyses, and (3) to give recommendations for which factors should be reported consistently in future clinical studies.

**Study Design:** Systematic review; Level of evidence, 4.

**Methods:** A systematic review of the literature was performed in accordance with the PRISMA guidelines. An initial search yielded 1754 titles, from which 56 full-text articles were screened for inclusion. A total of 29 full-text articles met the following inclusion criteria: (1) clinical studies regarding recurrent anterior shoulder instability; (2) surgical procedures performed including arthroscopic anterior labral repair; (3) reported clinical outcome data including failure rate; and (4) assessment of risk factors for surgical failure. Further subanalyses were performed for 15 studies that included a multivariate analysis, 17 studies that included glenoid bone loss, and 8 studies that analyzed the Instability Severity Index Score.

**Results:** After full-text review, 12 of the most commonly studied risk factors were identified and included in this review. The risk factors that were most consistently significant in multivariate analyses were off-track lesions (100%), glenoid bone loss (78%), Instability Severity Index Score (75%), level of sports participation (67%), number of anchors (67%), and younger age (63%). In studies of bone loss, statistical significance was more likely to be found using advanced imaging, with critical bone loss thresholds of 10% to 15%. Several studies found predictive thresholds of 2 to 4 for Instability Severity Index Score by receiver operating characteristic or multivariate analysis.

**Conclusion:** Studies reporting risk factors for failure of arthroscopic Bankart repair often fail to control for known confounding variables. The factors with the most common statistical significance among 15 multivariate analyses are off-track lesions, glenoid bone loss, Instability Severity Index Score, level of sports participation, number of anchors, and younger age. Studies found significance more commonly with advanced imaging measurements or arthroscopic assessment of glenoid bone loss and with lower thresholds for the Instability Severity Index Score (2-4). Future studies should attempt to control for all relevant factors, use advanced imaging for glenoid bone loss measurements, and consider a lower predictive threshold for the Instability Severity Index Score.

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## Lower Extremity

Journal of Arthroscopy, Volume 38, Issue 10, pages 2771-2942

### **Hip Arthroscopic Microfracture Augmented With Platelet-Rich Plasma-Infused Micronized Cartilage Allograft Significantly Improves Functional Outcomes**

T.D. Luo, E.C. Beck, et al.

DOI: <https://doi.org/10.1016/j.arthro.2022.02.021>

#### Purpose

To evaluate functional outcomes and survivorship in patients at 1 year after undergoing arthroscopic microfracture augmented with hyaline allograft for symptomatic chondral defects of the hip.

#### Methods

Consecutive patients with and without prior hip procedures presenting with Outerbridge grade IV chondral lesion of the acetabulum or femoral head were prospectively followed. Patients underwent hip microfracture augmented with hyaline allograft suspended in autologous platelet-rich plasma between October 2016 and April 2018. Extent of cartilage degeneration was quantified using the chondromalacia severity index (CMI). Patient functional scores, including Tegner, Hip Outcome Score-Activities of Daily Living (HOS-ADL), Sport-Specific Subscale (HOS-SSS), modified Harris Hip Score (mHHS), and Nonarthritic Hip Score (NAHS) were collected preoperatively and at minimum 1-year postoperatively. Minimal clinically important difference (MCID) was analyzed. Statistical significance was established at  $P < .05$ . Pearson's coefficient analysis was performed to identify preoperative variables correlated with clinical outcomes.

#### Results

Fifty-seven patients (86.4%) had minimum 1-year follow-up and were included in the final analysis, with a mean age and body mass index (BMI) of  $38.3 \pm 9.1$  years and  $27.7 \pm 4.9$  kg/m<sup>2</sup>, respectively. Comparison of baseline and postoperative score averages demonstrated significant improvements in Tegner scores ( $3.7 \pm 2.9$  vs  $5.1 \pm 2.6$ ;  $P = .003$ ), HOS-ADL ( $63.3 \pm 16.4$  vs  $89.1 \pm 14.5$ ;  $P < .001$ ), HOS-SSS ( $40.8 \pm 20.4$  vs  $79.5 \pm 21.6$ ;  $P < .001$ ), mHHS ( $61.5 \pm 16.2$  vs  $87.0 \pm 17.7$ ;  $P < .001$ ), and NAHS ( $56.6 \pm 14.9$  vs  $78.7 \pm 18.3$ ;  $P < .001$ ). The percentage of patients who achieved MCID for HOS-ADL, HOS-SSS, mHHS, and NAHS were 89.8%, 83.0%, 75.6%, and 81.6%, respectively. Overall, 91.8% of patients met the threshold for achieving MCID in at least one outcome score. Of the 57 patients, 5 (8.8%) failed clinically, with 1 (1.8%) undergoing revision surgery and 4 (6.9%) undergoing conversion to total hip arthroplasty. There was a direct correlation between preoperative alpha angle and postoperative HOS-ADL. Femoral chondral lesion size and CMI inversely correlated with postoperative HOS-ADL.

#### Conclusions

Treatment of hip chondral defects with microfracture and hyaline allograft augmentation demonstrated excellent survivorship and significantly improved patient report outcomes at 1 year.

#### Level of Evidence

IV, retrospective case series.

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## **Patient-Reported Outcome Surveys for Femoroacetabular Impingement Syndrome Demonstrate Strong Correlations, High Minimum Clinically Important Difference Agreement and Large Ceiling Effects**

M.J. Hartwell, K.K.J. Soriano, et al.

DOI: <https://doi.org/10.1016/j.arthro.2022.03.023>

### **Purpose**

To determine the correlation between different patient-reported outcome (PRO) measurements used to assess outcomes after arthroscopic treatment of femoroacetabular impingement syndrome (FAIS) in a single cohort of patients.

### **Methods**

Patients undergoing primary hip arthroscopy for FAIS (without dysplasia, arthritis, or joint hypermobility) were retrospectively analyzed from a prospectively collected cohort. PROs collected before surgery and at 2-year follow-up included the Visual Analog Scale (VAS) for pain, modified Harris Hip Score (mHHS), Hip Disability and Osteoarthritis Outcome Scores (HOOS) with subscales for symptoms, pain, activities of daily living (ADL), sport, and quality of life (QoL), and the physical and mental components of the Short Form-12 (SF-12 PCS and SF-12 MCS).

### **Results**

Three hundred patients with 2 years' follow-up (mean age  $35.1 \pm 11.3$ , BMI  $24.7 \pm 3.8$ , 52.7% female, median Tönnis grade 1) were identified. All patients underwent femoroplasty and labral repair. There was a strong correlation among nearly all the PRO surveys at 2-year follow-up, with the highest correlations identified between mHHS and HOOS-Pain ( $r = .86$ ,  $P < .001$ ) and mHHS and HOOS-ADL ( $r = .85$ ,  $P < .001$ ). Preoperative scores and the change from preoperative to postoperative scores demonstrated an overall moderate correlation between surveys. There was a consistently weak correlation between the SF-12 MCS and all other PROs. There were strong agreements (67%-77%) in the patients achieving minimal clinically important differences (MCID) for each PRO survey. All surveys except the SF-12 demonstrated a ceiling effect after surgery, with 13% to 43% of patients achieving the maximum score.

### **Conclusions**

PRO surveys used for FAIS demonstrate strong correlations, especially in the evaluation of patients during the postoperative period. MCID for VAS, mHHS, and HOOS demonstrate strong agreement, whereas large ceiling effects were seen with the mHHS and HOOS. The results support a more efficient use of PRO scores while being able to accurately capture patient outcomes.

### **Level of Evidence**

IV, retrospective case series.



## **Anterior Tibial Subluxation of Lateral Compartment Is Associated With High-Grade Rotatory Instability for Acute But Not Chronic Anterior Cruciate Ligament Injuries: An Magnetic Resonance Imaging Case-Control Study**

A. Liu, W. Cui, et al.

DOI: <https://doi.org/10.1016/j.arthro.2022.04.012>

### **Purpose**

To investigate whether anterior tibial subluxation obtained from magnetic resonance imaging (MRI) could be a predictor of high-grade rotatory instability for anterior cruciate ligament (ACL) injuries, including acute and chronic cases.

### **Methods**

From September 2016 to August 2018, we retrospectively investigated 163 patients with ACL injuries who subsequently underwent primary ACL reconstruction. Among them, 30 patients with high-grade rotatory instability (grade II/III pivot shift) were included in the high-grade group, and their age and sex were matched 1:2 to low-grade cases (<grade II pivot shift). On preoperative MRI, we measured anterior tibial subluxation, posterior tibial slope, as well as the time from injury to surgery. Meniscal lesions were documented from arthroscopy. Multivariable logistic regression was used to determine predictors of high-grade rotatory instability. Furthermore, subgroup comparisons between 2 groups were divided into acute ( $\leq 3$  months) and chronic ( $> 3$  months) phases.

### **Results**

The high-grade group had a larger anterior tibial subluxation of lateral compartment (8.1 mm vs 5.9 mm;  $P = .004$ ) than the low-grade group, whereas no significant difference was found in anterior tibial subluxation of medial compartment ( $P > .05$ ). Moreover, high-grade anterior tibial subluxation of lateral compartment ( $\geq 6$  mm) was found to be an independent predictor (odds ratio, 12.992;  $P = .011$ ) associated with concomitant meniscal tears after ACL injuries. Anterior tibial subluxation of lateral compartment demonstrated statistical significance between the two groups when comparing subgroups within 3 months but not beyond 3 months.

### **Conclusion**

In ACL-injured patients, high-grade anterior tibial subluxation of lateral compartment ( $\geq 6$  mm) could be a unique predictor of high-grade knee rotatory instability for acute but not chronic injuries. Prolonged time from injury to surgery and lateral meniscus tears were risk factors for high-grade rotatory laxity in chronic patients.

### **Level of Evidence**

Level III, retrospective prognostic trial.



# **Clinically Depressed Patients Having Anterior Cruciate Ligament Reconstruction Show Improved but Inferior Rate of Achieving Minimum Clinically Important Difference for Patient-Reported Outcomes Measurement Information System Compared With Situationally Depressed or Nondepressed Patients**

J. Schaffer, B. Kuhns, et al.

DOI: <https://doi.org/10.1016/j.arthro.2022.04.013>

## **Purpose**

To determine whether the preoperative diagnosis of depression predicted worse postoperative outcomes, including physical therapy (PT) compliance, return-to-sport, and patient-reported outcomes using the Patient-Reported Outcomes Measurement Information System (PROMIS) after anterior cruciate ligament (ACL) reconstruction.

## **Methods**

A multisurgeon series of consecutive patients who had undergone ACL reconstruction with minimum 2-year follow-up were included. Chart review was conducted to determine depression diagnosis status, demographic data, rehabilitation PT compliance, return to sports, and patient-reported outcome data using PROMIS. Patients who met the PROMIS threshold for mild depression but did not carry a clinical diagnosis of depression were classified as “situationally depressed.”

## **Results**

Ninety-five of 115 consecutive patients (81%) met inclusion criteria with an average follow-up of  $34 \pm 1.9$  months. Fourteen patients (15%) had a preoperative diagnosis of depression, whereas 21 (22%) were considered situationally depressed. Clinically depressed patients had a greater rate of PT noncompliance ( $33.2\% \pm 17.6\%$  vs  $21.9\% \pm 12.6\%$ ;  $P = .02$ ) and a lower postoperative PROMIS Physical Function ( $50.8 \pm 7.7$  vs  $57.8 \pm 11.0$ ;  $P = .03$  compared with patients without depression). Situationally depressed patients had lower preoperative physical function ( $35.4$  vs  $42.5$ ;  $P = .04$ ) with no differences in postoperative outcomes scores compared to the non-depressed cohort. 19/21 (90.5%) of situationally depressed patients had postoperative resolution of their depressive symptoms.

## **Conclusions**

Situationally depressed patients without a clinical diagnosis of depression can expect significant improvements in both pain and function, as well as a resolution of their depressed mood based on PROMIS scores as they progress through recovery after ACL reconstruction. Clinically depressed patients also experience significant improvements; however, their rate of achieving the minimum clinically important difference for PROMIS outcomes may be less than their nondepressed or situationally depressed counterparts.

## **Level of Evidence**

III, prognostic comparative trial.

## **Younger Patients Are More Likely to Undergo Arthroscopic Meniscal Repair and Revision Meniscal Surgery in a Large Cross-Sectional Cohort**

K.E. Bradley, N. Cevallos, et al.

DOI: <https://doi.org/10.1016/j.arthro.2022.04.020>

### **Purpose**

To evaluate recent trends in the treatment of meniscal tears with arthroscopic repair and debridement and to assess revision surgery within 2 years using a large cross-sectional database.

### **Methods**

Patients with a diagnosis of meniscal tear from 2010 to 2017 were queried using the Mariner data set from PearlDiver. Patient demographic data were analyzed and tracked via International Classification of Diseases, Tenth Revision codes to investigate subsequent ipsilateral meniscal procedures and conversion to total knee arthroplasty within 2 years after index meniscal surgery.

### **Results**

Of the 1,383,161 patients with a diagnosis of meniscal tear, 53.0% underwent surgical treatment. Surgical treatment consisted of meniscal debridement in 96.6% of patients and meniscal repair in 3.4%. The percentage of meniscal repairs increased from 2.7% to 4.4% over the 8-year period evaluated, whereas the percentage of meniscal debridement decreased from 97.3% to 95.6% ( $P < .0001$ ). Younger patients were more likely to undergo meniscal repair (23% of those aged 10-19 years) than older patients (<1% of those aged  $\geq 60$  years). Among the 191,729 patients with International Classification of Diseases, Tenth Revision coding and 2-year follow-up, 10.6% of patients with index meniscal repair required a revision meniscal operation and 1.2% underwent conversion to arthroplasty. Subsequent meniscal procedures within 2 years after index meniscal repair included meniscal debridement in 81.6% of patients and revision repair in 18.4%. Patients who initially underwent meniscal debridement were less likely to undergo revision meniscal surgery (5.1%), but 4.7% required conversion to arthroplasty. Patients aged 10 to 19 years were most likely to undergo revision meniscal procedures after both index meniscal repair (12.8%) and meniscal debridement (8.8%).

### **Conclusions**

The rate of meniscal repair is increasing over time, with patients younger than 30 years most likely to undergo repair for a meniscal tear. Revision surgery for meniscal repair or debridement is more common in adolescents and patients who undergo an index meniscal repair.

### **Level of Evidence**

Level III, retrospective cohort study.

## **Intra-Articular Magnesium Plus Bupivacaine Is the Most Effective and Safe Postoperative Analgesic Option Following Knee Arthroscopy: A Network Meta-analysis**

Y. He, H. He, et al.

DOI: <https://doi.org/10.1016/j.arthro.2022.03.013>

### **Purpose**

To evaluate the comparative efficacy and safety of single-dose intra-articular injection of commonly used analgesics after knee arthroscopy.

### **Methods**

A systematic literature review was done to search for randomized controlled trials (RCTs) published from database inception to October 1, 2020, that compared analgesics (i.e., morphine, bupivacaine, ropivacaine, and magnesium alone or in combination) with placebo or each other after knee arthroscopy. The primary outcomes were postoperative pain intensity at 2 hours and 24 hours. Secondary outcomes included the time to first analgesic request, number of patients requiring supplementary analgesics and side effects. We estimated summary standardized mean differences (SMDs) or odds ratios with 95% credible intervals (95% CrIs) using Bayesian network meta-analysis with random effects.

### **Results**

In total, 78 randomized controlled trials comprising 4,425 participants were included. Compared with placebo, magnesium plus bupivacaine was most likely to be effective in relieving pain at both 2-hour (SMD =  $-3.81$ , 95% CrI  $-5.28$  to  $-2.35$ ) and 24-hour after surgery (SMD =  $-2.81$ , 95% CrI:  $-4.29$  to  $-1.30$ ). Following was morphine plus bupivacaine (2-hour: SMD =  $-2.19$ , 95% CrI  $-3.05$  to  $-1.31$ ; 24-hour: SMD =  $-1.44$ , 95% CrI  $-2.14$  to  $-0.73$ ) and bupivacaine alone (2-hour: SMD =  $-1.66$ , 95% CrI  $-2.33$  to  $-0.98$ ; 24-hour: SMD =  $-0.67$ , 95% CrI  $-1.22$  to  $-0.07$ ); ropivacaine alone and magnesium alone were not effective on pain relief. The interval time to first analgesic request was significantly extended compared with placebo except for ropivacaine alone and magnesium alone. The number of patients requiring supplementary analgesics was reduced in all groups except ropivacaine alone. No statistically significant difference was found between any studied analgesics or placebo with regard to side effects.

### **Conclusions**

Of 6 common postoperative intra-articular analgesics, magnesium plus bupivacaine provides the most effective pain relief without increasing short-term side effects after knee arthroscopy.

### **Level of Evidence**

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

## **Males and Females Exhibit Comparable Outcomes Following Treatment of Osteochondritis Dissecans Lesions of the Knee: A Systematic Review**

B.J. Ross, C. E. Hermanns, et al.

DOI: <https://doi.org/10.1016/j.arthro.2022.03.015>

### **Purpose**

The purpose of this study was to evaluate the impact of patient sex on outcomes after treatment of osteochondritis dissecans (OCD) lesions of the knee through a systematic review of current evidence.

### **Methods**

This review was conducted according to the PRISMA guidelines using the PubMed, PubMed Central, Embase, Ovid Medline, Cochrane Libraries, and the Cumulative Index to Nursing and Allied Health Literature (CINAHL) databases. Relevant outcomes included functional (e.g., International Knee Documentation Committee and Subjective Knee Evaluation, Lysholm Knee Score) and clinical outcomes (e.g., symptom/pain resolution, reoperation rates) for males and females after operative or nonoperative treatment of knee OCD lesions.

### **Results**

Ten articles with a total of 691 (73%) males and 260 (27%) females were included. Mean age ranged from  $11.3 \pm 2.1$  years to  $34.5 \pm 10.3$  years, and follow-up ranged from 6 months to 16.3 years. In four studies reporting functional outcomes, no significant differences were found between males and females in any metric assessed (all  $P > .05$ ). Seven studies reported clinical outcomes after treatment of knee OCD lesions. One study determined males were more likely to have a successful nonoperative outcome than females (OR: 1.85, 95% CI: 1.00-3.40). Another study found males had a lower risk of developing symptomatic knee pain following operative or nonoperative treatment at a mean 14-year follow-up (HR: 0.24; 95% CI: 0.07-0.81). The remaining 5 studies reported statistically comparable clinical outcomes between males and females (all  $P > .05$ ).

### **Conclusion**

The present systematic review found mostly comparable clinical and functional outcomes between males and females following treatment of knee OCD lesions. Despite sex-related differences in the prevalence of these lesions and limited evidence of differences in clinical outcomes, these data suggest that sex does not independently predict outcomes after treatment.

### **Level of Evidence**

III, systematic review of Level II and III studies.

**Does Femoral Osteoplasty Improve Long-term Clinical Outcomes and Survivorship of Hip Arthroscopy? A 15-Year Minimum Follow-up Study**

Jeffrey J. Nepple MD, Frank W. Parilla MD, Deniz C. Ince BA, Serena Freiman MD, John C. Clohisy MD

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**Background:** Although femoral osteoplasty is common practice in treating cam-type femoroacetabular impingement (FAI), long-term data are lacking that support the ability of this procedure to optimize outcomes and alter natural history.

**Purpose:** To compare long-term clinical outcomes and survivorship of treatment for symptomatic FAI via arthroscopic correction of labral or chondral pathology with and without femoral osteoplasty.

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

**Methods:** A retrospective cohort study was performed across 2 consecutive cohorts of patients with isolated cam-type FAI who underwent hip arthroscopic treatment of labral or chondral pathology without femoral osteoplasty (HS group) or with femoral osteoplasty (HS-OST group). These unique cohorts were established at a distinct transition time in our practice before and after adoption of femoral osteoplasty for treatment of FAI. Clinical outcomes were measured using the modified Harris Hip Score (mHHS). Kaplan-Meier analysis was used to assess for total hip arthroplasty (THA)-free and reoperation-free survivorship.

**Results:** The final HS group included 17 hips followed for  $19.7 \pm 1.2$  years, and the final HS-OST group included 23 hips followed for  $16.0 \pm 0.6$  years. No significant patient or morphological differences were found between groups. Compared with the HS group, the HS-OST group had significantly higher final mHHS (82.7 vs 64.7 for HS-OST vs HS, respectively;  $P = .002$ ) and mHHS improvement (18.4 vs 6.1;  $P = .02$ ). The HS-OST group also had significantly greater 15-year THA-free survivorship versus the HS group (78% vs 41%, respectively;  $P = .02$ ) and reoperation-free survivorship (78% vs 29%;  $P = .003$ ).

**Conclusion:** This study demonstrated superior long-term clinical outcomes and survivorship with combined arthroscopy and femoral osteoplasty compared with hip arthroscopy alone. These long-term data strongly support the practice of femoral osteoplasty in patients with cam FAI morphologies and suggest that this treatment alters the natural history of FAI at long-term follow-up.

## External Validation of a Machine Learning Algorithm for Predicting Clinically Meaningful Functional Improvement After Arthroscopic Hip Preservation Surgery

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**Background:** Individualized risk prediction has become possible with machine learning (ML), which may have important implications in enhancing clinical decision making. We previously developed an ML algorithm to predict propensity for clinically meaningful outcome improvement after hip arthroscopy for femoroacetabular impingement syndrome. External validity of prognostic models is critical to determine generalizability, although it is rarely performed.

**Purpose:** To assess the external validity of an ML algorithm for predicting clinically meaningful improvement after hip arthroscopy.

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

**Methods:** An independent hip preservation registry at a tertiary academic medical center was queried for consecutive patients/athletes who underwent hip arthroscopy for femoroacetabular impingement syndrome between 2015 and 2017. By assuming a minimal clinically important difference (MCID) outcome/event proportion of 75% based on the original study, a minimum sample of 132 patients was required. In total, 154 patients were included. Age, body mass index, alpha angle on anteroposterior pelvic radiographs, Tönnis grade and angle, and preoperative Hip Outcome Score–Sports Subscale were used as model inputs to predict the MCID for the Hip Outcome Score–Sports Subscale 2 years postoperatively. Performance was assessed using identical metrics to the internal validation study and included discrimination, calibration, Brier score, and decision curve analysis.

**Results:** The concordance statistic in the validation cohort was 0.80 (95% CI, 0.71 to 0.87), suggesting good to excellent discrimination. The calibration slope was 1.16 (95% CI, 0.74 to 1.61) and the calibration intercept 0.13 (95% CI, –0.26 to 0.53). The Brier score was 0.15 (95% CI, 0.12 to 0.18). The null model Brier score was 0.20. Decision curve analysis revealed favorable net treatment benefit for patients with use of the algorithm as compared with interventional changes made for all and no patients.

**Conclusion:** The performance of this algorithm in an independent patient population in the northeast region of the United States demonstrated superior discrimination and comparable calibration to that of the derivation cohort. The external validation of this algorithm suggests that it is a reliable method to predict propensity for clinically meaningful improvement after hip arthroscopy and is an essential step forward toward introducing initial use in clinical practice. Potential uses include integration into electronic medical records for automated prediction, enhanced shared decision making, and more informed allocation of resources to optimize patient outcomes.

## **Elite Female Athletes Demonstrate a Comparable Improvement in Midterm Patient-Reported Outcome Scores and Rate of Return to Sport Compared With Elite Male Athletes After Hip Arthroscopic Surgery: A Sex-Based Comparison in Professional and Collegiate Athletes**

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**Background:** Few studies have compared outcomes, return to sport (RTS), and continuation of sport (CTS) after primary hip arthroscopic surgery between matched groups of male and female athletes with a minimum 5-year follow-up.

**Purpose:** (1) To report minimum 5-year patient-reported outcome (PRO) scores as well as RTS and CTS rates for elite female athletes undergoing hip arthroscopic surgery for femoroacetabular impingement syndrome (FAIS) and (2) to compare clinical results with those of a matched control group of elite male athletes.

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

**Methods:** Data were prospectively collected and retrospectively reviewed for elite (collegiate or professional) female athletes who underwent primary hip arthroscopic surgery for FAIS between March 2009 and March 2016. Inclusion criteria were preoperative and minimum 5-year scores for the modified Harris Hip Score, Nonarthritic Hip Score, Hip Outcome Score–Sport Specific Subscale, and visual analog scale for pain. Exclusion criteria were Tönnis grade >1, hip dysplasia, previous ipsilateral hip surgery/conditions, and those unwilling to participate. Rates of achieving the minimal clinically important difference (MCID), Patient Acceptable Symptom State (PASS), and maximum outcome improvement satisfaction threshold (MOIST) were recorded in addition to RTS. CTS was also recorded and defined as athletes reporting continued sport activity at a minimum 5-year follow-up after initially reporting returning to sport. Elite female athletes were propensity matched in a 1:1 ratio to elite male athletes for comparison.

**Results:** A total of 81 hips in elite female athletes that underwent primary hip arthroscopic surgery met the inclusion criteria, and follow-up was available for 65 hips (80.2%) at a mean of  $67.6 \pm 6.5$  months, with a mean age of  $24.3 \pm 6.8$  years. Female athletes demonstrated significant improvements in all recorded PRO scores; achieved the MCID, PASS, and MOIST at high rates; returned to sport at a rate of 80.4%; and continued sport at a rate of 97.1%. Female athletes demonstrated lower preoperative PRO scores compared with male athletes, but postoperative PRO scores; improvements in scores; rates of achieving the MCID, PASS, MOIST; and RTS and CTS rates were similar between female and male athletes.

**Conclusion:** Elite female athletes undergoing primary hip arthroscopic surgery for FAIS demonstrated favorable PRO scores and high RTS and CTS rates at a minimum 5-year follow-up. These results were comparable with those of a propensity-matched control group of elite male athletes.

[BACK](#)

Knee Surgery, Sports Traumatology, Arthroscopy, October 2022, volume 30, issue 10, pages: 3249 - 3257

**Autologous chondrocyte implantation combined with anterior cruciate ligament reconstruction: similar short-term results in comparison with isolated cartilage repair in ligament intact joints**

Mehl, J., Feucht, M. et al.

DOI: <https://doi.org/10.1007/s00167-021-06764-9>

**Purpose**

Both acute ruptures of the anterior cruciate ligament (ACL) as well as chronic ACL insufficiency show a high association with focal cartilage defects of the knee. However, the results after combined ACL reconstruction and cartilage repair are not well investigated. The aim of the present study was to investigate the short-term outcomes after autologous chondrocyte implantation (ACI) in combination with ACL reconstruction and to compare the results with patients who underwent isolated ACI in ligament intact knees.

**Methods**

All patients who were registered in the German Cartilage Registry with ACI for focal cartilage defects in the knee joint in combination with ACL reconstruction and who completed the 24 month follow-up were included in the study group. A matched-pair procedure according to gender, defect location, defect size, and age was used to create a control group of patients with isolated ACI in ACL intact joints. The Knee Injury and Osteoarthritis Outcome Score (KOOS) and the numeric analog scale for pain (NAS) were used to assess the preoperative state as well as the clinical outcomes 12 and 24 months after surgery.

**Results**

A total of 34 patients were included in both the study group (age mean  $33.3 \pm SD 8.8$  years) and the control group ( $33.6 \pm 8.4$  years) with a median defect size of 466 (25%-75% IQR 375–600) mm<sup>2</sup> and 425 (IQR 375–600) mm<sup>2</sup>, respectively. In comparison with the preoperative state (median 67, IQR 52–75), the study group showed a significant increase of the total KOOS after 12 months (78, IQR 70–86;  $p = 0.014$ ) and after 24 months (81, IQR 70–84;  $p = 0.001$ ). The NAS for pain did not change significantly in the postoperative course. In comparison with the control group there was no significant difference for the total KOOS neither preoperative (control group median 67, IQR 52–73) nor at any postoperative time point (12 months: 82, IQR 67–93; 24 months: 81, IQR 71–91).

**Conclusion**

The clinical short-term outcomes after ACI at the knee joint in combination with ACL reconstruction are good and similar to the results after isolated ACI in ligament intact knees.

**Level of evidence**

III.



## **Anterior cruciate ligament autograft maturation on sequential postoperative MRI is not correlated with clinical outcome and anterior knee stability**

Lutz, P.M, Achtnich, A. et al.

DOI: <https://doi.org/10.1007/s00167-021-06777-4>

### **Purpose**

Magnetic resonance imaging (MRI) signal intensity is correlated to structural postoperative changes of the anterior cruciate ligament (ACL) autograft. The purpose of this study was to investigate the ACL autograft maturation process via MRI over 2 years postoperatively, compare it to a native ACL signal and correlate the results with clinical outcome, return to preinjury sports levels, and knee laxity measurements.

### **Methods**

ACL autograft signal intensity was measured in 17 male patients (age,  $28.3 \pm 7.0$  years) who underwent ACL reconstruction with hamstring autograft at 6 weeks, 3-, 6-, 12-, and 24 months postoperatively by 3 Tesla MRI. Controls with an intact ACL served as control group (22 males, 8 females; age,  $26.7 \pm 6.8$  years). An ACL/PCL ratio (APR) and ACL/muscle ratio (AMR) was calculated to normalize signals to soft tissue signal. APR and AMR were compared across time and to native ACL signal. Clinical outcome scores (IKDC, Lysholm), return to preinjury sports levels (Tegner activity scale), and knee laxity measurement (KT-1000) were obtained and correlated to APR and AMR at the respective time points.

### **Results**

The APR and AMR of the ACL graft changed significantly from the lowest values at 6 weeks to reach the highest intensity after 6 months ( $p < 0.001$ ). Then, the APR and AMR were significantly different from a native ACL 6 months after surgery ( $p < 0.01$ ) but approached the APR and AMR of the native ACL at 1- and 2 years after surgery ( $p < 0.05$ ). The APR changed significantly during the first 2 years postoperatively in the proximal ( $p < 0.001$ ), mid-substance ( $p < 0.001$ ), and distal ( $p < 0.01$ ) intraarticular portion of the ACL autograft. A hypo-intense ACL MRI signal was associated with return to the preinjury sports level ( $p < 0.05$ ). No correlation was found between ACL MRI graft signal and clinical outcome scores or KT-1000 measurements.

### **Conclusion**

ACL grafts undergo a continuous maturation process in the first 2 years after surgery. The ACL graft signals became hyper-intense 6 months postoperatively and approximated the signal of a native intact ACL at 12- and 24 months. Patients with a hypo-intense ACL graft signal at 2 years follow-up were more likely to return to preinjury sports levels. The results of the present study provide a template for monitoring the normal ACL maturation process via MRI in case of prolonged clinical symptoms. However, subjective outcome and clinical examination of knee laxity remain important to assess the treatment success and to allow to return to sports.

### **Level of evidence**

III.

## **Few young athletes meet newly derived age- and activity-relevant functional recovery targets after ACL reconstruction**

Ithurnburn, M.P., Barenius, B. et al.

DOI: <https://doi.org/10.1007/s00167-021-06769-4>

### **Purpose**

National registry data have established Knee injury and Osteoarthritis Outcome Score (KOOS) functional recovery target values for adults after anterior cruciate ligament (ACL) reconstruction. However, the specificity of these target values for young athletes after ACL reconstruction is unclear. The purpose of this analysis was to (1) derive age- and activity-relevant KOOS functional recovery target values from uninjured young athlete data and (2) determine clinical measures at the time of RTS clearance associated with meeting the newly-derived functional recovery target values in young athletes following ACLR.

### **Methods**

Two hundred and twenty-two young athletes (56 uninjured controls,  $17.2 \pm 2.4$  years, 73% female; 166 after ACL reconstruction,  $16.9 \pm 2.2$  years, 68% female) were included in this cross-sectional analysis from a larger cohort study. Uninjured control participants completed the KOOS, and functional recovery target values were defined as the lower bound of the 95% confidence interval for KOOS subscales. ACL reconstruction participants completed testing within 4 weeks of return-to-sport clearance, including the KOOS, single-leg hop tests, and isometric quadriceps strength. In ACL reconstruction participants, logistic regression was used to determine predictors of meeting all KOOS functional recovery target values (primary outcome) among demographic/injury, hop, and strength data ( $\alpha \leq 0.05$ ).

### **Results**

KOOS functional recovery target values for each subscale from uninjured athlete data were: Pain  $\geq 94$ , Symptoms  $\geq 92$ , Activities of Daily Living  $\geq 97$ , Sport  $\geq 92$ , and Quality-of-Life  $\geq 92$ . At the time of return-to-sport clearance, ACL reconstruction participants met the KOOS functional recovery targets in the following proportions: Pain, 63%; Symptoms, 42%; Activities of Daily Living, 80%; Sport, 45%; Quality-of-Life, 24%; overall functional recovery (met all subscale targets), 17%. In ACL reconstruction participants, significant predictors of overall functional recovery (primary outcome) were: younger age, hamstring graft, pediatric ACL reconstruction, quadriceps strength limb-symmetry index  $> 90\%$ , single-hop limb-symmetry index  $> 90\%$ , and crossover-hop limb-symmetry index  $> 90\%$ .

### **Conclusions**

KOOS functional recovery target values derived from uninjured young athletes were higher than those previously reported. Small proportions of young athletes following recent RTS clearance after ACLR met these newly-derived functional recovery target values, and factors associated with meeting functional recovery target values included younger age, hamstring autograft and pediatric ACLR, and having  $> 90\%$  LSI for quadriceps strength and single-leg hop tests.

### **Level of evidence**

I.

## **Low posterior tibial slope is associated with increased risk of PCL graft failure**

Winkler, P.W., Wagala, N.N. et al.

DOI: <https://doi.org/10.1007/s00167-021-06760-z>

### **Purpose**

To evaluate the effect of posterior tibial slope (PTS) on patient-reported outcomes (PROs) and posterior cruciate ligament (PCL) graft failure after PCL reconstruction.

### **Methods**

Patients undergoing PCL reconstruction with a minimum 2-year follow-up were included in this retrospective cohort study. A chart review was performed to collect patient-, injury-, and surgery-related data. Medial PTS was measured on preoperative lateral radiographs. Validated PROs, including the International Knee Documentation Committee Subjective Knee Form, Knee injury and Osteoarthritis Outcome Score, Lysholm Score, Tegner Activity Scale, and Visual Analogue Scale for pain, were collected at final follow-up. A correlation analysis was conducted to assess the relationship between PTS and PROs. A logistic regression model was performed to evaluate if PTS could predict PCL graft failure.

### **Results**

Overall, 79 patients with a mean age of  $28.6 \pm 11.7$  years and a mean follow-up of  $5.7 \pm 3.3$  years were included. After a median time from injury of 4.0 months, isolated and combined PCL reconstruction was performed in 22 (28%) and 57 (72%) patients, respectively. There were no statistically significant differences in PROs and PTS between patients undergoing isolated and combined PCL reconstruction (non-significant [n.s.]). There were no significant correlations between PTS and PROs (n.s.). In total, 14 (18%) patients experienced PCL graft failure after a median time of 17.5 months following PCL reconstruction. Patients with PCL graft failure were found to have statistically significantly lower PTS than patients without graft failure ( $7.0 \pm 2.3^\circ$  vs.  $9.2 \pm 3.3^\circ$ ,  $p < 0.05$ ), while no differences were found in PROs (n.s.). PTS was shown to be a significant predictor of PCL graft failure, with a 1.3-fold increase in the odds of graft failure for each one-degree reduction in PTS ( $p < 0.05$ ).

### **Conclusions**

This study showed that PTS does not affect PROs after PCL reconstruction, but that PTS represents a surgically modifiable predictor of PCL graft failure.

### **Level of evidence**

III.

## **Acute and subacute anterior cruciate ligament reconstructions are associated with a higher risk of revision and reoperation**

Ding, D.Y., Chang, R.N. et al.

DOI: <https://doi.org/10.1007/s00167-022-06912-9>

### **Purpose**

(1) Report concomitant cartilage and meniscal injury at the time of anterior cruciate ligament reconstruction (ACLR), (2) evaluate the risk of aseptic revision ACLR during follow-up, and (3) evaluate the risk of aseptic ipsilateral reoperation during follow-up.

### **Methods**

Using a United States integrated healthcare system's ACLR registry, patients who underwent primary isolated ACLR were identified (2010–2018). Multivariable Cox proportional-hazards regression was used to evaluate the risk of aseptic revision, with a secondary outcome evaluating ipsilateral aseptic reoperation. Outcomes were evaluated by time from injury to ACLR: acute (< 3 weeks), subacute (3 weeks–3 months), delayed (3–9 months), and chronic (≥ 9 months).

### **Results**

The final sample included 270 acute (< 3 weeks), 5971 subacute (3 weeks–3 months), 5959 delayed (3–9 months), and 3595 chronic (≥ 9 months) ACLR. Medial meniscus [55.4% (1990/3595 chronic) vs 38.9% (105/270 acute)] and chondral injuries [40.0% (1437/3595 chronic) vs 24.8% (67/270 acute)] at the time of ACLR were more common in the chronic versus acute groups. The crude 6-year revision rate was 12.9% for acute ACLR, 7.0% for subacute, 5.1% for delayed, and 4.4% for chronic ACLR; reoperation rates a 6-year follow-up was 15.0% for acute ACLR, 9.6% for subacute, 6.4% for delayed, and 8.1% for chronic ACLR. After adjustment for covariates, acute and subacute ACLR had higher risks for aseptic revision (acute HR 1.70, 95% CI 1.07–2.72,  $p = 0.026$ ; subacute HR 1.25, 95% CI 1.01–1.55,  $p = 0.040$ ) and aseptic reoperation (acute HR 2.04, 95% CI 1.43–2.91,  $p < 0.001$ ; subacute HR 1.31, 95% CI 1.11–1.54,  $p = 0.002$ ) when compared to chronic ACLR.

### **Conclusions**

In this cohort study, while more meniscal and chondral injuries were reported for ACLR performed ≥ 9 months after the date of injury, a lower risk of revision and reoperation was observed following chronic ACLR relative to patients undergoing surgery in acute or subacute fashions.

### **Level of evidence**

III.

## **Lower anatomical femoral ACL tunnel can be created in the large volume of femoral intercondylar notch**

Iriuchishima T. & Goto B.

DOI: <https://doi.org/10.1007/s00167-022-06921-8>

### **Purpose**

The purpose of this study was to investigate the correlation between femoral intercondylar notch volume and the characteristics of femoral tunnels in anatomical single bundle anterior cruciate ligament (ACL) reconstruction.

### **Methods**

Fifty-one subjects (24 male and 27 female: median age 27: range 15–49), were included in this study. Anatomical single bundle ACL reconstruction was performed in all subjects using a trans-portal technique. Femoral tunnel length was measured intra-operatively. Three-dimensional computed tomography (3D-CT) was taken at pre and post-surgery. The intercondylar notch volume was calculated with a truncated-pyramid shape simulation using the pre-operative 3D-CT image. In the post-operative 3D-CT, the modified quadrant method was used to measure femoral ACL tunnel placement.

### **Results**

Femoral tunnel placement was  $47.6 \pm 10.5\%$  in the high-low (proximal–distal) direction, and  $22.6 \pm 5.4\%$  in the shallow-deep (anterior–posterior) direction. Femoral tunnel length was  $35.3 \pm 4.4$  cm. Femoral intercondylar notch volume was  $8.6 \pm 2.1\text{cm}^3$ . A significant correlation was found between femoral intercondylar notch volume and high-low (proximal–distal) femoral tunnel placement (Pearson's coefficient correlation: 0.469,  $p = 0.003$ ).

### **Conclusion**

Femoral ACL tunnel placement at a significantly lower level was found in knees with large femoral intercondylar notch volume in the trans-portal technique. For the clinical relevance, although the sample size of this study was limited, surgeons can create femoral ACL tunnel low (distal) in the notch where close to the anatomical ACL footprint in the knees with large femoral intercondylar notch volume.

### **Level of evidence**

III.

## **Time, graft, sex, geographic location, and isokinetic speed influence the degree of quadriceps weakness after anterior cruciate ligament reconstruction: a systematic review and meta-analysis**

Tsai, L., Jeanfreau, C.M. et al.

DOI: <https://doi.org/10.1007/s00167-022-06906-7>

### **Purpose**

Although quadriceps weakness after ACL reconstruction (ACLR) is well documented, the magnitude of reported weakness varies considerably. Such variation raises the possibility that certain patients may be more susceptible to quadriceps weakness after ACLR. This meta-analysis identified factors explaining between-study variability in quadriceps weakness post-ACLR.

### **Methods**

Studies between 2010 and 2020 were screened for the following criteria: human subjects, unilateral ACLR, and strength reported both for the ACLR leg and the uninjured or healthy-control leg. 122 studies met the criteria, resulting in 303 and 152 Cohen's d effect sizes (ESs) comparing ACLR legs to uninjured legs (a total of 4135 ACLR subjects) and to healthy controls (a total of 1,507 ACLR subjects vs. 1-193 healthy controls), respectively. Factors (time, graft, sex, activity, mass/height, geographic area, concomitant injury, and type of strength testing) that may affect study ES were examined.

### **Results**

Meta-regressions indicated an association between time post-ACLR and study ESs ( $P < 0.001$ ) and predicted full recovery ( $ES = 0$ ) to occur at 54–59 months post-ACLR. When compared to uninjured legs, patients with patellar tendon autografts had greater deficits than studies using hamstring tendon autografts ( $P = 0.023$ ). When compared to uninjured legs, studies including only males reported greater deficits than studies combining males and females ( $P = 0.045$ ); whereas when compared to healthy controls, studies combining males and females reported greater deficits than studies with males ( $P = 0.013$ ). When compared to controls, studies from USA reported greater deficits than studies from Europe ( $P = 0.003$ ). Increased isokinetic-testing speed was associated with smaller deficits ( $P \leq 0.025$ ). Less than 25% of patients achieved a between-limb symmetry in quadriceps strength  $> 90\%$  between 6 and 12 months post-ACLR.

### **Conclusion**

Time post-surgery, graft, sex, geographic location, and isokinetic speed influenced the magnitude of post-ACLR quadriceps weakness. Patients with patellar tendon autografts demonstrated greater between-limb asymmetry in quadriceps strength, while female strength deficits were underestimated to a greater extent. A slower isokinetic speed provided a more sensitive assessment of quadriceps strength post-ACLR. The overwhelming majority of patients were returning to sport with significantly impaired quadriceps strength.

### **Level of evidence**

III.

## **Steep lateral tibial slope measured on magnetic resonance imaging is the best radiological predictor of anterior cruciate ligament reconstruction failure**

Ye, Z., Xu, J. et al.

DOI: <https://doi.org/10.1007/s00167-022-06923-6>

### **Purpose**

To identify the radiological predictive risk factors for anterior cruciate ligament reconstruction (ACLR) failure, compare the diagnostic accuracies of different parameters of conventional radiographs and magnetic resonance imaging (MRI), and determine the cutoff values for patients at higher risk.

### **Methods**

Twenty-eight patients who were diagnosed as ACLR failure via MRI or arthroscopic examination were included in the study group. They were matched to 56 patients who underwent primary ACLR with the same surgical technique and without graft failure at the minimum 24-month follow-up by age, sex, and body mass index. On true lateral whole-leg radiographs, the posterior tibial slope (PTS) referenced to the tibial mechanical axis (PTS-mechanical), PTS referenced to the tibial proximal anatomical axis (PTS-anatomical), and anterior tibial translation (ATT) were measured. On the sagittal slices of MRI, the medial tibial slope (MTS), medial tibial plateau (MTP) subluxation (MTPsublx), lateral tibial slope (LTS), and lateral tibial plateau (LTP) subluxation (LTPsublx) were obtained. Receiver operator characteristic (ROC) curves were constructed to compare the diagnostic performance and determine the cutoff values of different radiological parameters.

### **Results**

The study group demonstrated higher values of PTS-mechanical ( $10.7^\circ \pm 2.9^\circ$  vs  $8.7^\circ \pm 1.9^\circ$ ,  $p = 0.003$ ), PTS-anatomical ( $13.2^\circ \pm 2.8^\circ$  vs  $10.5^\circ \pm 2.5^\circ$ ,  $p < 0.001$ ), ATT ( $10.7 \pm 3.3$  mm vs  $8.9 \pm 2.2$  mm,  $p = 0.014$ ), LTS ( $9.4^\circ \pm 2.1^\circ$  vs  $5.5^\circ \pm 2.5^\circ$ ,  $p < 0.001$ ), and LTPsublx ( $8.2 \pm 2.8$  mm vs  $6.8 \pm 1.9$  mm,  $p = 0.009$ ) as compared with the control group. The area under the ROC curve of LTS was significantly larger than that of PTS-mechanical ( $p = 0.006$ ) and PTS-anatomical ( $p = 0.020$ ). Based on the maximum Youden indexes, the cutoff values of PTS-mechanical, PTS-anatomical, and LTS were  $10.1^\circ$  (sensitivity, 64.3%; specificity, 78.6%),  $12.0^\circ$  (sensitivity, 71.4%; specificity, 71.4%), and  $7.7^\circ$  (sensitivity, 85.7%; specificity, 80.4%), respectively.

### **Conclusion**

Due to the morphological asymmetry of the MTP and LTP, steep LTS measured on MRI is the best radiological predictor of ACLR failure. Detailed measurement of the LTS on MRI is recommended to evaluate the risk of ACLR failure prior to the surgery.

### **Level of evidence**

III.

## **Hydrogel-based autologous chondrocyte implantation leads to subjective improvement levels comparable to scaffold based autologous chondrocyte implantation**

Niethammer, T.R., Uhlemann, F. et al.

DOI: <https://doi.org/10.1007/s00167-022-06886-8>

### **Purpose**

Scaffold-based autologous chondrocyte implantation is a well-established treatment for cartilage defects in the knee joint. Hydrogel-based autologous chondrocyte implantation using an in situ polymerizable biomaterial is a relatively new treatment option for arthroscopic cartilage defects. It is therefore important to determine if there are significant differences in the outcomes. The aim of this study is to compare the outcomes (using subjective parameters) of hydrogel-based autologous chondrocyte implantation (NOVOCART® Inject) with the outcomes of scaffold based autologous chondrocyte Implantation (NOVOCART® 3D) using biphasic collagen scaffold.

### **Methods**

The data of 50 patients, which were paired with 25 patients in each treatment group, was analyzed. The main parameters used for matching were gender, number of defects and localization. Both groups were compared based on Visual Analogue Scale (VAS) and subjective IKDC scores, both of which were examined pre-operatively and after 6, 12 and 24 months.

### **Results**

Significant benefits in both VAS and IKDC scores after 2 years of follow-up in both groups were found. Comparing the groups, the results showed that in the hydrogel-based autologous chondrocyte implantation group, significant changes in IKDC scores are measurable after 6 months, while it takes 12 months until they are seen in the scaffold based autologous chondrocyte group.

### **Conclusion**

Hydrogel-based autologous chondrocyte and scaffold based autologous chondrocyte show comparable improvements and significant benefits to the patients' subjective well-being after a 2-year-follow-up.

### **Level of evidence**

III.



## **A high level of knee laxity after anterior cruciate ligament reconstruction results in high revision rates**

Fiil, M., Nielsen, T.G. et al.

DOI: <https://doi.org/10.1007/s00167-022-06940-5>

### **Purpose**

The literature indicates a lack of consensus on the correlation between knee laxity after anterior cruciate ligament reconstruction (ACLR) and subjective clinical outcomes and the need for revision surgery. Therefore, using high-volume registry data, this study aimed to describe the relationship between objective knee laxity after ACLR and subjective symptom and functional assessments and the need for revision surgery. The hypothesis was that greater postoperative knee laxity would correlate with inferior patient-reported outcomes and a higher risk for revision surgery.

### **Methods**

In this study, 17,114 patients in the Danish knee ligament reconstruction registry were placed into three groups on the basis of objective side-to-side differences in sagittal laxity one year after surgery: group A ( $\leq 2$  mm), Group B (3–5 mm) and Group C ( $> 5$  mm). The main outcome measure was revision rate within 2 years of primary surgery, further outcome measures were the knee injury and osteoarthritis outcome score (KOOS) as well as Tegner activity score.

### **Results**

The study found the risk for revision surgery was more than five times higher for Group C [hazard ratio (HR) = 5.51] than for Group A. The KOOS knee-related Quality of Life (QoL) sub-score exhibited lower values when comparing Groups B or C to Group A. In addition, the KOOS Function in Sport and Recreation (Sport/Rec) sub-score yielded lower values for groups B and C in comparison with Group A.

### **Conclusion**

These results indicate that increased post-operative sagittal laxity is correlated with an increased risk for revision surgery and might correlate with poorer knee-related QoL, as well as a decreased function in sports. The clinical relevance of the present study is that high knee laxity at 1-year follow-up is a predictor of the risk of revision surgery.

### **Level of evidence**

III.

## **Integration of polyurethane meniscus scaffold during ACL revision is not reliable at 5 years despite favourable clinical outcome**

Pereira, H., Cengiz, I.F. et al.

DOI: <https://doi.org/10.1007/s00167-022-06946-z>

### **Purpose**

The aim of this study was to evaluate the clinical outcome at 5-year follow-up of a one-step procedure combining anterior cruciate ligament (ACL) reconstruction and partial meniscus replacement using a polyurethane scaffold for the treatment of symptomatic patients with previously failed ACL reconstruction and partial medial meniscectomy. Moreover, the implanted scaffolds have been evaluated by MRI protocol in terms of morphology, volume, and signal intensity.

### **Methods**

Twenty patients with symptomatic knee laxity after failed ACL reconstruction and partial medial meniscectomy underwent ACL revision combined with polyurethane-based meniscal scaffold implant. Clinical assessment at 2- and 5-year follow-ups included VAS, Tegner Activity Score, International Knee Documentation Committee (IKDC), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and the Lysholm Score. MRI evaluation of the scaffold was performed according to the Genovese scale with quantification of the scaffold's volume at 1- and 5-year follow-ups.

### **Results**

All scores revealed clinical improvement as compared with the preoperative values at the 2- and 5-year follow-ups. However, a slight, but significant reduction of scores was observed between 2 and 5 years. Concerning the MRI assessment, a significant reduction of the scaffold's volume was observed between 1 and 5 years. Genovese Morphology classification at 5 years included two complete resorptions (Type 3) and all the remaining patients had irregular morphology (Type 2). With regard to the Genovese Signal at the 5-year follow-up, three were classified as markedly hyperintense (Type 1), 15 as slightly hyperintense (Type 2), and two as isointense (Type 1).

### **Conclusion**

Simultaneous ACL reconstruction and partial meniscus replacement using a polyurethane scaffold provides favourable clinical outcomes in the treatment of symptomatic patients with previously failed ACL reconstruction and partial medial meniscectomy at 5 years. However, MRI evaluation suggests that integration of the scaffold is not consistent.

### **Level of evidence**

Level IV.

## **Medial patellofemoral ligament reconstruction is superior to active rehabilitation in protecting against further patella dislocations**

Straume-Næsheim, T.M, Randsborg, P. et al.

DOI: <https://doi.org/10.1007/s00167-022-06934-3>

### **Purpose**

Isolated reconstruction of the medial patellofemoral ligament (MPFL-R) has become the predominant stabilizing procedure in the treatment of recurrent lateral patellar dislocation (LPD). To minimize the risk of re-dislocations, isolated MPFL-R is recommended in patients with no significant trochlea dysplasia and tibial tuberosity trochlear groove distance < 20 mm on computed tomography (CT). Incidentally, these criteria are the same that are used to identify first time LPD patients where conservative treatment is recommended. The purpose of this study was therefore to compare MPFL-R with active rehabilitation for patients with recurrent LPD (RLPD) in absence of the above mentioned underlying anatomical high-risk factors for further patellar dislocations.

### **Methods**

RLPD-patients aged 12–30 without underlying anatomical high-risk factors for further LPD were randomized into treatment either with isolated MPFL-R or active rehabilitation provided and instructed by a physiotherapist. All patients underwent diagnostic arthroscopy for concomitant problems. The main outcome measure was persistent patellar instability at 12 months. Knee function at baseline and 12 months was assessed using the following patient reported outcomes measures (PROMS); KOOS, Kujala, Cincinnati knee rating, Lysholm score and Noyes sports activity rating scale.

### **Results**

Between 2010 and 2019, 61 patients were included in the study (MPFL-R, N = 30, Controls, N = 31). Persistent patellar instability at 12 months was reported by 13 (41.9%) controls, versus 2 (6.7%) in the MPFL-group (RR 6.3 (95% CI 1.5–25.5). No statistically significant differences in activity level were found between the MPFL-group and the Controls at neither baseline nor follow up. The patients with persistent instability at 12 months did not score significantly lower on any of the PROMs compared to their stable peers, regardless of study group.

### **Conclusion**

Patients with recurrent patellar dislocations have a six-fold increased risk of persistent patellar instability if treated with active rehabilitation alone, compared to MPFL-R in combination with active rehabilitation, even in the absence of significant anatomical risk factors. Active rehabilitation of the knee without MPFL-R improves patient reported knee function after one year, but does not protect against persistent patellar instability.

### **Level of evidence**

I.

## **Different injury patterns exist among patients undergoing operative treatment of isolated PCL, combined PCL/ACL, and isolated ACL injuries: a study from the Swedish National Knee Ligament Registry**

Zsidai, B., Horvath, A. et al.

DOI: <https://doi.org/10.1007/s00167-022-06948-x>

### **Purpose**

To compare demographic characteristics and concomitant injury patterns in patients undergoing primary isolated posterior cruciate ligament reconstruction (PCL-R) and combined posterior cruciate ligament (PCL) and anterior cruciate ligament (ACL) reconstruction (PCL-R/ACL-R) with isolated ACL reconstruction (ACL-R) as a reference using data from the Swedish National Knee Ligament Registry (SNKLR).

### **Methods**

This cohort study based on the SNKLR comprised patients undergoing either PCL-R, ACL-R, or combined PCL-R/ACL-R between January 1, 2005 and December 31, 2019 in Sweden. Demographic and surgery-related data with regards to injury mechanism, concomitant intraarticular lesions and their treatment, neurovascular damage, and concomitant ligamentous injuries were extracted. Exclusion criteria included concomitant fractures of the femur, fibula, patella or tibia, and quadriceps or patellar tendon injury.

### **Results**

A total of 45,564 patients were included in this study. Isolated PCL-R, combined PCL-R/ACL-R, and isolated ACL-R were performed in 192 (0.4%), 203 (0.5%) and 45,169 (99.1%) patients, respectively. Sports were identified as the cause of 64% of PCL-Rs, 54% of PCL-R/ACL-Rs, and 89% of ACL-Rs, while a traffic-related mechanism was identified in 20% of PCL-Rs, 27% of PCL-R/ACL-Rs and 2% of ACL-Rs. Meniscus injury prevalence was 45% in ACL-Rs, 31% in PCL-R/ACL-Rs and 16% in isolated PCL-Rs ( $p < 0.001$ ). Cartilage injuries were more common in PCL-R (37%) and PCL-R/ACL-R patients (40%) compared to ACL-R patients (26%,  $p < 0.001$ ). Concomitant knee ligament injury was identified in 28–44% of PCL-R/ACL-R patients. Neurovascular injuries were present in 9% of PCL-R/ACL-Rs, 1% of PCL-Rs, and 0.3% of ACL-Rs ( $p < 0.001$ ).

### **Conclusion**

Differences in injury mechanisms among patient groups confirm that operatively treated PCL tears are frequently caused by both traffic and sports. Cartilage and ligament injuries were more frequent in patients with PCL-R compared to ACL-R. Consequently, combined PCL and ACL tears should raise suspicion for concomitant knee lesions with clinical relevance during the operative treatment of these complex injuries.

### **Level of evidence**

III.

## **Combined ACL and ALL reconstruction reduces the rate of reoperation for graft failure or secondary meniscal lesions in young athletes**

Laboudie, P., Douiri, A. et al.

DOI: <https://doi.org/10.1007/s00167-022-06956-x>

### **Purpose**

Graft failure and secondary meniscal tears are major concerns after anterior cruciate ligament (ACL) reconstruction in young athletes. The aim was to evaluate the link between ACL reconstruction with and without anterolateral ligament (ALL) reconstruction and outcomes in young patients participating in pivoting sports.

### **Methods**

This was a retrospective study of data collected prospectively. Patients less than 20 years, involved in pivoting sports and undergoing primary ACL reconstruction with a quadruple hamstring tendon (4HT) graft or 4HT graft combined with anterolateral ligament reconstruction (4HT + ALL) were included. Survival analysis was performed to identify the prognostic indicators for reoperation due to graft failure or secondary meniscal lesions. Knee laxity was assessed and patient reported outcome measures (PROMs) were collected.

### **Results**

A total of 203 patients (mean ( $\pm$  SD) age: 16.3  $\pm$  2 years) with a mean follow-up of 4.8  $\pm$  0.9 (range: 3.3–6.8) years were included. There were 101 4HT and 102 4HT + ALL grafts. Graft rupture rates were 11.9% for 4HT grafts and 5.8% for 4HT + ALL grafts (n.s.). There were 9.9% secondary meniscal procedures for 4HT grafts vs. 1.9% for 4HT + ALL grafts ( $p = 0.02$ ). With reoperation for graft failure or secondary meniscal lesions at final follow-up as the endpoint, survival was better in the 4HT + ALL group (91.4% vs. 77.8%, respectively;  $p = 0.03$ ). Absence of ALL reconstruction (HR = 4.9 [95%CI: 1.4–17.9];  $p = 0.01$ ) and preoperative side-to-side laxity  $> 3$  mm (HR = 3.1 [95%CI: 1.03–9.1];  $p = 0.04$ ) were independently associated with an increased rate of reoperations. Mean ( $\pm$  SD) side-to-side laxity was 1.3  $\pm$  1.3 mm (range: – 2 to 5) for 4HT grafts vs. 0.9  $\pm$  1.3 mm (range: – 6 to 4.8) for 4HT + ALL grafts (n.s.) 6 months post-surgery. The rate of return to the same sport at the same level was 42.2% for 4HT grafts vs. 52% for 4HT + ALL grafts (n.s.). There was no significant difference in subjective outcomes including PROMs between the two groups.

### **Conclusion**

Combined ALL + ACL reconstruction reduced the rate of graft failure and secondary meniscal injury in young athletes when compared to ACL reconstruction alone. Subjective results were comparable, with a similar rate of complications. Combined reconstruction should be preferred in this young population.

### **Level of evidence**

Level IV.

## **Acetabular retroversion does not affect outcome in primary hip arthroscopy for femoroacetabular impingement**

Dippmann, C., Siersma, V. et al.

DOI: <https://doi.org/10.1007/s00167-022-06918-3>

### **Purpose**

The surgical treatment of femoral-acetabular impingement syndrome (FAIS) in patients with acetabular retroversion (AR) is arthroscopical or by a reverse periacetabular osteotomy (PAO). The purpose of the present study was to investigate the results after arthroscopic treatment of FAIS in patients with and without radiographic signs of AR in a large, prospective cohort from the Danish Hip Arthroscopy Registry (DHAR). The hypothesis was there is no difference in clinical outcome between the two groups.

### **Methods**

Data on 4914 hip arthroscopies performed during 2012–2019 were obtained from DHAR. Patients with radiographic signs of osteoarthritis (Tönnis > 1), hip dysplasia (CEA < 25°), other hip pathologies or previous hip surgery were excluded. The clinical outcomes for patients with AR [defined by a positive posterior wall sign (PWS) in combination with a positive Ischial Spine Sign (ISS)] and patients without AR (no PWS, no ISS) were analyzed 1 and 2 years after surgery. The primary outcomes were the six domains of the Copenhagen Hip and Groin Outcome score (HAGOS), while secondary outcomes were the Hip Sports Activity Scale (HSAS), a visual analogue pain scale (VAS) and a numeric rating scale (NRS) for pain.

### **Results**

A total of 3135 hip arthroscopies were included, of which 339 had AR, 1876 did not, and 920 presented one of the two signs (PWS and ISS). There were no statistically significant differences 1 and 2 years after surgery (n.s.) between patients with and without AR in HAGOS domain scores, HSAS, VAS, or NRS. Both groups showed improvement at both follow-ups. The two groups did not differ in relation to intraoperative findings and the procedures they have had.

### **Conclusion**

The outcome 1 and 2 years after arthroscopic treatment of FAIS is not different for patients with and without AR.

### **Level of evidence**

III.

## **Depression and anxiety are associated with worse baseline function in hip arthroscopy patients**

Kaveeshwar, S., Rocca, M.P. et al.

DOI: <https://doi.org/10.1007/s00167-022-06963-y>

### **Purpose**

The purpose of this study was to analyze the correlation between baseline depression and anxiety and preoperative functional status in hip arthroscopy patients.

### **Methods**

A prospective, institutional review board-approved orthopaedic registry was used to retrospectively study 104 patients undergoing hip arthroscopy. Enrolled patients were administered baseline questionnaires for Patient-Reported Outcomes Measurement Information System (PROMIS) domains, Musculoskeletal Outcomes Data Evaluation and Management System (MODEMS) preoperative expectations, and Numeric Pain Scale (NPS).

### **Results**

The average baseline PROMIS Depression and Anxiety scores were  $49.9 \pm 9.8$  and  $55.5 \pm 9.3$ , respectively. Bivariate analysis demonstrated that greater baseline PROMIS Anxiety correlated with worse preoperative PROMIS PI ( $p < 0.001$ ), Fatigue ( $p < 0.001$ ), Social Satisfaction ( $p < 0.001$ ), and NPS score ( $p = 0.013$ ). Bivariate analysis showed that greater PROMIS Depression correlated with worse preoperative PROMIS PF ( $p = 0.001$ ), PI ( $p < 0.001$ ), Fatigue ( $p < 0.001$ ), SS ( $p < 0.001$ ), and NPS score ( $p = 0.004$ ). After controlling for confounders, multivariable analysis confirmed increased PROMIS Depression as an independent predictor of worse preoperative PROMIS PF ( $p = 0.009$ ), MODEMS Expectations ( $p = 0.025$ ), and NPS score ( $p = 0.002$ ). Increased PROMIS Anxiety was predictive of worse baseline PROMIS PI ( $p < 0.001$ ), Fatigue ( $p < 0.001$ ), and Social Satisfaction ( $p < 0.001$ ). A previous clinical diagnosis of depression or anxiety was only an independent predictor of worse baseline PROMIS Fatigue ( $p = 0.002$ ) and was insignificant in all other models.

### **Conclusion**

Increasing severity of depression and anxiety correlated with and predicted worse functional status at baseline in hip arthroscopy patients. As compared to clinical diagnosis of anxiety and depression, PROMIS metrics have superior utility in recognizing potentially modifiable mental health concerns that predict worse preoperative status. Ultimately, the study identifies an at-risk population undergoing hip arthroscopy that requires particular attention and potential mental health intervention in the preoperative setting.

### **Level of evidence**

III.

## **Arthroscopic modified Broström procedure achieves faster return to sports than open procedure for chronic ankle instability**

Hou, Z., Su, T. et al.

DOI: <https://doi.org/10.1007/s00167-022-06961-0>

### **Purpose**

To compare the clinical outcomes, rate of return to sports, postural control, and muscle strength between the arthroscopic and open modified Broström procedure for chronic lateral ankle instability (CLAI) patients.

### **Methods**

From September 2018 to April 2019, 70 patients diagnosed with CLAI were prospectively included with arthroscopic modified Broström procedure (n = 36) and open modified Broström procedure (n = 34). They were evaluated at five time points (preoperation and 3 months, 6 months, 1 year and 2 years postoperatively). The main results examined the rate of return to sports, American Orthopaedic Foot and Ankle Society Score (AOFAS), Foot and Ankle Ability Measure (FAAM), visual analogue scale (VAS), centre of pressure (COP) excursion velocity, time to boundary (TTB), plantar pressure, isokinetic muscle strength and complications.

### **Results**

Compared with the open group, the arthroscopic group demonstrated a significantly shorter period of return to the preinjury sport ( $13.2 \pm 2.4$  weeks vs.  $18.7 \pm 3.1$  weeks,  $P = 0.023$ ) and a higher early sport ratio (80.6 vs. 61.8%,  $P = 0.011$ ) combined with better FAAM sports and AOFAS at 3 months and 6 months postoperatively and VAS at 3 months postoperatively. In addition, better anterior–posterior postural control stability, less time to peak force under lateral hindfoot and better dorsiflexion strength were shown in the arthroscopic group at 6 months postoperatively. No significant difference was found in clinical scores, posture control or muscle strength at the 1- or 2-year follow-up between the two groups.

### **Conclusions**

Shorter period and higher rates of return to sport activities and better clinical scores, posture control and muscle strength were achieved in the arthroscopic group at 6 months postoperatively, and no clinical differences were found between arthroscopic and open modified Broström procedure 1 year or 2 years postoperatively. Arthroscopic modified Broström procedure is a reliable procedure for CLAI injuries with the demand for fast exercise recovery.

### **Clinical registration**

ChiCTR1900023999.

### **Level of evidence**

II.

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## **Miscellaneous**

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### **Hand dominance and experience improve bimanual performance on arthroscopic simulator task**

Feeley, A.A., Gibbons, J.P et al.

DOI: <https://doi.org/10.1007/s00167-022-06920-9>

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**Purpose**

The aim of this study was to identify if experience in arthroscopy confers ambidexterity to the operator and the role of baseline characteristics in arthroscopic simulator performance.

**Methods**

A prospective comparative study was carried out across four regional Orthopaedic training centres. Participants were divided into novice, intermediate or experienced groups based on arthroscopic experience. Baseline demographics including age, sex, handedness, and gaming history were also collected. Following familiarisation with the procedure, participants were asked to complete a simulated task requiring bimanual control consisting of visualisation with camera control and manipulation of highlighted objects using a grasping instrument. One attempt using camera control and grasping accuracy per hand was performed by each participant, with scores for each hand collected for analysis. Performance scores for camera alignment, camera path length, grasper path length and grasping efficiency were collected. Time taken to completion was also noted for each attempt.

**Results**

Fifty-six participants were recruited to the study. A significant difference in grasping efficiency between groups in the dominant hand was demonstrated ( $p = 0.013$ ). Novices demonstrated laterality with superior performance in grasping efficiency in the dominant hand ( $p = 0.001$ ). No significant difference was noted between dominant and non-dominant hand performance in the experienced group

**Conclusion**

Arthroscopic simulation-based training is a valuable learning tool for orthopaedic training. This study demonstrated that experienced orthopaedic surgeons have a greater degree of ambidexterity than intermediate or novice groups, hypothesised by authors to be conferred through conventional orthopaedic training. Dedicated bimanual control tasks to reduce laterality in trainees should be incorporated in simulated surgical curricula.

**Level of evidence**

III.