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Arthroscopy
Volume 36, issue 2

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BACK

Upper extremity

Arthroscopy, Volume 36, Issue 2

Normal Glenoid Ossification in Pediatric and Adolescent Shoulders Mimics Bankart Lesions: A Magnetic Resonance Imaging–Based Study

Sreetha Sidharthan, B.S., Harry G. Greditzer IV, M.D., Madison R. Heath, B.S., Joash R. Suryavanshi, B.A., Daniel W. Green, M.D., M.S., Peter D. Fabricant, M.D., M.P.H.

Arthroscopy, Volume 36, Issue 2, Received: May 6, 2019; Accepted: August 3, 2019

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Purpose
The purpose of this descriptive study was to define patterns of ossification and fusion of growth centers around the pediatric and adolescent glenoid as a function of age using 3-dimensional, frequency-selective, fat-suppressed spoiled gradient recalled echo magnetic resonance (MR) imaging sequences, with a particular focus on the anterior glenoid rim because of its clinical relevance as a potential confounder of glenohumeral instability.

Methods
Picture Archiving and Communication System records at an urban academic tertiary care orthopaedic facility from October 2005 to December 2018 were queried for shoulder MRI in patients aged 9 to 17 years. Patients were excluded if they had any diagnoses that could alter glenoid development. All images were independently evaluated by a musculoskeletal fellowship-trained radiologist. Secondary ossification centers were characterized as cartilage anlage, ossified, or fused at 3 anatomic sites: the anterior glenoid rim, coracoid, and superior glenoid rim.

Results
A total of 250 MR examinations (143 males, 107 females) were assessed in this study. The glenoid develops in a predictably sequential manner with ossification at the anterior glenoid rim lagging behind the coracoid and superior glenoid rim. The earliest age of anterior glenoid rim ossification was 11 years for both males (range 11-17) and females (range 11-12). Anterior glenoid rim ossification peaked at age 16 among males (34.8%, 8/23) and age 11 among females (27.3%, 3/11).

Conclusions
Glenoid ossification and fusion progress in a predictable and chronological manner. This pattern should be used as a guideline when interpreting pediatric shoulder MRI examinations. In particular, an anterior glenoid ossification center should not be confused with an anterior glenoid injury (e.g., Bankart lesion), particularly in males 11 to 17 years old and females 11 to 12 years old.

Level of Evidence
IV (case series).

BACK

Prevention of Perioperative Hypothermia: A Prospective, Randomized, Controlled Trial of Bair Hugger Versus Inditherm in Patients Undergoing Elective Arthroscopic Shoulder Surgery

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Purpose
To determine if a clinically significant difference in the core body temperature (CBT) exists between the Bair Hugger (BH) and Inditherm (IT) warming devices in patients undergoing arthroscopic shoulder surgery.

Methods
This was a parallel, 2-treatment, prospective, randomized, controlled trial conducted in patients undergoing elective arthroscopic shoulder surgery in the beach-chair position using room-temperature irrigation fluid. The BH was used as the indicative forced-air warming device, whereas the IT served as the indicative resistive heating system. By use of a minimal clinically significant difference of 0.6°C and standard deviation of 0.6°C, a power analysis showed that a sample size of 90 patients (45 per group) would be required. Patients fulfilling the inclusion criteria were recruited from the clinics of the senior authors. Anesthetic and surgical protocols were standardized. The intraoperative CBT was recorded every 5 minutes using a nasopharyngeal thermistor probe. Demographic data as well as the volume of irrigation fluid used were also noted.

Results
A steady decline in the CBT was observed in both groups up to 30 minutes after induction of anesthesia. Beyond 30 minutes, the BH group showed a gradual increase in temperature whereas it continued to decline in the IT group. A statistically significant difference in the CBT was observed from 60 minutes onward ($P = .025$). This difference continued to increase up to 90 minutes ($P < .001$). At no time was a rise in the CBT observed in the IT group. At completion of the study and surgical procedure, 13 of 47 patients in the BH group and 32 of 44 patients in the IT group had hypothermia ($P = .0002$).

Conclusions
The CBT was statistically significantly better with the use of the BH compared with the IT mattress. However, the differences in the CBT did not reach the level of clinical significance of 0.6°C. Far fewer patients in the BH group had hypothermia at the end of surgery. Therefore, this study supports the use of the BH in elective arthroscopic shoulder surgery for the prevention of hypothermia.

Level of Evidence
Level I.

BACK

Biomechanical Effect of Superior Capsule Reconstruction Using a 3-mm and 6-mm Thick Acellular Dermal Allograft in a Dynamic Shoulder Model

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Arthroscopy, Volume 36, Issue 2, Received: January 5, 2019; Accepted: August 9, 2019

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Purpose
To biomechanically compare the effect of superior capsule reconstruction (SCR) using a 3- and 6-mm thick acellular dermal allograft for the treatment of irreparable rotator cuff tears.

Methods
Eight fresh-frozen cadaveric shoulders were tested using a dynamic shoulder model. Maximum abduction angle (MAA), glenohumeral superior translation (ghST), subacromial peak contact pressure (sPCP), and cumulative deltoid force (cDF) were compared among 4 conditions: (1) intact shoulder, (2) simulated irreparable rotator cuff tear (RCT), (3) SCR using a 3-mm-thick acellular dermal allograft, (4) SCR using a 6-mm-thick acellular dermal allograft.

Results
Compared with the intact state, simulated irreparable RCTs significantly decreased MAA ($P < .001$), while significantly increasing ghST ($P = .001$), sPCP ($P < .001$), and cDF ($P < .001$). SCR with a 3-mm-thick graft significantly increased MAA ($P = .01$) and decreased ghST ($P = .01$) compared with the RCT state, however, showed similar sPCP and cDF. Compared with the torn state, SCR with a 6-mm-thick graft significantly increased MAA ($P < .001$) and significantly decreased ghST ($P < .001$), sPCP ($P < .001$), and cDF ($P = .001$). Using a 6-mm-thick graft demonstrated similar MAA, ghST, sPCP, and cDF compared with the intact state. When comparing the 3-mm to the 6-mm thick graft, significant differences were found in ghST ($P = .03$), sPCP ($P < .001$), and cDF ($P = .02$).

Conclusions
SCR with a 6-mm-thick acellular dermal allograft better restored normal glenohumeral joint position and forces compared with a 3-mm-thick graft for the treatment of irreparable RCTs.

Clinical Relevance
Graft thickness may affect the clinical success following SCR with commercially available dermal allografts. Using a thicker (>3 mm) graft was able to biomechanically better restore native glenohumeral joint properties.

BACK

Risk of Revision Shoulder Surgery, Complications, and Prolonged Opioid Use in Patients Undergoing Shoulder Arthroscopy Who Have Previously Undergone Anterior Cervical Discectomy and Fusion

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Arthroscopy, Volume 36, Issue 2, Received: March 12, 2019; Accepted: August 14, 2019

https://doi.org/10.1016/j.arthro.2019.08.037

Purpose
To compare postoperative complications, rates of revision, and opioid use of those who undergo shoulder arthroscopy with and without previous anterior cervical discectomy and fusion (ACDF).

Methods
The PearlDiver database from 2007 to 2017 was used to query all patients who underwent shoulder arthroscopy as determined by Current Procedural Terminology (CPT). Patients were then separated among those who had a previous instance of ACDF and those who did not as filtered by CPT. Postoperative complications within 30 days, readmission rates, opioid use, and revision procedures were assessed for each cohort using a mix of International Classification of Diseases Ninth and Tenth Revision Clinical Modification codes, CPT, as well as generic drug codes.

Results
A total of 91,029 patients undergoing shoulder arthroscopy were identified, of whom 1,267 (1.4%) had a history of ACDF. Compared with patients without previous ACDF, patients with a history of ACDF had significantly greater respiratory complication rates (1.3% vs 0.5%: adjusted odds ratio [aOR] 2.16, 95% confidence interval [CI]1.30-3.59, P = .003), 30-day complication rates (3.7% vs 2.2%: aOR 1.48, 95% CI 1.10-1.99, P = .011), 1-year revision rates (15.2% vs 7.7%: aOR 2.00, 95% CI 1.71-2.33, P < .0001), and greater opioid use at 1 month, 3 months, 6 months, and 12 months (P < .0001).

Conclusions
This study revealed that patients who undergo shoulder arthroscopy with a history of ACDF are twice as likely to undergo revision arthroscopy within 2 years of surgery and are at an increased risk of complications within 30 days postoperatively as well as prolonged opioid use compared with those without a history of ACDF. With these findings, both spine and shoulder surgeons should aim to be more aware of surgical history, especially of the cervical spine, to better counsel patients' clinical course and expected outcomes following shoulder arthroscopy.

Level of Evidence
III, retrospective cohort study.

BACK

Superior Capsular Reconstruction for the Operatively Irreparable Rotator Cuff Tear: Clinical Outcomes Are Maintained 2 Years After Surgery

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Arthroscopy, Volume 36, Issue 2, Received: March 13, 2019; Accepted: August 19, 2019

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Purpose
To evaluate the results of arthroscopic superior capsular reconstruction (SCR) after 2-year minimum follow-up and to compare the results with those seen in a previously studied group of patients at 1 year postoperatively.

Methods
The retrospective study period was October 2014 through September 2016. Inclusion criteria were arthroscopic dermal allograft SCR performed for operatively irreparable posterosuperior rotator cuff tear with intact or repairable subscapularis tendon, failure of nonoperative treatment, and clinical follow-up at 1 and minimum 2 years postoperatively. Patients lost to follow-up or undergoing revision of the SCR were excluded from the analysis. The primary outcome measure was American Shoulder and Elbow Surgeons (ASES) score (mean, [95% confidence interval], P value). Secondary outcomes included visual analog pain rating (0-10), subjective shoulder value, and active forward elevation and external rotation (degrees). Radiographic analysis included acromiohumeral interval (millimeters) and graft integrity 1-year postoperation. Complications and reoperations were reviewed from the medical record.

Results
Forty-one patients met inclusion criteria at mean 34 months postoperatively, and 8 were excluded. ASES score improved from 52 (46-57) preoperative to 90 (87-92; P < .0001) and 89 (86-92; P < .0001) at 1-year postoperation and at final follow-up without diminishing in the interim (P = .9). All secondary clinical outcomes improved from preoperative to final follow-up. Subjective shoulder value diminished 5% between 1 year and final follow-up (P = .03), whereas active external rotation improved 11° during this time (P = .02). In total, 85% of grafts were fully healed, with acromiohumeral interval improved from 7 (6-8) mm to 8 mm (7-9; P = .04). There were 2 (5%) revisions and 6 (14%) failures to reach the minimally clinically important improvement in ASES score: a 19% rate of unsatisfactory outcomes. There was an additional 1 reoperation (2%) and 1 (2%) medical complication.

Conclusions
Arthroscopic joint preservation surgery for massive, operatively irreparable posterosuperior rotator cuff tears with dermal allograft SCR and associated procedures results in improved clinical outcomes that are durable between 1 and minimum 2-year follow-up.

Level of Evidence
IV retrospective case series.

BACK

The 5-Factor Modified Frailty Index Predicts Complications, Hospital Admission, and Mortality Following Arthroscopic Rotator Cuff Repair

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Introduction
The purpose of this study is to evaluate the utility of the modified frailty index-5 (mFI-5) as a predictor for postoperative complications in patients undergoing arthroscopic rotator cuff repair (RCR).

Methods
The National Surgical Quality Improvement Program database was queried for patients undergoing arthroscopic RCR between 2006 and 2016. The mFI-5, a 5-factor score comprising comorbid diabetes, hypertension, congestive heart failure, chronic obstructive pulmonary disease, and functional status limiting independence, was calculated for each patient. Multivariate logistic regression models were used to evaluate the mFI-5 score as a predictor for complications including medical complications, surgical-site infections, hospital admission, discharge to a facility, and mortality.

Results
In total, 24,477 patients met criteria for inclusion. The mFI-5 was a strong predictor for medical complications ($P < .001$), hospital admission ($P < .001$), length of stay ($P = .007$), and discharge to a facility ($P = .001$) but not surgical-site infections ($P = .153$). For each point increase in mFI-5 score, the risk for a medical complication increased by 66%, readmission by 52%, and adverse discharge by 45%. However, of all the measured complications, the mFI-5 was the strongest predictor for mortality, with the risk more than doubling for each increase in mFI-5 point (odds ratio 2.66, $P = .025$).

Conclusions
The mFI-5 is a sensitive tool for predicting life-threatening medical complications, hospital admission, increased length of stay, adverse discharge, and mortality following arthroscopic RCR. The 5 comorbidities comprising the mFI-5 are easily obtained through the patient history, making it a practical clinical tool for identifying high-risk patients, informing preoperative counseling, and improving value-based health care.

Level of Evidence
Level III, prognostic.

BACK

A Comparison of Open-Construct PEEK Suture Anchor and Non-Vented Biocomposite Suture Anchor in Arthroscopic Rotator Cuff Repair: A Prospective Randomized Clinical Trial

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Purpose
To compare radiologic bone ingrowth and the clinical outcomes of an open-construct (PEEK) (polyether ether ketone) suture anchor with those of a non-vented biocomposite suture anchor in patients with arthroscopic rotator cuff repair.

Methods
Sixty-nine patients were randomly allocated into 2 groups based on type of suture anchors used for rotator cuff repair; group 1: open-construct PEEK anchor (36 patients), group 2: non-vented biocomposite anchor (33 patients). The status of bone ingrowth into the anchor and the presence of cyst formation were evaluated at 6 months postoperatively by computed tomography scan using the Modified Barber's ossification scale. The American Shoulder and Elbow Surgeons score, Constant score, and visual analog scale score for pain and range of motion were evaluated. Magnetic resonance imaging or ultrasonography was performed at 12 months postoperatively to examine the integrity of the repaired rotator cuff tendon.

Results
Significant improvements in shoulder function and pain relief were observed regardless of the anchor used (both Group 1 and 2; $P < .001$). No differences were found in functional scores and range of motion between the 2 groups. Group 1 showed better bone ingrowth grades than group 2 (poor 2.8 vs 24.2%, fair 27.8 vs 39.4%, good 38.9 vs 33.3%, and excellent 30.6 vs 3.0%; $P < .001$). The rate of cyst formation around the anchor on the 6 months' postoperative computed tomography (group 1: 14% and group 2: 12%) and re-tear rate at 12 months (5% each) showed no difference between the 2 groups.

Conclusions
Shoulder function was improved after complete rotator cuff repair and similar clinical outcomes were achieved regardless of suture anchor material and shape. However, the open-construct PEEK anchor provided better bone ingrowth into the anchor than the non-vented biocomposite anchor at 6 months after arthroscopic rotator cuff repair.

Level of Evidence
Level I; Prospective Randomized Trial

BACK

The Effect of Glenohumeral Fixation Angle on Deltoid Function During Superior Capsule Reconstruction: A Biomechanical Investigation

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Purpose
To evaluate the effect of dermal allograft fixation at different angles of glenohumeral abduction on deltoid forces during superior capsule reconstruction (SCR).

Methods
Fifteen cadaveric specimens were tested using a dynamic shoulder simulator. Following testing in the native state, shoulders underwent SCR in 2 of 5 possible fixation angles; 0°, 15°, 30°, 45°, or 60° of glenohumeral abduction, allowing for 6 specimens per group. Angles were measured radiographically with the glenoid fixed perpendicular to the floor. Maximum mean deltoid abduction force was compared among 5 separate conditions within each angle group: (1) native shoulder, (2) complete supraspinatus (SSP) and superior capsule tear, (3) SCR alone, (4) SCR with posterior margin sutured, and (5) SCR with anterior and posterior margins sutured.

Results
SSP tears significantly increased the maximum deltoid forces for all 5 fixation angles compared with the native state ($P < .05$). Specimens repaired at 0°, 30°, and 45° were unable to restore deltoid forces compared with the native state in any condition ($P < .05$). SCR at 15° with anterior and posterior margin convergence showed similar abduction forces compared with the native state ($P = .19$). When fixed at 60° abduction, SCR alone significantly reduced deltoid forces compared to SSP (Δ143N, $P < .001$) and native (Δ48N, $P < .001$). No significant differences were found between the 3 repair subtypes (SCR ± anterior/posterior margin repair) in the 60° group.

Conclusions
SCR with anterior and posterior margin convergence tensioned at 15° of glenohumeral abduction showed similar deltoid abduction force requirements compared with the native state, whereas graft fixation in 60° significantly reduced deltoid force in all SCR conditions.

Clinical Relevance
Increased graft tension with a greater abduction angle may provide greater functional outcome by placing less load on the deltoid. In contrast, graft fixation in lower abduction angles may require additional margin convergence to reproduce native forces.

BACK

Preoperative Diagnostic Rates and Clinical Outcomes After Arthroscopic Stabilization Procedures for Panlabral Tear of the Glenohumeral Joint

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Purpose
To evaluate preoperative diagnostic rates for panlabral tear using imaging studies or physical examinations and to evaluate clinical outcomes after arthroscopic stabilization procedures with 2 different patient surgical positions.

Methods
Patients who underwent arthroscopic stabilization for recurrent anterior shoulder instability with panlabral tear and were followed up for at least 2 years were included. A panlabral tear was defined as labral tear involving at least 270° of the glenoid surface on arthroscopic examination. All patients underwent preoperative magnetic resonance (MR) imaging or MR arthrography and physical examinations including anterior apprehension, posterior jerk, and compressive rotation tests. The clinical outcomes were assessed by the American Shoulder and Elbow Surgeons, Rowe, and visual analog scale for pain scores, and recurrence rate. According to patient position during surgery, patients were divided into group I (beach chair position) and group II (lateral decubitus position).

Results
Forty-eight patients (24 in group I and 24 in group II) were enrolled. Preoperative MR imaging or MR arthrography detected only 18.8% of panlabral tears. No patient had positive findings on all 3 physical examination tests for panlabral tear. Clinical outcomes were significantly improved after operation (American Shoulder and Elbow Surgeons score: 58.4 ± 6.2 preoperatively, 85.2 ± 6.4 at the final, $P < .001$; Rowe score: 49.0 ± 12.2 preoperatively, 86.8 ± 9.1 at the final, $P < .001$) and postoperative recurrence was occurred in 1patient (2%). No differences were found in clinical outcomes and recurrence rate (4% vs 0%) according to patient positioning, despite the larger number of suture anchors used in group II (6.2 ± 1.5 in group I, 7.6 ± 1.1 in group II, $P < .001$).

Conclusions
It remained difficult to preoperatively diagnose panlabral tear using standard physical examinations and imaging studies. Nevertheless, arthroscopic stabilization procedures for patients with panlabral tear provided satisfactory clinical outcomes with a low recurrence rate. Patient position during surgery did not alter clinical outcomes and recurrence rate, despite the use of different numbers of suture anchors.

Level of evidence
Level III, Retrospective comparative therapeutic trial

BACK

Safety of Arthroscopic Versus Open or Combined Heterotopic Ossification Removal Around the Elbow

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Purpose
To analyze the complications of arthroscopic heterotopic ossification (HO) excision and compare them with those of open removal of HO or a combined open-arthroscopic approach.

Methods
We performed a retrospective review of elbow HO removal cases performed by a single surgeon from 1997 to 2014. In all cases studied, the intention was to restore range of motion owing to the presence of HO causing functional impairment. The arthroscopic, open, and combined treatment groups were compared.

Results
The study cohort consisted of 223 surgical procedures performed on 213 elbows in 211 patients. Fifty major complications occurred in 46 cases (21%): 17 hematomas (8%) treated by irrigation and debridement, 8 cases of HO requiring reoperation (4%), 7 deep infections (3%), 4 contractures (2%), 3 cases of delayed-onset ulnar neuritis (1%), 2 cases of distal humeral avascular necrosis (1%), 2 tendon ruptures (1%), 2 cases of instability requiring reconstruction (1%), 2 postoperative fractures (1%), 1 intraoperative fracture (<0.5%), 1 case of worsening of pre-existing neuropathic pain (<0.5%), and 1 permanent partial posterior interosseous nerve injury (<0.5%). Of these 46 cases, the major complications occurred in 6 of the 41 (15%) performed arthroscopically, in 36 of the 158 (23%) performed open and in 4 of the 21 (17%) with combined (i.e. open + arthroscopic) HO removal. Preventive strategies, introduced to prevent hematomas and delayed-onset ulnar neuritis, reduced the rate of major complications from 35% during the period from 1997 to 2005 to 10% during the period from 2006 to 2014 ($P < .0001$). Moreover, the rate of reoperations was reduced from 34% to 10% in the same periods ($P < .0001$). Minor complications occurred in 36 cases (16%), including 17 cases of transient nerve palsy, 9 cases of superficial infection or delayed wound healing, 6 cases of mild instability, and 4 cases of hematoma resolved by aspiration.

Conclusions
The use of arthroscopy—or a combination of arthroscopic and open techniques—to remove HO around the elbow by a surgeon skilled in both arthroscopic and open elbow surgery does not increase the risk of major complications or need for reoperation compared with traditional open surgery. Preventive strategies, such as avoiding raising skin flaps by using multiple separate incisions for open and prophylactic ulnar nerve decompression in arthroscopic cases, were developed during the study period. These strategies were monitored prospectively and found to be effective in preventing two-thirds of the major complications needing reoperation with both open and arthroscopic HO removal.

Level of Evidence
Level III, retrospective comparative study of prospectively collected data.

BACK

Case Series of All-Arthroscopic Treatment for Terrible Triad of the Elbow: Indications and Clinical Outcomes

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Purpose
To evaluate the results of all-arthroscopic treatment of the terrible triad of the elbow, a combination of elbow dislocation, radial head dislocation, and coronoid process fracture, and its complications.

Methods
We performed a retrospective review of consecutive patients with terrible triad who underwent all-arthroscopic treatment between January 2011 and December 2016. All-arthroscopic treatment was performed in the unstable elbows after manual reduction. Clinical evaluation was performed at least 2 years postoperatively. Patients with another fracture in the upper extremity and previous fracture of the affected elbow were excluded. A radial head fracture that was stable enough to reduce or involved less than 25% of the articular surface for partial excision and Regan-Morrey classification type I and type II coronoid process fractures were treated arthroscopically. Range of motion, radiologic outcomes, surgical complications, and the Mayo Elbow Performance Score were evaluated at the final follow-up. The Mann-Whitney test was used for statistical analysis.

Results
A total of 24 patients met the inclusion criteria, and the average age was 47.6 years. Coronoid process fractures were fixed in all patients, by use of Kirschner wires in 15 (62.5%) and pullout sutures in 9 (37.5%). Radial head fractures were treated using screw or K-wire fixation in 4 patients (16.7%); only the fragment of the fracture was resected in 11 patients (45.8%). In all 24 cases (100%), the lateral collateral ligaments were repaired. At the final follow-up, the mean flexion contracture angle was 4.8° ± 1.1° and the mean flexion angle was 132.5° ± 6.3°. Clinical scores were satisfactory, with a mean Mayo Elbow Performance Score of 93 points. However, nonunion of coronoid fractures was observed in 4 patients (16.7%). There was 1 case of pin-site irritation.

Conclusions
All-arthroscopic treatment for the terrible triad can provide an excellent safety profile without the need for a large incision if the indications are met.

Level of Evidence
Level IV, therapeutic case series.

BACK

The Critical Shoulder Angle Shows a Reciprocal Change in Magnitude When Evaluating Symptomatic Full-Thickness Rotator Cuff Tears Versus Primary Glenohumeral Osteoarthritis as Compared With Control Subjects: A Systematic Review and Meta-analysis

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Purpose
To determine whether a high critical shoulder angle (CSA) is associated with symptomatic full-thickness rotator cuff (RC) tears and/or whether a low CSA is associated with primary glenohumeral osteoarthritis (GHOA).

Methods
A systematic review was performed following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. All observational studies that examined an association between CSA and full-thickness RC tears and/or primary GHOA were included. A primary meta-analysis was performed including all studies that met the inclusion criteria regardless of radiographic quality. A secondary meta-analysis was performed to explore the hypothesis that radiographic quality was a source of heterogeneity, which excluded those studies in which radiograph quality was not strictly defined and controlled.

Results
For the primary meta-analysis, 11 studies met the inclusion criteria for RC tears and 5 for primary GHOA. The CSA was greater in the RC tear group than the control group (mean difference 4.03°, 95% confidence interval 2.95°-5.11, 95% prediction interval 0.0487°-8.01°; $P < .001$). The CSA was lower in the GHOA group than the control group (mean difference –3.98°, 95% confidence interval –5.66° to –2.31°, 95% prediction interval –10.2° to –2.19°; $P < .001$).A high level of heterogeneity was observed in the RC tear analysis ($I2 = 88.4$), which decreased after the exclusion of 5 studies based on radiographic quality ($I2 = 75.3$). A high level of heterogeneity also was observed in the primary GHOA analysis ($I2 = 87.3$), which decreased after the exclusion of 2 studies based on the radiographic quality ($I2 = 48.2$).

Conclusions
There is a reciprocal change in magnitude of the CSA when evaluating symptomatic full-thickness RC tears versus primary GHOA as compared with control subjects. Radiographic quality is a source of heterogeneity in studies that investigate a link between CSA and RC tears and primary GHOA.

Level of evidence
Level III, systematic review and meta-analysis of Level III studies.

BACK

Fascia Lata Autograft Versus Human Dermal Allograft in Arthroscopic Superior Capsular Reconstruction for Irreparable Rotator Cuff Tears: A Systematic Review of Clinical Outcomes

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Purpose
To determine the clinical outcomes of arthroscopic superior capsular reconstruction (ASCR) using either fascia lata autograft or human dermal allograft for irreparable rotator cuff tears (IRCTs).

Methods
A systematic review was performed according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) guidelines by searching the MEDLINE, Embase, and Cochrane Library databases through January 31, 2019. The inclusion criteria were as follows: 5 or more consecutive patients who underwent ASCR for IRCTs; clinical outcome measures reported at a minimum follow-up of 12 months; and magnetic resonance imaging assessment at a minimum follow-up of 6 months. The methodologic quality was evaluated using the Methodological Index for Non-randomized Studies (MINORS). A narrative synthesis of data was performed. Mean outcome improvements were compared with minimal clinically important differences.

Results
We identified 7 eligible studies that included 344 shoulders in 338 patients who underwent ASCR for IRCTs (all Level IV studies). The mean MINORS score was 12.3 ± 1.60. Of the 7 studies, 5 had a high risk of bias (MINORS score ≤12): 2 studies using only fascia lata autograft and 3 studies using only human dermal allograft. The mean age of patients ranged from 59.4 to 66.9 years. The mean follow-up time ranged from 12 to 48 months. All studies reported statistically significant and clinically important mean improvements in active elevation (range of means, 28°-56°), the Constant score (range of means, 12-47.1 points), or the American Shoulder and Elbow Surgeons score (range of means, 29.3-56 points). In total, 218 shoulders underwent postoperative magnetic resonance imaging. The graft tear rate reported in studies using fascia lata autograft (181 shoulders) ranged from 5% to 32%, whereas the values reported in studies using human dermal allograft (37 shoulders) ranged from 20% to 75%.

Conclusions
ASCR using either fascia lata autograft or human dermal allograft leads to significant and clinically important improvements in clinical outcomes in IRCT patients at 12 months or later.

Level of Evidence
Level IV, systematic review of Level IV studies

BACK

Journal of Shoulder and Elbow Surgery (JSES), Volume 29, issue 2

The clinical and radiologic outcome of microfracture on arthroscopic repair for full-thickness rotator cuff tear

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DOI: https://doi.org/10.1016/j.jse.2019.07.010

Background
The persistent incidence of retear despite improvements in techniques led orthopedic surgeons to the application of principles of tissue bioengineering to achieve enhanced repair and functional outcomes. The purpose of this study was to compare clinical and radiologic outcomes of arthroscopic single-row repair augmented with microfracture (SRM) at the greater tuberosity with single-row (SR) and double-row (DR) repair in the treatment of full-thickness rotator cuff tears.

Materials and methods
This is a retrospective comparative study. A total of 123 patients were enrolled for arthroscopic repair of full-thickness rotator cuff tears, with 40 patients treated by SR, 44 by SRM, and 39 by DR. The minimum follow-up was 2 years. The primary outcome was retear rate, which was detected by magnetic resonance imaging, and the secondary outcome was functional outcome.

Results
The mean age of the patients was 59.2 years, 58.1 years, and 60.6 years in the SR, SRM, and DR groups, respectively. The retear rate was 33%, 14%, and 36% in the SR, SRM, and DR groups, respectively (P = .045). The SRM group had significantly improved functional outcomes compared with the SR and DR groups in terms of the postoperative Constant score and visual analog scale score (P = .001 and .002, respectively). Delta Constant scores were nonsignificant for retear and intact tendons (P = .137).

Conclusion
SRM has a significantly lower retear rate and better functional outcome than SR and DR repair.

Levels of evidence:
Level III, Retrospective Cohort Design, Treatment Study

BACK

A retrospective cohort analysis of arthroscopic Bankart repair with or without remplissage in patients with off-track Hill-Sachs lesion evaluated for functional outcomes, recurrent instability, and range of motion

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Background
Lone Bankart repair is associated with high rates of recurrence, especially in off-track Hill-Sachs (HS) lesion. The objective of the study was to assess the impact of remplissage in off-track HS lesion influencing the rate of redislocation and range of motion (ROM) of the shoulder.

Material and method
We retrospectively reviewed 136 patients for arthroscopic Bankart repair without remplissage (group 1, n = 77) or with remplissage (group 2, n =59) for recurrent anterior dislocation of the shoulder with glenoid bone loss of <25%. Further subgroups of on- and off-track HS lesion were based on computed tomographic assessment. At a minimum follow-up of 2 years; patients were evaluated for functional scores (Rowe, Constant-Murley, Western Ontario Shoulder Instability Index), redislocations, and ROM.

Results
At a mean follow-up of 54 and 44 months in group 1 and 2, respectively, there was no difference in postoperative functional scores. There were significantly more dislocations in patients with Bankart repair with off-track lesion than in patients with Bankart repair with on-track lesion (P = .02). There were significantly fewer redislocations in patients with off-track lesion who underwent Bankart repair and remplissage than in those who did not undergo remplissage (P = .0007). Compared with group 1 patients, those in group 2 revealed a statistically significant loss of ROM.

Conclusions
Although a nonremplissaged off-track HS lesion remains an important risk factor for recurrent instability, remplissage also results in significant loss of shoulder ROM compared with those who do not undergo remplissage.

Level of evidence:
Level III, Retrospective Cohort Design, Treatment Study

BACK

The arthroscopic triple-row modified suture bridge technique for rotator cuff repair: functional outcome and repair integrity

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Background
The optimal technique for arthroscopic rotator cuff repair is still controversial. Large tears with a high grade of retraction have an especially high risk of retearing. This study reports the clinical and radiologic results of a triple-row modified suture bridge technique for the treatment of full-thickness rotator cuff tears with medium and high grades of retraction.

Methods
A total of 101 shoulders in 100 patients underwent a triple-row modified suture bridge reconstruction for full-thickness rotator cuff tears with retraction grade II and grade III according to Patte; 81 patients were reached for follow-up 36.2 months after surgery. At follow-up, clinical outcome was assessed by the American Shoulder and Elbow Surgeons score, subjective shoulder value, visual analog scale score, University of California–Los Angeles shoulder score, and Constant score (CS). At follow-up, an ultrasound examination was performed to determine tendon integrity or retears in all patients.

Results
The overall retear rate was 4.9% (4/81). The clinical outcome was good to excellent (American Shoulder and Elbow Surgeons score, 94 ± 11; subjective shoulder value, 92 ± 12; University of California–Los Angeles shoulder score, 33 ± 5; Constant score, 90 ± 9). In the radiologic follow-up, no retear was found in any of the follow-up patients after an average of 36.2 months. There was no significant difference in clinical outcome parameters between rotator cuff tears Patte II and Patte III ($P > .05$).

Conclusion
For tears with a high grade of retraction, surgical treatment using a triple-row modified suture bridge technique represents a good treatment option with a low rate of retearing and good to excellent clinical results.

Level of evidence:
Level IV, Case Series, Treatment Study

BACK

Lower Extremity

Arthroscopy, Volume 36, Issue 2

Return to Play in Amateur Soccer Players Undergoing Hip Arthroscopy: Short- to Mid-Term Follow-Up

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Arthroscopy, Volume 36, Issue 2, Received: January 14, 2019; Accepted: August 9, 2019

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Purpose
To describe patient-reported outcomes (PROs) and return to play at any level in amateur soccer players undergoing hip arthroscopy for femoroacetabular impingement syndrome at short- to mid-term follow-up.

Methods
Data were prospectively collected and retrospectively reviewed for patients who underwent hip arthroscopy between March 2009 and June 2014. Patients who participated in amateur soccer within 1 year prior to surgery and intended to return to their sport after hip arthroscopy for femoroacetabular impingement syndrome were considered for inclusion in our study. Patients were excluded if they had a preoperative Tönnis osteoarthritis grade of 2 or greater, previous ipsilateral hip conditions or hip surgical procedures, or Workers' Compensation status. The patients from the initial group who had preoperative and minimum 2-year postoperative measures for the modified Harris Hip Score, Non-Arthritic Hip Score, Hip Outcome Score–Sports Specific Subscale, and visual analog scale for pain were included in our final group. In addition to PROs, data regarding the patients' return to soccer, surgical complications, and secondary surgical procedures were collected.

Results
A total of 41 patients were eligible for inclusion in our study, of whom 34 (82.9%) had a mean follow-up period of 47.4 months. Five patients were not eligible because they did not intend to return to soccer. There were 15 male hips (44.1%) and 19 female hips (55.9%). The mean age at surgery was 20.8 ± 7.4 years. All PROs and the visual analog scale score improved significantly from preoperatively to latest follow-up. Of the 34 patients, 27 (79.4%) returned to soccer. Of the patients who returned to soccer, 19 (70.4%) were competing at the same level or a higher level compared with their highest level within 1 year of surgery. Regardless of competitive level, 21 patients (77.8%) reported that their athletic ability was the same as or higher than it was within 1 year of surgery.

Conclusions
Hip arthroscopy was associated with significant improvements in PROs for amateur soccer players. There was a high level of return to soccer and a high proportion of patients whose competitive level was similar or improved. As such, hip arthroscopy is a good option for soccer players, in the absence of underlying osteoarthritis, presenting with hip pathology.

Level of Evidence
Level IV, case series.

BACK

The Reduction of Heterotopic Ossification Incidence After Hip Arthroscopy in Patients Treated With Selective Cyclooxygenase 2 Inhibitor (Celecoxib)

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Arthroscopy, Volume 36, Issue 2, Received: August 29, 2018; Accepted: August 15, 2019

https://doi.org/10.1016/j.arthro.2019.08.034

Purpose
To evaluate the effectiveness of celecoxib, a selective cyclooxygenase 2 inhibitor, in reducing heterotopic ossification (HO) after hip arthroscopic surgery and to evaluate celecoxib's impact on clinical outcomes.

Methods
We performed a retrospective review of patients who received hip arthroscopy performed by the same surgeon between January 1, 2012, and December 31, 2016. Patients who had an allergy to sulfa drugs, had pre-existing HO or previous surgery on the operative side, or failed to complete radiographic follow-up at 6 months postoperatively were excluded. Patients in the treatment group received 400 mg of celecoxib postoperatively for 6 weeks, whereas the control group received no postoperative celecoxib. The incidence of HO was assessed using anteroposterior radiographs obtained at 6 months, 1 year, and 2 years postoperatively. Patients completed the International Hip Outcome Tool 33 survey, and the proportion of patients who met the minimal clinically important difference, substantial clinical benefit (SCB), and absolute SCB was calculated.

Results
A total of 559 patients were identified. After application of the exclusion criteria, 454 patients were included in the study (211 in control group and 243 in treatment group). The overall incidence of HO was 20.3% (n = 92). The treatment group had a significantly lower incidence of HO at 6 months ($P = .006$), 1 year ($P < .001$), and 2 years ($P = .008$) postoperatively. At 2 years postoperatively, the treatment group had a significantly higher International Hip Outcome Tool 33 score on average: 64.2 versus 57.3 ($P = .023$). No significant difference in the proportion of patients reaching the minimal clinically important difference, SCB, or absolute SCB was found at any of the postoperative time points.

Conclusion
The findings of this study suggest that a prophylactic treatment regimen of 400 mg of celecoxib once daily for 6 weeks significantly reduces the incidence of HO formation after hip arthroscopic surgery; however, it did not impact clinical outcomes.

Level of Evidence
Level III, retrospective, comparative case-control study.

BACK

Arthroscopic Treatment of Acute Septic Arthritis of the Hip Joint in Pediatric Patients Aged 10 Years or Younger

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Arthroscopy, Volume 36, Issue 2, Received: March 6, 2019; Accepted: August 19, 2019

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Purpose
To present the results of arthroscopic treatment of acute septic arthritis of the hip joint in children aged 10 years or younger.

Methods
Patients with a minimum follow-up period of 2 years who underwent arthroscopic treatment (anterolateral and medial subadductor 2-portal approach) of acute septic arthritis of the hip joint between January 2014 and January 2017 were included in this retrospective case-series study. The exclusion criteria included fungal infection, late presentation (≥5 days after the onset of the symptoms), presence of concomitant osteomyelitis, osseous pathologic conditions on radiography suggesting osteomyelitis, immunocompromised condition, history of surgery or infection surgery from the affected extremity, immobility owing to neuromuscular pathologic conditions, and identification of inflammatory or reactive arthritis during follow-up. The diagnosis of septic arthritis was confirmed according to the Waldvogel criteria. Clinical outcomes were assessed according to the Bennett score and Harris Hip Score.

Results
We evaluated 15 hips in 15 patients (6 female and 9 male patients) with a mean age of 5.2 years (range, 2-10 years) in this study. The mean hospital stay was 4.2 days (range, 3-7 days), and the mean antibiotic-use period was 34 days (range, 26-45 days). The most causative pathogen was Staphylococcus aureus (40%) (including methicillin-sensitive S aureus) and was isolated and cultured in all patients. All patients had full range of motion of the hip joint. All of the Bennett scores were excellent; the mean Harris Hip Score was 96.3 (range, 92.5-100) after a minimum follow-up period of 24 months (mean, 26.1 ± 3.2 months; range, 24-35 months). No patient needed additional surgical intervention. No degenerative changes or avascular necrosis developed.

Conclusions
According to our results, arthroscopic treatment is an effective choice for the treatment of acute septic arthritis of the hip joint in children aged 10 years or younger.

Level of Evidence
Level IV, retrospective case series.

BACK

Performance and Return to Sport After Hip Arthroscopy in the National Basketball Association

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Arthroscopy, Volume 36, Issue 2, Received: June 12, 2019; Accepted: September 10, 2019

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Purpose
To determine: (1) return to sport (RTS) rate in National Basketball Association (NBA) players following hip arthroscopy, (2) postoperative career length and games per season, (3) pre- and postoperative performance, and (4) postoperative performance compared with control players.

Methods
NBA athletes who underwent hip arthroscopy and matched controls were identified. RTS was defined as playing in at least 1 game after surgery. Player efficiency ratings were used for performance evaluation. Continuous variables of each group were compared using a 2-tailed paired samples Student t test for normally distributed data. $\chi 2$ was used to analyze categorical data. RTS was used as the primary outcome with statistical significance defined by a P value < .05. A Bonferroni correction was used to control for the remaining multiple comparisons with statistical significance defined by a P value ≤.008.

Results
Twenty-three players (24 hips) were analyzed (mean age 27.5 ± 3.1 years; mean experience in the NBA 5.8 ± 2.8 years at time of surgery). Small forwards (n = 8, 33.3%) represented the largest proportion of players that underwent hip arthroscopy. Twenty players (21 surgeries, 87.5%) were able to RTS in NBA at an average of 5.7 ± 2.6 months. The overall 1-year NBA career survival rate of players undergoing hip arthroscopy was 79.2%. Players in the control group (5.2 ± 3.5 years) had a similar career length as (P = .068) players who underwent surgery (4.4 ± 3.0 years). There was no significant (P = .045) decrease in games per season following surgery. There was no significant difference in performance postoperatively compared with preoperatively (P = .017) and compared with matched controls following surgery (P = .570).

Conclusions
The RTS rate for NBA athletes after hip arthroscopy is high. There was no decrease in games played, career lengths, or performance following hip arthroscopy in NBA players versus preoperatively and matched controls.

Level of evidence
Level III case-control study

BACK

Independent Suture Tape Reinforcement of Tripled Smaller-Diameter and Quadrupled Grafts for Anterior Cruciate Ligament Reconstruction With Tibial Screw Fixation: A Biomechanical Full Construct Model

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Arthroscopy, Volume 36, Issue 2, Received: May 29, 2018; Accepted: June 22, 2019

https://doi.org/10.1016/j.arthro.2019.06.036

Purpose
To compare the effect of independent suture tape reinforcement on the dynamic elongation and stiffness behavior as well as ultimate strength of tripled smaller-diameter and quadrupled soft-tissue grafts for anterior cruciate ligament reconstruction (ACLR) with tibial screw fixation in a biomechanical in vitro study.

Methods
Tripled smaller-diameter (8 mm) and quadrupled (9 mm) bovine tendon grafts with and without suture tape reinforcement (n = 8 in each group) were tested using femoral suspensory and tibial interference screw fixation. The suture tape was femoral sided and fixed independent from the graft by passing it through the suspensory button and securing the 2 open tibial strands with a secondary interference screw. Dynamic testing was performed in position and force control at 250 N and 400 N, followed by pull to failure with the mode of failure noted. Dynamic elongation, stiffness, and ultimate strength were analyzed.

Results
Tripled constructs showed a significantly worse structural performance than quadrupled constructs at higher loads. Reinforcement of tripled and quadrupled grafts substantially decreased total elongation by 56% (4.54 ± 0.75 mm vs 2.01 ± 0.50 mm, $P < .001$) and 39% (3.25 ± 0.49 mm vs 1.98 ± 0.51 mm, $P < .001$), respectively, by significantly increasing dynamic stiffness. No statistical significance was found between the reinforced groups. Failure loads of reinforced tripled (1,074 ± 148 N vs 829 ± 100 N, $P = .003$) and quadrupled (1,125 ± 157 N vs 939 ± 76 N, $P = .023$) grafts were also significantly improved.

Conclusions
Independent reinforcement of soft-tissue grafts with suture tape strengthened the performance especially of tripled smaller-diameter grafts for ACLR with tibial screw fixation by significantly improving dynamic elongation at increased stiffness and ultimate strength. Quadrupled reinforced grafts showed no over-constraining and structurally behaved similarly to tripled grafts with reinforcement.

Clinical Relevance
Independent reinforcement for ACLR may provide an option for protecting autografts or allografts against irreversible lengthening during the maturation and remodeling phases of healing.

BACK

Avoiding Injury to the Popliteal Neurovascular Bundle in All-Inside Suturing of the Posterior Horn of the Lateral Meniscus: A Magnetic Resonance Imaging Assessment of Portal Selection and Safety

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https://doi.org/10.1016/j.arthro.2019.08.041

Purpose
We assessed the risk of injury to the popliteal neurovascular bundle (PNVB) while suturing the posterior horn of the lateral meniscus (PHLM).

Methods
We simulated all-inside suturing of the PHLM using magnetic resonance imaging of 60 knees. Lines were drawn from the medial and the lateral edges of the patellar tendon to the PHLM at increasing distances from the posterior cruciate ligament (PCL) to simulate suturing device trajectory. Distance from each line to the PNVB was measured (d). A similar analysis was performed using lines drawn from 1 cm medial and 1 cm lateral to the patellar tendon. We compared the average “d” at increasing distances from the PCL, between the different simulated portal entry points. We have also analyzed the association between different demographic characteristics and the shortest distance from the PVNB to the PHLM.

Results
Of 1200 measurements performed, the simulated suturing trajectory transected the PNVB 343 times (28.6%). At 0 mm from the PCL, the safest portal was the 1-cm lateral portal ($P < .001$), with an average “d” of 2.7 mm. At 3 mm, 6 mm, 9 mm, and 12 mm from the PCL, the safest portal was the 1-cm medial portal ($P < .001$), with average “d” of 3.8 mm, 6.9 mm, 10.1 mm, and 13.5 mm, respectively. Average distance between the PHLM and the PNVB was 7.8 mm. Shorter distance between the PHLM and the PNVB was associated with younger age and female sex ($P = .014$ and .001, respectively).

Conclusions
All-inside suturing of the PHLM at 0 mm from the PCL is safer with a more lateral portal. Beyond 3 mm from the PCL, a more medial portal carries a lower risk to the PNVB. Young and female patients have a shorter distance between the PHLM and the PNVB, suggesting a greater risk for injury to the PNVB. Careful preoperative magnetic resonance imaging assessment may assist in safer portal selection when planning repair of the PHLM.

Clinical Relevance
This study describes a magnetic resonance imaging–based risk assessment for injury of the PVNB while suturing the PHLM. It allows the orthopaedic surgeon a better understanding of the anatomic relationship between the popliteal neurovascular bundle and the lateral meniscus and can assist in portal selection and safety.

BACK

Degenerative Meniscus Lesions: An Expert Consensus Statement Using the Modified Delphi Technique

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https://doi.org/10.1016/j.arthro.2019.08.014

Purpose
The purpose of this study was to perform an evidence-based, expert consensus survey using the Delphi panel methodology to develop recommendations for the treatment of degenerative meniscus tears.

Methods
Twenty panel members were asked to respond to 10 open-ended questions in rounds 1 and 2. The results of the first 2 rounds served to develop a Likert-style questionnaire for round 3. In round 4, the panel members outside consensus were contacted and asked to either change their score in view of the group's response or argue their case. The level of agreement for round 4 was defined as 80%.

Results
There was 100% agreement on the following items: insidious onset, physiological part of aging, tears often multiplanar, not all tears cause symptoms, outcomes depend on degree of osteoarthritis, obesity is a predictor of poor outcome, and younger patients (<50 years) have better outcomes. There was between 90% and 100% agreement on the following items: tears are nontraumatic, radiographs should be weightbearing, initial treatment should be conservative, platelet-rich plasma is not a good option, repairable and peripheral tears should be repaired, microfracture is not a good option for chondral defects, the majority of patients obtain significant improvement and decrease in pain with surgery but results are variable, short-term symptoms have better outcomes, and malalignment and root tears have poor outcomes.

Conclusions
This consensus statement agreed that degenerative meniscus tears are a normal part of aging. Not all tears cause symptoms and, when symptomatic, they should initially be treated nonoperatively. Repairable tears should be repaired. The outcome of arthroscopic partial meniscectomy depends on the degree of osteoarthritis, the character of the meniscus lesion, the degree of loss of joint space, the amount of malalignment, and obesity. The majority of patients had significant improvement, but younger patients and patients with short-term symptoms have better outcomes.

Level of Evidence
Level V – expert opinion.

BACK

Preoperative Validation of the Patient-Reported Outcomes Measurement Information System in Patients With Articular Cartilage Defects of the Knee

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Purpose
To validate the Patient-Reported Outcomes Measurement Information System (PROMIS) physical function computer adaptive test (PF CAT) with current patient-reported outcome (PRO) instruments in patients with cartilage injuries of the knee.

Methods
Patients scheduled for osteochondral autograft or allograft transplant, microfracture, autologous chondrocyte implantation, allograft cartilage resurfacing, and chondroplasty were prospectively enrolled in the study and completed PROMIS PF CAT, Knee Injury and Osteoarthritis Outcome Score (KOOS activities of daily living, pain, symptoms, sport, and quality of life), Short Form-36 Health Survey (SF-36 physical function [PF] and Physical Component Summary), and EuroQol-5 Dimension questionnaires. The Spearman correlation coefficient was used to compare instruments. Instrument correlations were defined as excellent (>0.7), excellent to good (0.61-0.69), good (0.4 to 0.6), and poor (<0.39), with significance defined as $P < .05$.

Results
A total of 293 knees in 275 patients (54.5% male) undergoing 319 cartilage procedures were analyzed. The most commonly performed cartilage procedure was chondroplasty (n = 118; 37.0%), followed by microfracture (n = 100; 31.3%). The mean age was 34.0 ± 14.7 and the mean body mass index was 30.0 ± 6.9. The PROMIS PF CAT had an excellent correlation with the SF-36 PF ($r = 0.819$; $P < .001$), SF-36 Physical Component Summary ($r = 0.766$; $P < .001$), KOOS activities of daily living ($r = 0.733$; $P < .001$), KOOS Sport ($r = 0.709$; $P < .001$), and EuroQol-5 Dimension ($r = 0.752$; $P < .001$) instruments; an excellent-good correlation with the KOOS pain ($r = 0.662$; $P < .001$), and KOOS quality of life ($r = 0.640$; $P < .001$) scores; and a good correlation with the KOOS symptoms ($r = 0.519$; $P < .001$) scale. The PROMIS PF CAT had no floor or ceiling effects and the smallest question burden (mean 4.17 ± 0.93 questions). Dimensionality analyses demonstrated that the smallest amount of unexplained variance was present in the PROMIS PF CAT (3.6%).

Conclusion
The PROMIS PF CAT is an effective tool for preoperative outcome assessment in patients with cartilage defects of the knee. It correlates strongly with legacy PRO measures of physical function with no ceiling and floor effects and a minimal time burden for completion. Further study is warranted to determine postoperative performance and to evaluate the responsiveness of PROMIS to change within a patient.

Level of Evidence
III; Prognostic retrospective comparative study.

BACK

There Is No Difference in Radiographic Outcomes After Average 9 Years After Arthroscopic Partial Medial Meniscectomy for Both Posterior Horn Tears and Posterior Horn Root Tears

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https://doi.org/10.1016/j.arthro.2019.08.039

Purpose
To compare the serial changes in radiographic outcomes in terms of the mechanical axis (MA) angle and medial joint space width (JSW) between medial meniscus posterior root tear (MM PRT) and non-root tear (MM NRT) after arthroscopic partial meniscectomy (APM).

Methods
Patients who underwent APM for degenerative MM PRT or MM NRT from January 1999 to July 2012 were retrospectively reviewed. One hundred ten patients each in the MM PRT group and the MM NRT group, who were matched through propensity score matching (adjusting for confounding factors such as age, sex, body mass index, anatomic axis, cartilage state of the medial compartment, and follow-up period), were included in the study. The MA angle on weightbearing whole-leg radiographs and the medial JSW on weightbearing 45° flexion posteroanterior radiographs were measured to evaluate the radiographic outcomes. The serial changes were compared between radiographs taken before surgery, at postoperative 3 to 5 years, and at postoperative 5 years to the last follow-up. The linear mixed model was used to compare the changes in radiographic outcomes during the follow-up period between groups.

Results
The 2 groups were balanced with standardized mean differences of <0.2 after propensity score matching. Both the MM PRT and NRT groups showed increased varus alignment after surgery. However, there was no significant difference in the change in the MA angle during the follow-up period between groups (P = .182). The medial JSW also showed progression of joint space narrowing after surgery in both groups; however, there was no significant difference in the change in medial JSW during the follow-up period between groups (P = .270).

Conclusion
The radiographic outcomes after partial meniscectomy in terms of the MA angle and medial JSW show comparable results between degenerative MM PRT and NRT after proper matching of confounding factors.

Level of evidence
Level III, retrospective comparative study.

BACK

Revision Anterior Cruciate Ligament Reconstruction After Primary Anatomic Double-Bundle Anterior Cruciate Ligament Reconstruction: A Case Series of 40 Patients

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https://doi.org/10.1016/j.arthro.2019.08.038

Purpose
To evaluate the surgical methods according to the status of tunnels at the time of revision anterior cruciate ligament reconstruction (ACLR) and to evaluate clinical outcomes of revision ACLR in patients who underwent primary ACLR with the anatomic 4-tunnel double-bundle (DB) technique.

Methods
A total of 487 patients who underwent primary anatomic DB ACLR from April 2010 to July 2016 were retrospectively reviewed, and among those knees, the patients who underwent revision ACLR were included in the study. The patients with concomitant posterior cruciate ligament injuries were excluded. Forty patients (40 knees) were identified and enrolled. The surgical methods were reviewed. The range of motion, objective laxity using KT-2000, Lysholm score, Hospital for Special Surgery score, International Knee Documentation Committee subjective score, and Tegner score after revision ACLR were compared with those after primary ACLR in the same patient using paired t-test with Bonferroni correction.

Results
The timing of reinjury after primary ACLR and mean interval between primary and revision ACLR were 18 months (range 1.5-80 months) and 24 months (range 4-82 months), respectively. Among 40 patients, 38 patients (95%) underwent 1-stage revision with the DB technique using pre-existing tunnels without compromised positioning of the grafts, and the other 2 patients (5%) underwent 2-stage revision. The postrevision range of motion, KT-2000, Lysholm score, Hospital for Special Surgery score, International Knee Documentation Committee subjective score, and Tegner score were 137 ± 7°, 2.4 ± 1.2 mm, 91.4 ± 5.8, 98.9 ± 2.2, 78.6 ± 11.5, and 5.5 ± 1.2, respectively, and did not show any differences from those after primary ACLR.

Conclusions
In the revision setting after primary anatomic DB ACLR, most of the cases could be managed with 1-stage revision with DB technique using pre-existing tunnels, and the objective laxity and clinical scores after revision DB ACLR were comparable with those after primary DB ACLR.

Level of Evidence
Case series, Level IV.

BACK

Clinical and Functional Outcomes of Anterior Cruciate Ligament Reconstruction With Autologous Hamstring Tendon in Patients Aged 50 Years or Older

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Purpose
To assess the clinical and functional outcomes, including the return to sports and the progression of arthritis, in patients aged 50 years or older after anterior cruciate ligament (ACL) reconstruction.

Methods
A retrospective series of patients aged 50 years or older with ACL rupture who received ACL reconstruction surgery with autologous hamstring tendon was examined. Preoperative and postoperative functional outcomes were evaluated with the International Knee Documentation Committee (IKDC) subjective score, Lysholm score, and Tegner activity score. Associated injuries, postoperative complications, and the rate of return to preinjury sports were documented. A paired t test and the minimal clinically important difference (MCID) and patient acceptable symptom state (PASS) were used for statistical evaluation.

Results
A total of 67 patients with a mean age of 56.6 years were enrolled. The mean follow-up time was 30.2 months. Clinical improvement in the IKDC score (from 41.4 preoperatively to 88.9 postoperatively), Lysholm score (from 49.8 to 86.1), and Tegner activity score (from 2.7 to 4.4) was noted. Regarding clinically relevant values of the MCID, all patients (100%) showed a ΔLysholm score exceeding 8.9; 66 of 67 patients (98.5%) revealed a ΔIKDC score exceeding 16.7; and 47 of 67 patients (70.1%) showed a ΔTegner activity score of more than 1. For the PASS, none of the patients had an IKDC score over 75.9 preoperatively whereas 60 patients (89.5%) had a score exceeding 75.9 postoperatively. Associated lesions included meniscal injuries (73.1%) and osteochondral lesions (89.6%). Of the patients, 36 (53.7%) returned to preinjury sports and 18 (22.9%) returned to sports with less intensity. No major complication, rerupture, or deterioration of arthritis was noted.

Conclusions
Patients aged 50 years or older receiving ACL reconstruction achieved significant improvements in IKDC, Lysholm, and Tegner scores. All patients reached the MCID for the ΔLysholm score; 98.5%, for the ΔIKDC score; and 70.1%, for the ΔTegner activity score. None of the patients reached the PASS for the preoperative IKDC value, whereas 89.5% reached the PASS postoperatively. Among patients aged 50 years or older, 53.7% returned to preinjury sports and 26.9% returned to sports with lower intensity.

Level of Evidence
Level IV, therapeutic case series.

BACK

Clinical Outcomes of Arthroscopic Primary Anterior Cruciate Ligament Repair: A Systematic Review from the Scientific Anterior Cruciate Ligament Network International Study Group

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Purpose
To perform a systematic review of contemporary studies reporting clinical outcomes of primary anterior cruciate ligament (ACL) repair to determine whether these studies demonstrate any significant benefit of ACL repair and whether there is evidence of a deterioration of mid-term outcomes as seen in historical data.

Methods
A systematic review was conducted in accordance with Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines. A PubMed search using the keywords “repair” AND “Anterior Cruciate Ligament” was performed (limits: English language, publication date between January 1, 2014, and January 13, 2019). All identified studies reporting clinical outcomes of arthroscopic ACL repair were included. Critical appraisal was conducted using the Cochrane Risk of Bias Tool for Randomized Clinical Trials and the Methodological Index for Non-Randomized Studies. Basic parameters of each study including population characteristics, repair technique, physical examination findings, and clinical outcome scores were recorded and evaluated.

Results
Nineteen eligible studies were identified (including 5 comparative studies). None of the comparative studies showed any significant difference between repair and reconstruction groups with respect to International Knee Documentation Committee (IKDC), Lysholm, Tegner, side-to-side laxity difference, Lachman, pivot shift tests, or graft rupture rates. Four non-comparative studies reported outcomes at medium- to long-term follow up (range of mean follow up 43.3-79 months) with a mean Lysholm score between 85.3 and 100, mean IKDC subjective score between 87.3 and 100, and mean Tegner activity score between 5 and 7.

Conclusions
Comparative studies identified no significant differences between ACL repair and reconstruction with respect to Lysholm, IKDC, side-to-side laxity difference, pivot shift grade, or graft rupture rates. However, these studies had major limitations including small numbers and short durations of follow up. Case series demonstrated that excellent outcomes can be achieved at medium- to long-term follow up with the SAR technique.

Level of Evidence
IV; Systematic review of Level II to IV investigations.

BACK

Knee Surgery, Sports Traumatology, Arthroscopy (KSSTA), Volume 28, Issue 2

Age, gender, quadriceps strength and hop test performance are the most important factors affecting the achievement of a patient-acceptable symptom state after ACL reconstruction

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Purpose
To assess the percentage of patients achieving an acceptable symptom state 2 years after primary anterior cruciate ligament reconstruction (ACLR) and to identify factors affecting its achievement, in a large cohort.

Methods
Patients who underwent primary ACLR at Capio Artro Clinic, Stockholm, Sweden, from 2005 to 2015, were identified in our clinic registry. Patients who had completed the Knee injury and Osteoarthritis Outcome Score (KOOS) at the 2-year follow-up were included. The primary outcome was the achievement of a patient-acceptable symptom state (PASS) for each KOOS subscale. A multivariate logistic regression analysis was used to determine whether patient age, gender, time from injury to surgery, pre-injury Tegner activity level, graft type, cartilage injury, the presence of medial meniscus (MM) or lateral meniscus (LM) resection or repair and the recovery of 6-month symmetrical (limb symmetry index [LSI] of ≥ 90%) isokinetic quadriceps or hamstring strength and single-leg-hop test performance were factors associated with the achievement of a PASS for each KOOS subscale.

Results
A total of 2335 primary ACLRs were included. More than 60% of the patients reported a PASS on four of the five KOOS subscales. Age ≥ 30 years and an LSI of ≥ 90% for 6-month isokinetic quadriceps strength increased the odds of achieving a PASS across all KOOS subscales. Female gender reduced the odds of achieving a PASS on the Pain (OR 0.76; 95% CI 0.62–0.94; P = 0.01), activities of daily living (ADL) (OR 0.79; 95% CI 0.64–0.97; P = 0.02) and sport and recreation (OR 0.72; 95% CI 0.58–0.89; P = 0.003) subscales. The presence of an MM repair reduced the odds of achieving a PASS on the Pain (OR 0.59; 95% CI 0.36–0.96; P = 0.03) subscale. Hamstring tendon (HT) autograft rather than bone-patellar tendon-bone (BPTB) autograft showed increased odds (OR 2.02; 95% CI 1.31–3.10; P = 0.001), whereas a cartilage injury showed reduced odds (OR 0.73; 95% CI 0.55–0.97; P = 0.03) of achieving a PASS on the sport and recreation subscale. An LSI of ≥ 90% for 6-month single-leg-hop test performance increased the odds of achieving a PASS on the ADL (OR 1.37; 95% CI 1.09–1.71; P = 0.005), Sport and Recreation (OR 1.40; 95% CI 1.11–1.77; P = 0.004), and quality of life (OR 1.28; 95% CI 1.00–1.63; P = 0.04) subscales.

Conclusion
More than 60% of the patients reported an acceptable symptom state on four of the five KOOS subscales 2 years after primary ACLR. Age ≥ 30 years and female gender were the non-modifiable factors that consistently increased and reduced, respectively, the odds of achieving a PASS. A symmetrical 6-month isokinetic quadriceps strength and single-leg-hop test performance were the modifiable factors that consistently increased the opportunity of achieving a PASS 2 years after primary ACLR.

Level of evidence
III.

BACK

Good mid-term outcomes and low rates of residual rotatory laxity, complications and failures after revision anterior cruciate ligament reconstruction (ACL) and lateral extra-articular tenodesis (LET)

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Background
Residual rotational instability remains a controversial factor when analysing failure rates of anterior cruciate ligament (ACL) reconstruction. Anatomical and biomechanical studies have demonstrated a very important role of anterolateral structures for rotational control. Revision ACL is considered one of the main indications for a lateral extra-articular tenodesis (LET). Yet, few series evaluating these procedures are published.

Purpose
To perform a systematic review of studies that assessed outcomes in patients treated with revision ACL surgery associated with a lateral extra-articular procedure.

Study design
Systematic review.

Methods
A comprehensive literature search was performed in February 2018 using PubMed, Scopus, Web of Search and Cochrane. Inclusion criteria were series of ACL revision reconstructions associated with lateral extra-articular procedures. Clinical outcomes (Lysholm, subjective IKDC, KOOS, Cincinnati and WOMAC), joint stability measures (Lachman test, pivot-shift, arthrometer assessment and navigation assessment), graft type, reported chondral and meniscal injury, radiographic outcomes, complications and failures were recorded. Articles were assessed for level of evidence and methodology using a modifcation of the ACL Methodology Score (AMS) system.

Results
Twelve studies met the inclusion criteria out of the 231 abstracts; 9 retrospective evaluations, two prospective cohorts and one combination of two populations (a retrospective and prospective series). A total of 851 patients evaluated with a mean age of 28.8 years (range 16–68 years) and a weighted mean follow-up of 4.9 years (range 1–10 years). The mean time from primary ACL reconstruction to revision was 5.3 years (reported in 7 studies, including 710 patients). The Lysholm, IKDC, and
KOOS scores indicated favorable results in studies that reported these outcomes. Objective evaluations reported 86% objective A and B IKDC results, 2.6 mm mean side-to-side arthrometric diference and 80% negative pivot-shift. About 74% of patients returned to their previous sport (evaluated in six studies). Few studies reported radiological evaluation. Fifty-nine complications (8.0%) and 24 failures (3.6%) were reported. The mean modifed ACL Methodology Score was 55.5 (range 32–72).

Conclusion
Good mid-term results were obtained for combined revision ACL reconstruction and lateral extra-articular procedures. Despite the fact that in clinical practice LET are a common indication associated with revision ACL, there are no high-level studies supporting this technique.

Level of evidence
IV

BACK

Procedure length is independently associated with overnight hospital stay and 30-day readmission following anterior cruciate ligament reconstruction

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Purpose
The purpose was to characterize the independent efect of procedure length on the rates of 30-day perioperative complications, hospital readmissions, and overnight hospital stay in patients undergoing arthroscopic anterior cruciate ligament reconstruction (ACLR). We hypothesized that longer procedure length in primary ACLR increases the risk for post-operative complications.

Methods
Primary ACLR cases from 2005 to 2015 were identifed in the American College of Surgeons National Surgical Quality Improvement Program registry. Patients were categorized into two cohorts based on procedure length, either less than or greater than 90 min. Two equal-sized propensity-matched cohorts were generated to account for diferences in baseline and operative characteristics. Thirty-day clinical outcomes were compared using bivariate analyses between propensity-matched groups that controlled for patient-specifc factors and concurrent meniscal repair. Multivariate logistic regression models were used to identify independent predictors of hospital readmission and overnight hospital stay.

Results
In total, 12,077 ACLR cases were identifed. The rate of any 30-day complication was increased in longer procedures relative to shorter procedures (1.6% vs 0.9%, p=0.006), as were the rates of returning to the operating room (0.6% vs 0.3%, p=0.03), hospital readmission (1.0% vs 0.3%, p=0.001), and overnight hospital stay (16.2% vs 6.0%, p<0.001). Obesity was a risk factor for both hospital readmission and overnight hospital stay, while hypertension, diabetes, chronic obstructive
pulmonary disease, and a smoking history were associated with increased rates of overnight hospital stay. The most common reasons for hospital readmission were deep vein thrombosis or pulmonary embolism (25.0% of all readmitted patients), surgical site infection (25.0%), and post-operative pain (14.1%).

Conclusions
In this propensity-matched analysis adjusting for baseline patient characteristics and operative factors, procedure length of greater than or equal to 90 min in ACLR was independently associated with an increased risk of hospital readmission and overnight hospital stay. As a surrogate measure of surgical complexity, operative time may be a useful perioperative variable for post-operative risk stratifcation and patient counseling.

Level of evidence
III

BACK

Trends in knee arthroscopy utilization: a gap in knowledge translation

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Purpose
To evaluate the longitudinal trends in knee arthroscopy utilization in relation to published negative randomized controlled trials, focusing on annual rates, patient demographics and associated 30-day post-operative complications.

Methods
The American College of Surgeons National Surgical Quality Improvement Program database was queried using Current Procedural Terminology billing codes to identify arthroscopy cases between 2006 and 2016. 30-day post-operative complications were identifed, and potential risk factors analysed using univariate and multivariate analyses.

Results
68,346 patients underwent knee arthroscopy, of which 47,446 (69.5%) represented partial meniscectomies. The annual procedural rate, as a proportion of all reported cases, increased signifcantly from 2006 (0.3%) to 2016 (1.6%; $p<0.001$), along with a signifcant increase in average patient age (44.3±15.5 to 48.4±14.5; $p<0.001$). Specifcally focusing on the meniscectomy cohort, average patient age signifcantly increased from 47.9±15.1 to 50.7±13.5 ($p=0.001$). The overall incidence of complications was 2.0% (n=1333), with major complications in 0.9% (n=639) and minor complications in 1.0% (n=701). Common complications included a return to the operating room (0.5%), deep vein thrombosis/thrombophlebitis (0.4%), and superfcial infection (0.2%). Operating time>90 min, diabetes, steroid use, ASA class 2+, and dialysis-dependency were the predictors of overall complication rates.

Conclusion
Despite the publication of negative trials and new clinical practice guidelines, knee arthroscopy utilization and average patient age continue to increase. Given the high utilization, even low adverse event rates equate to substantial numbers of patients with minor and major complications. The NSQIP data show a gap in knowledge translation to clinical practice and highlight the need for improved clinical guidelines.

Level of evidence Cohort study
Level III.

BACK

Compliance in post-operative rehabilitation is a key factor for return to sport after revision anterior cruciate ligament reconstruction

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Purpose
To assess the rate of return to sport (RTS) following revision Anterior Cruciate Ligament Reconstruction (ACLR) in a rehabilitation-based cohort of patients. A secondary goal of the study was to evaluate the association between compliance in post-operative rehabilitation and RTS rate.

Methods
The study cohort included 79 sport-active patients (62 males, 17 females, 30.0±10.2 years old) who underwent revision ACLR surgery and followed the same functional-oriented rehabilitation protocol. Patients were evaluated using a RTS survey: return to any kind of sport participation, return to the same pre-injury sport, return to the same sport at the same pre-injury level. With regards to compliance in post-operative rehabilitation, patients were then grouped in (1) Fully Compliant (FC), (2) Moderately Compliant (MC), (3) Scarcely Compliant (SC), and (4) Non-Compliant (NC).

Results
At an average follow-up of 29±12 months, 86% of the patients returned to some kind of sport activity, 62% returned to the same pre-injury sport activity and 59% returned to the same pre-injury level of sport activity. While no surgical aspects were correlated with RTS, higher BMI was found to have a negative infuence (p=0.033). Regardless of the type of sport, compliance signifcantly afected RTS at the same pre-injury level (p=0.006): 86% in FC, 67% in MC, 50% in SC, and 45% in NC. For each compliance goal achieved, the probability of RTS increased by 68% (OR=1.68; p=0.027).

Conclusion
RTS at the same pre-injury level after revision ACLR is challenging. A higher compliance in rehabilitation signifcantly increases the chances of RTS.

Level of evidence
IV

BACK

No diference in postoperative rotational laxity after ACL reconstruction in patients with and without anterolateral capsule injury: quantitative evaluation of the pivot-shift test at 1-year follow-up

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Purpose
To compare rotational laxity in anterior cruciate ligament (ACL)-reconstructed knees retrospectively with and without concomitant anterolateral capsule (ALC) injury confrmed by magnetic resonance imaging (MRI) prior to ACL reconstruction.

Methods
Sixty-two ACL-reconstructed knees (26 men, 36 women; median age 20 (range 13–59)) were included. Pivot-shift test was performed before ACL reconstruction and 1 year postoperatively under anesthesia with both clinical grading and quantitative measurement simultaneously. Clinical grading was determined according to the International Knee Documentation Committee (IKDC) criteria (none, glide, clunk, or gross), and an electromagnetic measurement system was used to provide tibial acceleration as a quantitative parameter. The resence of concomitant ALC injury was confrmed retrospectively by MRI. The pivot-shift test was compared between ACL-reconstructed knees with and without ALC injury test for clinical grading and the independent t test for quantitative evaluation.

Results
ALC injury was identifed in 26 of 62 (42%) knees. Before ACL reconstruction, there was no diference in the pivotshift test results between the ACL-defcient knees with and without ALC injury in IKDC grading (n.s.) or tibial acceleration (1.1±0.7 m/s2 and 1.4±1.1 m/s2, respectively, n.s.). At 1 year postoperatively, no diference was observed between groups (IKDC, p=0.90; tibial acceleration, 0.6±0.3 m/s2 and 0.8±0.6 m/s2, n.s.).

Conclusions
Concomitant ALC injury at the time of ACL injury had no efect on the rotational laxity of the knee in the postoperative course after ACL reconstruction. Therefore, additional treatment for ALC injury may not be warranted.

Level of evidence
IV.

BACK

Psychological factors are associated with return to pre-injury levels of sport and physical activity after ACL reconstruction

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DOI: https://doi.org/10.1007/s00167-019-05696-9

Purpose
The impetus of anterior cruciate ligament reconstruction (ACLR) is to allow patients to return to sport and to remain engaged in physical activity. Many patients exhibit defcits in psychological domains of health-related quality of life which may impede return to sport and physical activity participation. Therefore, the purpose of this study was to examine the association of patient-based, specifcally psychological, and functional outcomes with return to sport and physical activity.

Methods
Forty participants, a minimum of 1-year post-ACLR, reported to the laboratory for one-testing session. Participants completed a series of patient-based and functional outcome assessments. Participants were also instructed to wear a pedometer for 1 week to monitor their daily steps.

Results
Twenty-fve participants (62%) did not return to sport and 29 participants (72%) did not average 10,000 steps per
day. Individuals with elevated levels of self-reported kinesiophobia were 17% less likely to return to sport. Self-reported
knee self-efcacy and knee-related quality of life accounted for 27.1% of the variance of average daily step counts.

Conclusions
Psychological factors, specifcally injury-related fear and self-efcacy, were associated more significantly than functional outcomes with return to sport and physical activity levels. Clinicians should examine psychological factors throughout rehabilitation in patients after ACLR. Future research should explore the efectiveness of psychoeducation techniques to decrease injury-related fear and enhance self-efcacy in this population.

Level of evidence
III.

BACK

Quadriceps tendon autograft ACL reconstruction has less pivot shift laxity and lower failure rates than hamstring tendon autografts

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DOI: https://doi.org/10.1007/s00167-019-05720-y

Purpose
Quadriceps tendon (QT) autograft ACL reconstruction was hypothesized to possess less anterior knee laxity, pivot shift laxity, and lower failure rates than hamstring tendon (HT) autografts.

Methods
Terms “hamstring tendon autograft” and “ACL reconstruction” or “quadriceps tendon autograft” and “ACL reconstruction” were searched in Embase and PubMed. Inclusion criteria required that studies included patients treated for primary ACL injury with reconstruction using either a QT autograft (Group 1) or a HT autograft (Group 2) and instrumented anterior knee laxity assessment. Extracted information included surgical fxation method, graft type, graft thickness or diameter, single vs. double bundle surgical method, publication year, time between the index knee injury and surgery, % women, initial and fnal subject number, subject age, follow-up length, side-to-side anterior knee laxity diference, Lysholm Score, Subjective IKDC score, anterior knee laxity side-to-side diference grade, ipsilateral pivot shift laxity grade, and failure rate. The Methodological Index for Nonrandomized Studies was used to evaluate study methodological quality.

Results
The QT group (Group 1) had 17 studies and the HT group (Group 2) had 61 studies. Overall, Group 2 had greater pivot shift laxity (OR 1.29, 95% CI 1.05–1.59, p=0.005). Group 2 suspensory femoral fxation had greater pivot shift laxity (OR 1.26, 95% CI 1.01–1.58, p=0.02) than Group 1 compression femoral fxation. Group 2 compression femoral fxation also had more anterior knee laxity (OR 1.25, 95% CI 1.03–1.52, p=0.01) than Group 1 compression femoral fxation and higher failure rates based on initial (OR 1.69, 95% CI 1.18–2.4, p=0.002) and fnal (OR 1.89, 95% CI 1.32–2.71, p=0.0003)
subject number. Failure rate for HT compression femoral fxation was greater than suspensory femoral fxation based on initial (OR 2.08, 95% CI 1.52–2.84, p<0.0001) and fnal (OR 2.26, 95% CI 1.63–3.16, p<0.0001) subject number.

Conclusions
Overall, QT autografts had less pivot shift laxity and lower failure rates based on fnal subject number than HT autografts. Compression QT autograft femoral fxation had lower pivot shift laxity than suspensory HT autograft femoral fxation. Compression QT autograft femoral fxation had less anterior knee laxity and lower failure rates than compression HT autograft femoral fxation. Suspensory HT autograft femoral fxation had lower failure rates than compression HT autograft femoral fxation. Greater knee laxity and failure rates may be related to a combination of HT autograft diameter and
confguration (tissue quality and dimensions, strands, bundles, and suturing method) variability and fxation mode.

Level of evidence
Level IV.

BACK

Over-the-top ACL reconstruction restores anterior and rotatory knee laxity in skeletally immature individuals and revision settings

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Purpose
To investigate the objective outcomes following anterior cruciate ligament reconstruction (ACLR) with the overthe-top (OTT) technique.

Methods
Thirty-fve ACL-defcient patients with mean follow-up of 2.2 years were retrospectively reviewed. This included 14 skeletally immature individuals (age: 14±1 years) who underwent primary OTT ACLR (adolescent group) and 21 skeletally mature individuals (age: 25±8 years) who underwent OTT revision ACLR (revision group). The tibial tunnel was created at the anatomic position for all cases. No lateral extra-articular tenodesis was performed. Before and after surgery, the side-to-side diference (SSD) in anterior laxity was measured using KT-1000 arthrometer. Lachman and pivot-shift tests were assessed according to IKDC grade. The graft failure rate was assessed.

Results
The post-operative SSD in anterior laxity was signifcantly reduced in the adolescent (pre-op, 3.9±1.8 mm; post-op, 1.2±0.8 mm; p=0.040) and revision groups (pre-op, 4.2±1.7 mm; post-op, 1.2±1.4 mm; p<0.001). Postoperative knee laxity measured by Lachman and pivot-shift tests were also signifcantly improved in both groups. Graft rupture occurred in two patients in the adolescent group (14.3%), and one patient in the revision group (4.8%).

Conclusion
ACLR with the OTT technique restored anterior and rotatory knee laxity in skeletally immature individuals and in revision settings. This one-step procedure may be a good option for skeletally immature individuals and revision settings.

Level of evidence
IV.

BACK

Superior knee self-efficacy and quality of life throughout the frst year in patients who recover symmetrical muscle function after ACL reconstruction

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Purpose
The aim of this study was to (1) describe psychological outcomes during the frst year after an anterior cruciate ligament (ACL) reconstruction and (2) compare psychological outcomes in patients who recover symmetrical muscle function with patients who do not.

Methods
The included patients had undergone a unilateral ACL reconstruction. Patients with a re-rupture and contralateral ACL injury were excluded. Three groups, based on the results from 5 tests of muscle function 12 months after reconstruction, were created. Three validated questionnaires (the Knee Self-Efcacy Scale; the Knee injury and Osteoarthritis Outcome Score subscale “Quality of Life”; the ACL Return to Sport after Injury scale) and a single question “Have you achieved your goal with rehabilitation?” were analysed in 4 diferent follow-ups after ACL reconstruction (10 weeks, 4, 8 and 12 months). Means and standard deviations were analysed with standard t tests and reported with 95% confdence intervals.

Results
A total of 328 patients (120 men, 37%), mean age 27.8±10 years, were included. Patients who did not recover symmetrical muscle function (n=56; 17%) at the 12-month follow-up reported inferior knee-related self-efcacy and quality of life than patients who recovered symmetrical muscle function (n=96; 29%) at all follow-ups, except quality of life at 4 months. The proportion of patients who stated they achieved their rehabilitation goal at 12 months was 17% for the entire cohort, 24% for patients who recovered muscle function and 5% for patients who did not recover muscle function.

Conclusion
Patients who recovered strength and hop symmetry 12 months after ACL reconstruction had superior knee-related self-efcacy and greater quality of life during the whole frst year after ACL reconstruction. These results can aid clinicians in the decision-making process by providing knowledge of patients who might need further attention during rehabilitation.

Level of evidence
III.

BACK

Cartilage damage at the time of anterior cruciate ligament reconstruction is associated with weaker quadriceps function and lower risk of future ACL injury

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Purpose
To determine whether articular cartilage damage noted at the time of primary anterior cruciate ligament reconstruction (ACLR) afects the likelihood of achieving ≥90% symmetry for isokinetic extension strength at 6 months after surgery or risk of recurrent ACL injury.

Methods
Five hundred and eight patients underwent primary ACLR and diagnostic arthroscopy. All identifed cartilage lesions were graded using the Outerbridge system. All patients underwent isokinetic strength testing. The association between cartilage Outerbridge grade and a ≥90% Limb Symmetry Index (LSI) and recurrent ACL injury risk at mean 38.7 month follow-up (SD 31.8) was evaluated via multivariate regression analysis.

Results
Grade 2 or higher damage was present in 394 (77.5%) of patients, grade 3 or higher in 143 (28.1%) and grade 4 in 83 (16.4%) at time of ACLR. Ipsilateral ACLR graft rupture occurred in 31 (6.1%) of patients. Contralateral ACL injury occurred in 19 (3.7%). Patients with grade 2 or higher damage were signifcantly less likely to meet an LSI goal of ≥90% for fast (300°/s) isokinetic extension. There was no association with slow isokinetic extension. Cartilage lesion severity at or beyond grade 2 had a similar efect on isokinetic testing results regardless of compartment involvement or performance of microfracture. Patients with grade 2–4 cartilage damage were less likely to sustain a second ipsilateral ACL injury or a contralateral native ACL injury.

Conclusions
Cartilage damage seen at time of ACL reconstruction is common and associated with lower likelihood of achieving≥90% symmetry for isokinetic extension strength at 6 months after surgery. However, lower recurrent ACL injury rates are seen in patients with concurrent cartilage damage. These data may inform future clinical decisions regarding operative managment of recurrent ACL injuries.

Level of evidence
III.

BACK

Anatomic femoral tunnel placement is difcult by the transtibial technique: comparison of three diferent femoral tunnel drilling techniques in double-bundle anterior cruciate ligament reconstructions

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Purpose
To compare the position and direction of femoral and tibial tunnels for both the anteromedial bundle (AMB) and posterolateral bundle (PLB) among three diferent femoral tunnel drilling techniques, transtibial (TT), transportal (TP), and outside-in (OI) techniques, in anatomic double-bundle ACL reconstruction to clarify advantages and disadvantages of each technique.

Methods
One-hundred and thirty-nine patients underwent primary ACL reconstruction with an autologous semitendinosus tendon in our institution between 2014 and 2016. Thirteen patients were excluded according to the exclusion criteria. Of the 126 patients, 98 patients agreed to be included in this study. Patients were then randomized into three groups according to the femoral tunnel drilling technique; the TT, TP, and OI groups. Femoral and tibial tunnel angles and positions were measured using three-dimensional computed tomography.

Results
Of patients who agreed to be included in this study, eight patients (seven in TT and one in OI) were excluded since the femoral tunnel could not be created at the intended position. Eighty-six patients (29 in TT, 29 in TP, and 28 in OI) were included for the analyses. Tunnel angles, as well as tunnel lengths, had signifcant diferences among diferent techniques depending on each technique's characteristics. In terms of tunnel position, femoral tunnel positions of both the AMB and
PLB in the TT group were signifcantly higher than those in the TP group (AMB: p=0.003, PLB: p=0.001), and the PLB tunnel position in the TP group had signifcantly smaller vaciance than that in the TT group (p=0.004) and OI group (0.002).

Conclusions
The femoral tunnel positions created by the TT technique were signifcantly higher, with larger variance, than the TP technique in double-bundle ACL reconstruction, although the positions seemed to be within anatomical footprint. In addition, there were several cases in which femoral tunnels could not be created at the intended position by the TT technique.

Level of evidence
I

BACK

Seventy percent long-term survival of the repaired ACL after dynamic intraligamentary stabilization

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Purpose
Primary repair of the anterior cruciate ligament (ACL) is regaining popularity. Long-term results are lacking. The purpose of the current study was to determine the survival of the primarily repaired ACL after dynamic intraligamentary stabilization.

Methods
Between 2011 and 2013, 57 patients with acute proximal ACL ruptures underwent DIS repair within 3 weeks from injury and were available for fnal follow-up at least 5 years postoperatively. Failure as an end point was defned as conversion to ACL reconstruction, failure to restore stability with persisting laxity side-to-side laxity of >5 mm or a late-traumatic re-rupture or loss of stability. Kaplan–Meier survival analysis was performed.

Results
Kaplan–Meier survival analysis demonstrated an overall survival of 70.0% (standard error SE 6.6%) at 74 months follow-up. Patients performing competitive sports prior to injury demonstrated an inferior long-term ACL survival of 56.4% (SE 11.6%). Patients performing recreational sport activities demonstrated a survival rate of 79.2% (SE 7.7%). The one factor demonstrating a direct infuence on failure after adjustment was a high-pre-injury level of physical (odds ratio 4.0 confdence interval 1.0–15.8, p=0.04).

Conclusion
The minimum 5 years survival rate after primary ACL repair using this technique was 70%. This value dropped to 56% in highly active patients performing competitive sports. Patients not sufering failure of repair demonstrated adequate restoration of knee laxity and high satisfaction. This study not only underlines the potential of ACL repair, but also highlights the danger of the procedure if strict patient selection is not appreciated.

Level of evidence Level
IV

BACK

Intraoperative fuoroscopy reduces the variability in femoral tunnel placement during single-bundle anterior cruciate ligament reconstruction

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Purpose
To evaluate the efect of using intraoperative fuoroscopy on femoral and tibial tunnel positioning variability in single-bundle anterior cruciate ligament (ACL) reconstruction.

Methods
A total of 80 consecutive patients with single-bundle ACL reconstruction between 2014 and 2016 were retrospectively reviewed. Among them, 40 underwent ACL reconstruction without fuoroscopy (non-fuoroscopy group) and 40 underwent fuoroscopy-assisted ACL reconstruction (fuoroscopy group). Femoral and tibial tunnel locations were evaluated using a standardized grid system with three-dimensional computed tomography images. Femoral and tibial tunnel location variability was compared between the groups.

Results
The operation time was longer in the fuoroscopy group than in the non-fuoroscopy group (61.3 ±5.2 min vs. 55.5±4.5 min, $p<0.001$). In the fuoroscopy group, a guide pin was repositioned in 16 (40%) cases on the femoral side and 2 (5%) cases on the tibial side. No signifcant diference in the femoral tunnel location was observed between the fuoroscopy and non-fuoroscopy groups (anterior–posterior plane, 29.0%±3.2% vs. 30.0%±6.1%; proximal–distal plane, 30.8%±4.8% vs. 29.4%±8.3%; all parameters, n.s.); variability was signifcantly lower in the fuoroscopy group ($p<0.001$ for both anterior–posterior and proximal–distal planes). No signifcant diference in the tibial tunnel location and variability was observed between the fuoroscopy and non-fuoroscopy groups (medial–lateral plane, 45.8%±2.0% vs. 46.6%±2.4%; anterior–posterior plane, 31.2%±4.0% vs. 31.0%±5.4%) (all parameters, n.s.).

Conclusions
Tunnel positioning with fuoroscopic assistance is feasible and efective in achieving consistency in femoral tunnel placement despite a slightly longer operation time. Intraoperative fuoroscopy can be helpful in cases wherein identifying anatomical landmarks on arthroscopy was difcult or for surgeons with less experience who performed ACL reconstruction.

Level of evidence
IV

BACK

Quadriceps tendon autograft ACL reconstructed subjects overshoot target knee extension angle during active proprioception testing

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Purpose
To compare the active joint position sense (JPS), muscle strength, and knee functions in individuals who had anterior cruciate ligament (ACL) reconstruction with quadriceps tendon autograft, hamstring tendon autograft, tibialis anterior allograft and healthy individuals. It was hypothesized that when compared to an age and gender-matched healthy control group, subjects who were post-ACL reconstruction would display impaired active joint position sense, knee extensor and fexor strength symmetry and knee function at 1 year post-surgery. A secondary hypothesis was that diferences would exist between the quadriceps tendon autograft, hamstring tendon autograft and tibialis anterior allograft groups.

Methods
Sixty-seven patients with ACL reconstruction and 20 healthy individuals were included. Active JPS reproduction was measured at 15°, 45° and 75° of knee fexion. International Knee Documentation Committee (IKDC) subjective score and one-leg hop test were used to assess the functional status of the patients.

Results
The JPS detection was diferent at the 15° target angle between groups ($F3.86=24.56$, $p<0.001$). A significantly higher proportion of quadriceps tendon autograft group patients failed to identify the 15° active JPS assessment position compared to the other groups ($p<0.0001$). The quadriceps index was lower in patients compared to healthy individuals ($p<0.001$), while the hamstring index was similar (n.s.). The knee functional outcomes were similar between ACL reconstructed groups and healthy controls (n.s.).

Conclusion
Knee proprioception deficits and impaired muscle strength were evident among patients at a mean 13.5 months post-ACL reconstruction compared with healthy controls. Patients who underwent ACL reconstruction using a quadriceps tendon autograft may be more likely to actively over-estimate knee position near terminal extension. Physiotherapists may need to focus greater attention on terminal knee extension proprioceptive awareness among this patient group.

Level of evidence
III

BACK

American Journal of Sports Medicine (AJSM), Volume 48, Issue 2

Prospective Randomized Comparison of Capsular Management Techniques During Hip Arthroscopy

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Background: Capsular management during hip arthroscopy remains controversial. Studies evaluating this topic consist mostly of retrospective comparative reviews of prospectively gathered data on a large series of patients.

Purpose/Hypothesis: The purpose was to perform a prospective randomized trial to comparatively assess 3 commonly performed capsular management techniques. It was hypothesized that capsular closure during hip arthroscopy would result in superior outcomes when compared with unclosed capsulotomy management techniques.

Study Design: Randomized controlled trial; Level of evidence, 2.

Methods: Patients (N = 150) who had hip arthroscopy with labral repairs and femoral osteoplasties performed by the senior author were randomly assigned into 3 groups at the time of their surgery: T-capsulotomy without closure (TC), interportal capsulotomy without closure (IC), and interportal capsulotomy with closure (CC). All patients underwent labral repair and femoral osteoplasty. Patient-reported outcomes were obtained preoperatively and at 3, 6, 12, and 24 months postoperatively. Other outcomes obtained included the need for future hip surgery.

Results: Patient demographics, preoperative patient-reported outcomes, and radiographic measurements were similar among all 3 groups. Revision hip arthroscopy was performed in 5 TC cases, 2 IC cases, and 1 CC case (P = .17). Conversion to hip arthroplasty occurred in 4 patients in the TC group and none in the IC and CC groups (P = .02). The CC group showed higher modified Harris Hip Score (mHHS) and Hip Outcome Score–Activities of Daily Living (HOS-ADL) at the 2-year follow-up when compared with the IC group (P = .003 and P < .001, respectively). When compared with the TC group, the CC group demonstrated superior mHHS (86.2 vs 76), HOS-ADL (85.6 vs 76.8), and HOS-SSS (Hip Outcome Score–Sports-Specific Subscale; 74.4 vs 65.3) at the final 2-year follow-up (P < .001). At the 2-year follow-up, the IC group had a higher mHHS (81.7 vs 76), HOS-ADL (82 vs 76.8), and HOS-SSS (71.4 vs 65.3; P > .001) as compared with the TC group.

Conclusion: Patients undergoing complete capsular closure during hip arthroscopy showed improved patient-reported and surgical outcomes when compared with those with unrepaired T-capsulotomy or interportal capsulotomy. These results suggest that repair after capsulotomy may be a favorable arthroscopic capsular management technique.

BACK

The Influence of Lumbosacral Spine Pathology on Minimum 2-Year Outcome After Hip Arthroscopy: A Nested Case-Control Analysis

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Background: Previous literature has examined the association between lumbosacral pathology and hip pathomechanics. However, the effect of lumbosacral pathologies and previous lumbosacral surgery on achieving meaningful outcomes after hip arthroscopy for femoroacetabular impingement syndrome (FAIS) has yet to be studied conclusively.

Purpose: To determine whether a history of lumbosacral spine pathology has an influence on achieving minimal clinically important differences (MCIDs) after hip arthroscopy for FAIS.

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

Methods: Patients undergoing hip arthroscopy for FAIS by a single, fellowship-trained orthopaedic surgeon between January 2012 and April 2017 with minimum 2-year follow-up were retrospectively reviewed. Patients with a history of lumbosacral spine pathology (eg, lumbosacral fusion, disc or vertebral pathology, or history of lumbosacral fractures) were matched 1:2 by age, body mass index, and sex to patients without spine pathology. Clinical outcomes including the Hip Outcome Score–activities of daily living subscale (HOS-ADL), HOS–sports subscale (HOS-SS), modified Harris Hip Score (mHHS), international Hip Outcome Tool–12 (iHOT-12), visual analog scale (VAS) pain, and VAS satisfaction were compared between the groups using an independent t test. The threshold of every outcome score for achieving MCID was calculated separately for each group and frequencies were compared.

Results: A total of 83 of 108 eligible patients with lumbosacral pathology were identified and matched to 166 patients without any spine pathology. When compared with the non–spine pathology group, the lumbosacral pathology group had significantly lower 2-year postoperative outcome score averages across all reported outcome tools (all $P < .001$). There were significant differences in the proportion achieving the threshold for HOS-ADL (60.6% vs 80.0%; $P = .004$), HOS-SS (57.6% vs 82.1%; $P < .001$), mHHS (66.7% vs 81.7%; $P = .025$), and iHOT-12 (54.8% vs 87.6%; $P < .001$) scores for MCID when comparing the lumbosacral and nonlumbosacral pathology groups.

Conclusion: Patients with a history of lumbosacral pathology achieved significantly lower short-term meaningful clinical outcomes after undergoing hip arthroscopy for FAIS when compared with patients without spine pathology. The present study findings have implications for preoperative patient screening, shared decision-making processes/expectation management, and rehabilitation strategies.

BACK

What Neuromonitoring Changes Can Be Expected During Hip Arthroscopy in the Pediatric Population?

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Background: As its indications have evolved, hip arthroscopy is now performed more frequently in pediatric patients. However, despite this increase, there is a lack of evidence in the literature about its safety in this population in regard to traction injury of the nerves of the lower extremity.

Purpose: To determine neuromonitoring changes of the sciatic, femoral, and obturator nerves during hip arthroscopy in the pediatric population and determine the rate of and risk factors for clinical neurapraxia.

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

Methods: A retrospective review was performed of all pediatric patients who underwent hip arthroscopy with neuromonitoring from December 2013 to October 2018. Neuromonitoring included somatosensory evoked potentials (SSEPs) in the peroneal and posterior tibial nerves and electromyography (EMG) signal for the obturator, femoral, and peroneal and posterior tibial nerves. Traction was applied using a radiolucent traction table. We recorded total traction time, surgery time, SSEP changes >50% after traction application, and EMG activity. We also recorded whether there was a clinical neurapraxia and when nerve function returned, and analyzed surgical and patient characteristic data for risk factors for neurapraxia.

Results: A total of 89 patients had hip arthroscopy (median traction time, 69 minutes). SSEP changes >50% occurred in 78% of patients in the peroneal nerve and 73% in the posterior tibial nerve. EMG activity was observed in 9% of patients in the obturator nerve, 8% in the femoral nerve, 12% in the peroneal nerve, and 8% in the posterior tibial nerve. Clinical neurapraxia was seen in 19% of patients in either the peroneal nerve or posterior tibial nerve but resolved by 2 days postoperatively. Those who sustained a neurapraxia had a 32-minute longer surgery and 6-minute longer traction time. The clinical rate of neurapraxia of the pudendal nerve was 0%.

Conclusion: Neuromonitoring changes are common during hip arthroscopy and nearly 1 in 5 pediatric patients will have some decreased sensation in either the peroneal or the posterior tibial nerve that resolves within 1 to 2 days after surgery. In pediatric patients, longer surgery and traction times during hip arthroscopy are associated with a higher rate of neurapraxia than that reported for adults.

BACK

Application of Machine Learning for Predicting Clinically Meaningful Outcome After Arthroscopic Femoroacetabular Impingement Surgery

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https://doi-org.vu-nl.idm.oclc.org/10.1177/0363546519892905

Background: Hip arthroscopy has become an important tool for surgical treatment of intra-articular hip pathology. Predictive models for clinically meaningful outcomes in patients undergoing hip arthroscopy for femoroacetabular impingement syndrome (FAIS) are unknown.

Purpose: To apply a machine learning model to determine preoperative variables predictive for achieving the minimal clinically important difference (MCID) at 2 years after hip arthroscopy for FAIS.

Study Design: Case-control study; Level of evidence, 3.

Methods: Data were analyzed for patients who underwent hip arthroscopy for FAIS by a high-volume fellowship-trained surgeon between January 2012 and July 2016. The MCID cutoffs for the Hip Outcome Score–Activities of Daily Living (HOS-ADL), HOS–Sport Specific (HOS-SS), and modified Harris Hip Score (mHHS) were 9.8, 14.4, and 9.14, respectively. Predictive models for achieving the MCID with respect to each were built with the LASSO algorithm (least absolute shrinkage and selection operator) for feature selection, followed by logistic regression on the selected features. Study data were analyzed with PatientIQ, a cloud-based research and analytics platform for health care.

Results: Of 1103 patients who met inclusion criteria, 898 (81.4%) had a minimum of 2-year reported outcomes and were entered into the modeling algorithm. A total of 74.0%, 73.5%, and 79.9% met the HOS-ADL, HOS-SS, and mHHS threshold scores for achieving the MCID. Predictors of not achieving the HOS-ADL MCID included anxiety/depression, symptom duration for >2 years before surgery, higher body mass index, high preoperative HOS-ADL score, and preoperative hip injection (all $P < .05$). Predictors of not achieving the HOS-SS MCID included anxiety/depression, preoperative symptom duration for >2 years, high preoperative HOS-SS score, and preoperative hip injection, while running at least at the recreational level was a predictor of achieving HOS-SS MCID (all $P < .05$). Predictors of not achieving the mHHS MCID included history of anxiety or depression, high preoperative mHHS score, and hip injections, while being female was predictive of achieving the MCID (all $P < .05$).

Conclusion: This study identified predictive variables for achieving clinically meaningful outcome after hip arthroscopy for FAIS. Patient factors including anxiety/depression, symptom duration >2 years, preoperative intra-articular injection, and high preoperative outcome scores are most consistently predictive of inability to achieve clinically meaningful outcome. These findings have important implications for shared decision-making algorithms and management of preoperative expectations after hip arthroscopy for FAI.

BACK