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Upper extremity

Arthroscopy, Volume 35, Issue 5

A Superolaterally Placed Anchor for Subscapularis "Leading-Edge" Refixation: A Biomechanical Study

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Arthroscopy, Volume 35, Issue 5, Received: June 9, 2018; Accepted: November 25, 2018

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Purpose
To compare a conventional single-row (SR) repair technique and 2 double-row (DR) repair techniques to restore and protect the superolateral aspect of the subscapularis (SSC) tendon and ensure SSC leading-edge reconstruction in a cadaveric model.

Methods
The native footprint was measured in 15 pairs of human cadaveric shoulders (N = 30) with a mean age of 67.2 years. According to the Fox-Romeo classification, a 25% defect or 50% defect in a superior-inferior direction was created. Specimens were mounted onto a servohydraulic test system to analyze contact variables at 0° and 20° of abduction with a force-controlled ramped program up to 50 N. In addition, each specimen was cyclically loaded (10-100 N, 300 cycles). The tears were repaired with 1 of 3 constructs: a 2-anchor medially based conventional SR construct, a 2-anchor-based hybrid DR construct, or a 3-anchor-based DR construct. The outcome variables were ultimate tensile load, displacement, and pressurized footprint coverage.

Results
All reconstructions resulted in stable constructs with peak loads exceeding 450 N (P = .68). The overall displacement during cyclic loading was between 1.2 and 3.0 mm (P = .70). A significant difference was seen when the 2 arm positions of 0° and 20° of abduction were compared, showing a constant reduction of pressurized footprint coverage with the arm abducted (P = .01). Analyzing footprint coverage with respect to the region of interest—the leading edge of the SSC—we observed a significant difference between the SR construct and a construct using a superolaterally placed anchor (25% defect, P = .01; 50% defect, P = .01), whereas no statistical differences were detectable between the hybrid DR construct and the DR construct.

Conclusions
The leading edge of the SSC tendon can best be restored by using a superolateral anchor, whereas no statistical difference in load to failure in comparison with an SR construct or with the addition of a third anchor was detectable.

Clinical Relevance
The SSC is critical for proper shoulder function. Without an increase in the number of implants, a significantly better footprint reconstruction can be achieved by placing an anchor superior and lateral to the native footprint area close to the entrance of the bicipital groove.

BACK

Insulin Dependence Is Associated With Increased Medical Complications and Mortality After Shoulder Arthroscopy

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Purpose
To compare complications after shoulder arthroscopy in patients with insulin-dependent diabetes mellitus (IDDM), patients with non–insulin-dependent diabetes mellitus (NIDDM), and nondiabetic patients.

Methods
A retrospective analysis of the American College of Surgeons National Surgical Quality Improvement Program database for the years 2005 to 2016 was conducted. Logistic regression analyses were used to assess the relation between diabetic status (nondiabetic patients, n = 50,626; NIDDM patients, n = 5,332; and IDDM patients, n = 2,484) and outcomes. Multivariate models were established to adjust for age, sex, body mass index, hypertension, congestive heart failure, chronic obstructive pulmonary disease, smoking status, American Society of Anesthesiologists classification, and functional status.

Results
Patients with IDDM were at a higher risk of medical complications, with an adjusted odds ratio (AOR) of 1.524 (95% confidence interval [CI], 1.082-2.147), including pulmonary complications (AOR, 2.078; 95% CI, 1.089-3.964) and urinary tract infections (AOR, 2.129; 95% CI, 1.027-4.415). Patients with IDDM also had a higher risk of 30-day hospital admission (AOR, 1.581; 95% CI, 1.153-2.169) and 30-day mortality (AOR, 3.821; 95% CI, 1.243-11.750). Conversely, patients with NIDDM had comparable risks of medical and surgical complications, unplanned hospital admission, and death to nondiabetic patients.

Conclusions
Medical complications, 30-day hospital admission, and death after shoulder arthroscopy were more likely in patients with IDDM. These risks diminished among patients with NIDDM, with their risks being comparable with those of nondiabetic patients.

Level of Evidence
Level III, retrospective comparison study.

BACK

All-Arthroscopic Reconstruction of Severe Chronic Acromioclavicular Joint Dislocations

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Arthroscopy, Volume 35, Issue 5, Received: September 28, 2017; Accepted: November 23, 2018

https://doi.org/10.1016/j.arthro.2018.11.058

Purpose
To report the outcomes of all-arthroscopic coracoclavicular (CC) ligament reconstruction and simultaneous diagnosis and treatment of glenohumeral pathologies in patients with symptomatic, chronic (>6 weeks), complete (Rockwood type III-V) acromioclavicular joint (ACJ) separations.

Methods
We prospectively followed up 57 consecutive patients treated arthroscopically for chronic Rockwood type III (n = 11), type IV (n = 19), and type V (n = 27) ACJ dislocations. Previous ACJ surgery failed in 11 (19%). The mean delay between injury and surgery was 39 months (range, 6 months to 17 years). The mean age at surgery was 42 years (range, 19-71 years). After glenohumeral exploration, an arthroscopic modified Weaver-Dunn procedure with CC suture button fixation (Twinbridge) was performed. The CC reduction and tunnel position were analyzed with radiographs and computed tomography. The mean follow-up period was 36 months (range, 12-72 months).

Results
Intra-articular pathology was treated arthroscopically in 27 patients (48%): 17 labral tears, 8 rotator cuff tears (3 partial and 5 complete), and 15 biceps lesions (4 SLAP lesions and 11 subluxations). At last follow-up, 7 patients (12%) experienced recurrent ACJ instability: 2 frank dislocations (1 trauma and 1 infection) and 5 ACJ subluxations. There was no significant correlation between subluxation and clinical outcome. The rate of recurrent ACJ instability was significantly higher in patients with higher-grade ACJ dislocations ($P < .01$) and/or previous failed surgery ($P < .001$). Recurrent subluxation was observed in 3 cases of lateral migration of the coracoid button with lateral tunnel placement, as well as 2 cases of anterior migration of the clavicular button with anterior tunnel placement. The Constant score increased from 67 (range, 28-89) to 85.5 (range, 66-100), and the mean Subjective Shoulder Value increased from 54% to 85% ($P < .001$). At last follow-up, 95% of patients (54 of 57) were satisfied.

Conclusions
All-arthroscopic treatment allows successful CC ligament reconstruction and simultaneous diagnosis and treatment of frequently associated (48%) glenohumeral lesions. Higher-grade ACJ dislocations, previous ACJ surgery, and misplacement of bone tunnels are risk factors for recurrent instability.

Level of Evidence
Level IV, case series.

BACK

Diagnostic Value of Clinical Tests for Infraspinatus Tendon Tears

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Arthroscopy, Volume 35, Issue 5, Received: August 2, 2018; Accepted: December 3, 2018

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Purpose
To analyze and compare the diagnostic value and interpretation of 6 established clinical tests for infraspinatus tendon tears; to assess their ability to distinguish between partial- and full-thickness tears of the infraspinatus tendon; and to investigate whether conducting multiple tests increases the precision of diagnosis.

Methods
A total of 91 patients scheduled for shoulder arthroscopy from March 2015 to April 2017 were included in the present study. To assess the sensitivity, specificity, positive and negative predictive values, accuracy, diagnostic odds ratio, positive and negative likelihood ratios, and the area under the curve (AUC), intraoperative findings were compared with the results of 6 established clinical infraspinatus tests: the hornblower's test, the drop sign, the Patte sign, the external rotation lag sign (ERLS), the resisted external rotation test (RERT), and the infraspinatus scapular retraction test.

Results
A significant correlation was found between the results of the drop sign ($P = .02$), the ERLS ($P = .02$), and the RERT ($P = .02$) and the intraoperative findings. The RERT achieved the highest AUC (0.673). Assessing muscle weakness led to the highest diagnostic precision on the RERT (AUC = 0.673) as compared with pain (AUC = 0.528) or using both criteria (AUC = 0.655). No single clinical test was found to be useful in distinguishing between partial- and full-thickness tears. The combination of at least 2 or more tests improved the diagnostic precision significantly ($P \leq .007$). The combination of the RERT and the Patte sign showed the best AUC (0.681) and highest correlation with the intraoperative findings ($P = .023$).

Conclusions
The results of the present study indicate that out of all the clinical tests investigated, the drop sign and the RERT were in isolation able to accurately diagnose tears of the infraspinatus tendon. Only muscle weakness should be considered when interpreting the RERT because of its greater AUC values and correlation with the arthroscopic findings. The present study also showed that the analyzed tests are not capable of distinguishing between partial- and full-thickness tears of the infraspinatus tendon and that the combination of at least 2 tests improved the diagnostic value. The combination of the RERT and the Patte sign showed the best AUC and highest correlation with the intraoperative findings.

Level of Evidence
Level II, diagnostic study, prospective comparative study.

BACK

Comparison of Clinical Outcomes and Computed Tomography Analysis for Tunnel Diameter After Arthroscopic Bankart Repair With the All-Suture Anchor and the Biodegradable Suture Anchor

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Arthroscopy, Volume 35, Issue 5, Received: March 8, 2018; Accepted: December 7, 2018

https://doi.org/10.1016/j.arthro.2018.12.011

Purpose
To compare the clinical outcomes and radiological findings at the anchor site after arthroscopic Bankart repair with all-suture anchors and biodegradable suture anchors in patients with recurrent anterior shoulder dislocation.

Methods
The patients who underwent arthroscopic Bankart repair were divided into 2 groups depending on the type of the suture anchor used in different periods. Power analysis was designed based on the postoperative Rowe score. Clinical outcomes, including the Rowe score, American Shoulder and Elbow Surgeons score, subjective instability, and redislocation rates were evaluated. In all patients enrolled, the tunnel diameter of the anchor was assessed with computed tomography arthrogram at 1 year postoperatively. The Institutional Review Board of Ewha Womans University approved this study (no. EUMC 2017-05-058).

Results
A total of 67 patients were enrolled: 33 underwent surgery with a 1.3-mm (single-loaded) or 1.8-mm (double-loaded) all-suture anchor (group A), and 34 underwent surgery with a 3.0-mm biodegradable anchor (10.8 mm in length, 30% 1,2,3-trichloropropane/70% poly-lactide-co-glycolic acid) (group B). There were no significant differences in clinical outcomes between groups A and B in the American Shoulder and Elbow Surgeons score (preoperatively, 51.2 ± 13.7 vs 47.7 ± 12.2; 2 years postoperatively, 88.5 ± 12.3 vs 89.7 ± 10.9; P = .667) and Rowe score (preoperatively, 41.4 ± 10.5 vs 41.3 ± 9.4; 2 years postoperatively, 87.9 ± 14.9 vs 88.5 ± 14.6; P = .857). Postoperative redislocation (6.1% vs 5.9%, P = .682) and subjective instability rate (12.2% vs 17.7%, P = .386) of both groups showed no significant difference. Average tunnel diameter increment was significantly greater with the 1.8-mm all-suture anchor (2.8 ± 0.9 mm) than the 1.3-mm all-suture anchor (1.2 ± 0.8 mm) and 3.0-mm biodegradable anchor (0.8 ± 1.2 mm) (P < .001).

Conclusions
Arthroscopic Bankart repair with the all-suture anchor showed comparable clinical outcomes and postoperative stability as the conventional biodegradable suture anchor at 2 years after surgery. Tunnel diameter increment of the all-suture anchor was significantly greater than that of the biodegradable suture anchor at the 1-year computed tomography analysis. Although tunnel diameter increment was greater with the all-suture anchor, it did not influence the clinical outcomes.

Level of Evidence
Level III, retrospective comparative study.

BACK

Impact of Remplissage on Global Shoulder Outcome: A Long-Term Comparative Study

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Purpose
To evaluate the global function of patients treated by arthroscopic shoulder stabilization with or without remplissage at a minimum of 10 years of follow-up.

Materials
The inclusion criteria were existence of a recurrent anterior shoulder dislocation, with or without a Hill-Sachs lesion. The exclusion criteria were prior shoulder stabilization surgery and patients with a glenoid lesion that had been stabilized using the Latarjet procedure. Included patients with a Hill-Sachs lesion underwent surgical remplissage, and the others had Bankart repair only. The main criterion for failure was recurrence of instability or apprehension. The Rowe score and the Walch-Duplay score were used to assess shoulder function before surgery and 10 years afterward, in clinical reviews or telephone interviews.

Results
Seventy-nine patients underwent surgical Bankart repair with or without remplissage between November 2004 and January 2008 and were followed up for a mean duration of 128 months (range, 120-150); 12 patients were lost to follow-up, and 39 patients had Bankart stabilization only: the mean Instability Severity Index Score was 2.3 (range, 0-6). Three patients had recurrence with new dislocation, and 8 patients had apprehension. The Rowe score progressed from 54.3 (range, 25-65) to 83.8 (range, 70-100; $P < .01$), and the Walch-Duplay score rose from 46.8 (range, 25-75) to 85.6 (range 70-100; $P < .01$). Twenty-eight patients had arthroscopic Bankart repair + remplissage; the mean Instability Severity Index Score was 1.8 (range, 1-4). There was no recurrence, and no patient had apprehension. The Rowe score progressed from 51.8 (range, 20-65) to 92.3 (range, 70-100; $P < .01$), and the Walch-Duplay score rose from 58.7 (range, 30-75) to 91.4 (range, 70-100; $P < .01$). Functional scores in the second group were statistically significant better than in the first one.

Conclusions
Bankart repair combined with remplissage seems to be an effective method for restoring joint stability in patients with recurrent anterior shoulder dislocation with an associated Hill-Sachs lesion at a minimum of 10 years of follow-up. This technique appears to deliver better functional results than Bankart repair only, showing better scores for mobility and stability in the remplissage group. Limitations (pain and restriction of motion) reported in literature at short-term follow-up for this technical procedure do not seem to be anymore an issue at long-term follow-up.

Level of Evidence
Level III, retrospective comparative study.

BACK

Biomechanical Analysis of Medial-Row All-Suture Suture Anchor Fixation for Rotator Cuff Repair in a Pair-Matched Cadaveric Model

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Purpose
To compare the biomechanical properties of all-suture suture anchors (ASSAs) with conventional suture anchors (CSAs) for double-row rotator cuff repair (RCR).

Methods
Fourteen fresh-frozen human cadaveric shoulders were randomized into 2 RCR treatment groups: ASSA and CSA. All constructs received a double-row repair, with the lateral-row implants consisting of two 5.5-mm PEEK (polyether ether ketone) Footprint anchors. Each construct was loaded to a 10-N preload for 2 minutes, followed by cyclic loading from 10 to 160 N at a rate of 100 N/s for 100 cycles. Load-to-failure testing was performed immediately after cyclic loading testing at 1 mm/s from the zero position until failure. Cyclic creep, elongation amplitude, maximum load, stiffness, energy, and failure mode were recorded.

Results
No significant difference in cyclic creep (P = .117) or elongation amplitude (P = .428) was found between the ASSA and CSA groups during cyclic testing. Three specimens in each group (43% in each) failed by the suture tearing through the tendon. The remaining specimens in each group failed by the anchor pulling out of the humeral head. The mean maximum load was 617.73 ± 177.77 N and 545.13 ± 212.98 N for the ASSA and CSA groups, respectively (P = .339). Maximum elongation before failure was not different between groups (P = .122). Mean energy and stiffness were not statistically different between the ASSA and CSA groups (P = .629 and P = .973, respectively).

Conclusions
In this cadaveric analysis with a simplified unidirectional experimental setup, failure mechanics and maximum load between the ASSA and CSA constructs were similar, with no difference in energy and stiffness. Although the ASSA group showed slightly larger elongation than the CSA group, these differences may not be clinically relevant.

Clinical Relevance
This study provides a biomechanical head-to-head comparison of ASSAs and CSAs, indicating that ASSAs may be clinically equivalent to CSAs for use in an RCR.

BACK

Nonoperative Treatment of Rotator Cuff Disease With Platelet-Rich Plasma: A Systematic Review of Randomized Controlled Trials

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Arthroscopy, Volume 35, Issue 5, Received: May 23, 2018; Accepted: October 21, 2018

https://doi.org/10.1016/j.arthro.2018.10.115

Purpose
To perform a systematic review of randomized controlled trials on the use of platelet-rich plasma (PRP) for nonoperative treatment of rotator cuff disease.

Methods
Using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, 2 reviewers independently screened the MEDLINE, Embase, and Cochrane Library databases for prospective, randomized controlled trials comparing PRP with a control in the nonoperative treatment of chronic rotator cuff disease for inclusion. Clinical data were extracted and evaluated. The quality of evidence was assessed using The Cochrane Collaboration risk-of-bias tool.

Results
Five randomized controlled trials met the inclusion criteria, with 108 patients treated with PRP and 106 treated with a control. The mean age was 53.7 years, and 61.6% of patients were female patients. All of the studies found that the groups receiving PRP injections experienced improved clinical outcomes at final follow-up compared with baseline. Two studies found that PRP resulted in improved outcomes, mostly pain scores, compared with a control. One study compared PRP with formal exercise versus a saline solution injection with formal exercise therapy. It showed no difference in clinical outcomes between PRP and a saline solution injection when formal exercise therapy was used. Two other studies reported that PRP alone resulted in inferior outcomes to control groups receiving formal exercise therapy.

Conclusions
The currently limited available evidence on PRP for nonoperative treatment of chronic rotator cuff disease suggests that in the short term, PRP injections may not be beneficial. When directly compared with exercise therapy, PRP does not result in superior functional outcomes, pain scores, or range of motion. However, interpretation of this literature is confounded by the lack of reporting of the cytology and characteristics of PRP.

Level of Evidence
Level II, systematic review of Level I and II evidence.

BACK

Journal of Shoulder and Elbow Surgery (JSES), Volume 28, Issue 5

Liposomal bupivacaine reduces opiate consumption after rotator cuff repair in a randomized controlled trial

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DOI: https://doi.org/10.1016/j.jse.2019.01.008

Background
Arthroscopic rotator cuff repair (ARCR) provides excellent clinical outcomes but is often associated with significant postoperative pain. The use of intraoperative anesthesia in conjunction with multimodal pharmacologic strategies is a widely accepted approach for managing surgical pain and reducing opiate use. The purpose of this study was to determine whether using a combined field and suprascapular nerve block with liposomal bupivacaine (LB) in addition to an interscalene block would provide greater pain relief and a reduction in opiate consumption compared with an interscalene block alone.

Methods
The study enrolled 50 patients with full-thickness rotator cuff tears undergoing primary ARCR surgery. Patients were randomized to receive intraoperative LB (n = 25) or not (n = 25) and given postoperative “pain journals” to document visual analog scale pain scores and to track their daily opioid consumption during the first 5 postoperative days.

Results
Patients in the LB group reported statistically and clinically lower pain scores during postoperative days 1 and 2 ($P < .0001$ and $P = .03$, respectively). In addition, patients in the LB group consumed significantly fewer narcotics than the control group during the 5-day period, demonstrating a 64% reduction in total narcotic consumption ($P = .002$).

Conclusion
The findings of this study suggest that the addition of LB to multimodal anesthetic protocols significantly reduces the acute perioperative pain experienced following rotator cuff repair and the number of narcotic pills consumed in the first 5 days after ARCR. Furthermore, the findings provide guidelines for postoperative narcotic prescribing to reduce the quantity of opiates prescribed.

Level of evidence:
Level II, Randomized Controlled Trial, Treatment Study

BACK

Predictors of allocation to surgery in patients older than 50 years with partial-thickness rotator cuff tear

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DOI: https://doi.org/10.1016/j.jse.2018.12.014

Background
The purpose of this study was to determine the predictive factors for allocation to surgery in patients older than 50 years with symptomatic chronic partial-thickness rotator cuff tear (PTRCT).

Methods
Patients older than 50 years with a confirmed diagnosis of unilateral isolated PTRCT were included in this retrospective study. In the minimum follow-up of 2 years, eventual allocation to surgical or nonsurgical treatment was determined individually. Patients who underwent surgery were defined as failed conservative management and allocation to surgery. Data pertaining to patients' demographics, functional comorbidity index values, duration of symptoms, and American Shoulder and Elbow Surgeons scores were collected from our medical records. Tear side and Ellman classification, subacromial spur, and acromiohumeral intervals were also noted. A regression analysis was performed to determine the major predictors of allocation to surgery.

Results
There were 202 patients with a mean age of 62 years in group I (no-surgery group) and 70 patients with a mean age of 57 years in group II (surgery group). The mean age and functional comorbidity index values were significantly higher in group I than in group II ($P < .001$ and $P < .001$, respectively). Bursal-sided tears were significantly more common in group II ($P = .026$). According to the findings of regression analysis, tear side and functional comorbidity index were the major predictors of allocation to surgery ($P = .015$ and $P < .001$, respectively).

Conclusion
Our study results indicate that in patients older than 50 years with PTRCTs, those with fewer comorbidities and bursal-sided PTRCTs were significantly more likely to undergo surgery.

Level of evidence:
Level II, Retrospective Design, Prognosis Study

BACK

Establishing clinically significant outcome after arthroscopic rotator cuff repair

Gregory L. Cvetanovich, Anirudh K. Gowd, Joseph N. Liu, Benedict U. Nwachukwu, Brandon C. Cabarcas, Brian J. Cole, Brian Forsythe, Anthony A. Romeo, Nikhil N. Verma, Nikhil N. Verma

DOI: https://doi.org/10.1016/j.jse.2018.10.013

Background
Outcomes reporting in rotator cuff repair (RCR) literature has been variable. The minimal clinical important difference (MCID), substantial clinical benefit (SCB), and patient acceptable symptomatic state (PASS) bridge the gap between statistical significance and clinical relevance.

Methods
The American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES), Single Assessment Numeric Evaluation (SANE), and Constant-Murley (Constant) scores were collected preoperatively and 1 year postoperatively for patients undergoing RCR between 2014 and 2017. An anchor-based approach was used to calculate the MCID, SCB change, and PASS for the ASES questionnaire.

Results
The study included 288 patients who underwent RCR. The MCID, SCB, and PASS were, respectively, 11.1, 17.5, and 86.7 for ASES, 4.6, 5.5, and 23.3 for the Constant score, and 16.9, 29.8, and 82.5 for the SANE score. Factors associated with reduced odds of achieving MCID were current smoking for ASES (odds ratio, 0.056) and single-row repair for the Constant score (odds ratio, 0.310). Workers' compensation patients had reduced odds of achieving ASES SCB (odds ratio, 0.267) and were associated with reduced odds of achieving PASS by ASES (odds ratio, 0.244), SANE (OR, 0.452), and Constant (odds ratio, 0.313). Lower preoperative scores were associated with achieving MCID and SCB and higher preoperative Constant scores associated with PASS ($P < .001$).

Conclusion
This study establishes MCID, SCB, and PASS for ASES, Constant, and SANE scores in patients undergoing RCR. Factors associated with failing to achieve clinically significant values included current smoking, single-row repairs, high body mass index, and workers' compensation status.

Level of evidence:
Basic Science Study, Development or Validation of Outcomes Instrument

BACK

American Journal of Sports Medicine (AJSM), Volume 47, Issue 6

Comparison of Structural Integrity and Functional Outcome Between Delaminated and Nondelaminated Rotator Cuff Tears After En Masse Arthroscopic Repair: A Retrospective Cohort Study With Propensity Score Matching

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Background
Arthroscopic repair of delaminated rotator cuff tears (RCTs) has shown poor prognoses. Despite the importance of delaminated tears, only a few studies have compared delaminated and nondelaminated tears.

Purpose
This study aimed to compare the clinical outcomes and structural integrity after en masse arthroscopic rotator cuff repair between delaminated and nondelaminated RCTs and to evaluate whether infraspinatus tendon involvement affects the prognosis for delaminated tears after arthroscopic cuff repair, through use of propensity score matching for precise comparison.

Study Design
Cohort study; Level of evidence, 3.

Methods
This study included 180 consecutive patients with medium- or large-sized RCTs who had an arthroscopic rotator cuff repair with a minimum 2-year follow-up, of whom 57 and 123 had delaminated tears (group 1) and nondelaminated tears (group 2), respectively. The en masse repair technique using a single-row or transosseous-equivalent double-row suture-bridge technique was used for of all the delaminated cases. Preoperative and postoperative visual analog scale pain scores, shoulder active range of motion, American Shoulder and Elbow Surgeons (ASES) scores, and Constant scores were assessed. Magnetic resonance imaging was performed at least 24 months postoperatively to identify retear of the repaired rotator cuffs. After propensity score matching, 32 cases in both groups were successfully matched, and the clinical and radiological results were analyzed.

Results
Before propensity score matching, postoperative clinical outcomes were improved, showing no significant differences between the groups, excluding forward elevation ($P = .011$). Groups 1 and 2 had 17 (29.8%) and 11 retear cases (8.9%), respectively ($P < .001$). After propensity score matching, only the ASES score (72.5 vs 77.1) showed a significant superiority in group 2 ($P = .038$). Propensity-matched groups 1 and 2 had 8 (25.0%) and 2 (6.3%) retear cases, respectively ($P = .034$). No significant difference was found in structural integrity depending on whether the RCT included the infraspinatus tendon (IST). The odds ratio for retear of the delaminated tears, including IST, was 5.5 (95% confidence interval, 1.0-30.0, $P = .038$).

Conclusion
Delaminated RCT was a negative prognostic factor of structural integrity after repair and could affect the functional outcome. However, whether IST tear was involved had no effect on the prognosis after repair.

BACK

Does Arthroscopic Suture-Spanning Augmentation of Single-Row Repair Reduce the Retear Rate of Massive Rotator Cuff Tear?

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Background
Several surgical techniques have been proposed for massive rotator cuff tears (MRCTs), but the failure rates remain high. The suture-spanning augmentation technique of single-row (SSA-SR) repair was shown to reduce failure rates in cadaveric studies, but the outcome in vivo remains unclear.

Purpose
To determine if adding spanning sutures to SR repair during MRCT repairs can improve functional outcome and reduce failure rates.

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

Methods
The study included 71 patients with a diagnosed MRCT. The study group (n = 35) received SSA-SR repair. The control (n = 36) received SR repair. The American Shoulder and Elbow Surgeons (ASES) score, Constant score, UCLA (University of California, Los Angeles) score, and visual analog scale for pain were assessed preoperatively and 24 months postoperatively. Magnetic resonance imaging was arranged at 6 months postoperatively to evaluate the rotator cuff.

Results
At 6 months postoperatively, the overall retear rate was 31.0%. The retear rate was lower in the SSA-SR group (14.3%) than in the SR group (47.2%, P = .002). At 24 months, the SSA-SR group had markedly improved ASES, Constant, and UCLA scores in comparison with the SR group (P < .05). Within both groups, all scores had significant improvement as compared with the preoperative status (P < .05).

Conclusion
The SSA-SR repair technique showed improved functional and radiologic results. Based on the superior postoperative outcome of this technique, the SSA-SR repair technique can be a potential treatment option for MRCT repair.

BACK

Arthroscopic Repair of the Isolated Subscapularis Full-Thickness Tear: Single- Versus Double-Row Suture-Bridge Technique

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Background
No clinical comparative study has addressed isolated subscapularis tears after arthroscopic repair with either single-row or double-row suture-bridge technique.

Purpose/Hypothesis
The purpose of this study is to compare clinical outcomes and structural integrity after arthroscopic repair of an isolated subscapularis full-thickness tear with either the single-row technique or the double-row suture-bridge technique. The authors hypothesized that there would be no significant differences in clinical outcomes and structural integrity between approaches.

Study Design
Cohort study; Level of evidence, 3.

Methods
This study included 56 patients who underwent arthroscopic repair of an isolated subscapularis full-thickness tear with grade II or less fatty infiltration in the subscapularis muscle with either a single-row technique (n = 31) or a double-row suture-bridge technique (n = 25). Functional outcomes were assessed with the visual analog scale (VAS) for pain, Subjective Shoulder Value (SSV), American Shoulder and Elbow Surgeons (ASES) score, the University of California, Los Angeles (UCLA) shoulder score, and active range of motion. Magnetic resonance arthrography (MRA) or computed tomographic arthrography (CTA) was performed 6 months after surgery to assess the structural integrity of the repaired tendon.

Results
At the 2-year follow-up, all scoring parameters applied (VAS, SSV, ASES, and UCLA), subscapularis strength, and active range of motion improved significantly in both groups as compared with preoperative values ($P < .001$). However, there were no significant differences between groups in any of these clinical outcome measurements (VAS, 1.2 vs 1.1; SSV, 91.3 vs 91.8; ASES, 91.0 vs 91.4; UCLA, 31.9 vs 32.1). On follow-up MRA or CTA, the overall retear rate did not differ significantly between the single-row group (13%, 4 of 31) and the double-row group (12%, 3 of 25).

Conclusion
Arthroscopic single-row repair and double-row suture-bridge repair of isolated full-thickness subscapularis tears both yielded satisfactory clinical outcomes and structural integrity with no significant differences among patients with good muscle quality.

BACK

Lower Extremity

Arthroscopy, Volume 35, Issue 4

Low-Dose Computed Tomography Reduces Radiation Exposure by 90% Compared With Traditional Computed Tomography Among Patients Undergoing Hip-Preservation Surgery

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Purpose
To compare the delivered radiation dose between a low-dose hip computed tomography (CT) scan protocol and traditional hip CT scan protocols (i.e., “traditional CT”).

Methods
This was a retrospective comparative cohort study. Patients who underwent hip-preservation surgery (including arthroscopy, surgical hip dislocation, or periacetabular osteotomy procedures) at our institution between 2016 and 2017 were identified. Patients were excluded if they had a body mass index (BMI) greater than 35, they underwent previous surgery, or a radiation dose report was absent. The low-dose group included patients who underwent hip CT at our institution using a standardized protocol of 100 kV (peak), 100 milliampere-seconds (mAs), and a limited scanning field. The traditional CT group included patients who had hip CT scans performed at outside institutions. The total effective dose (Ehip), effective dose per millimeter of body length scanned, patients' age, and patients' BMI were compared by univariate analysis. The correlation of Ehip to BMI was assessed.

Results
The study included 41 consecutive patients in the low-dose group and 18 consecutive patients in the traditional CT group. Low-dose CT resulted in a 90% reduction in radiation exposure compared with traditional CT (Ehip, 0.97 ± 0.28 mSv vs 9.68 ± 6.67 mSv; $P < .0001$). Age (28 ± 11 years vs 26 ± 10 years, $P = .42$), sex (83% female patients vs 76% female patients, $P = .74$), and BMI (24 ± 3 vs 24 ± 3, $P = .75$) were not different between the 2 groups. Ehip had a poor but significant correlation to BMI in the low-dose CT group ($R2 = 0.14$, slope = 0.03, $P = .02$) and did not correlate to BMI in the traditional CT group ($R2 = 0.13$, $P = .14$).

Conclusions
A low-dose hip CT protocol for the purpose of hip-preservation surgical planning resulted in a 90% reduction in radiation exposure compared with traditional CT.

Level of Evidence
Level II, diagnostic study.

BACK

Increased Prevalence of Femoroacetabular Impingement in Patients With Proximal Hamstring Tendon Injuries

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Purpose
To determine the prevalence of clinically diagnosed femoroacetabular impingement (FAI) in a consecutive series of patients presenting with proximal hamstring tendon injury and to correlate this with pelvic anatomic factors.

Methods
The prevalence of clinically symptomatic cam-, pincer-, and mixed-type and overall FAI was calculated among a consecutive series of patients presenting to a hip preservation clinic with a confirmed clinical and radiographic diagnosis of proximal hamstring tendon injury between 2012 and 2017. The presence of a cam lesion was determined by an alpha angle > 50° on radiographs and computed tomography radial sequences of the head-neck junction and a femoral head-neck offset ratio < 0.18. Clinical diagnoses of osseous impingement were determined according to accepted pathomorphologic signs and measurements. A diagnosis of FAI was confirmed by imaging findings of acetabular overcoverage for pincer-type FAI and the presence of an anterior or lateral cam lesion for cam-type FAI.

Results
Overall, 120 hips in 97 patients (mean age, 45 years) were included in this study. A clinical diagnosis of FAI was noted in 70.8% of hips (pincer-type 9.2%, cam-type 40.8%, mixed-type 20.8%), an approximate 2- to 7-fold increased prevalence in comparison with the general population from prior studies.

Conclusions
The prevalence of FAI is high in patients with symptomatic proximal hamstring tendon pathology. Because FAI results in restriction of hip range of motion and altered pelvic tilt, future studies are warranted to investigate whether the presence of FAI acts as a predisposing factor for injury to the hamstring muscle complex.

Level of Evidence
Level IV, case series.

BACK

Arthroscopic Acetabular Labral Repair in Patients Over the Age of 60 Years: A Matched Case-Control Study

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Arthroscopy, Volume 35, Issue 5, Received: May 9, 2018; Accepted: November 7, 2018

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Purpose
To report the results of labral repair in a population of patients older than 60 years and compare these with a matched population of younger adults.

Methods
We compared 21 consecutive patients older than 60 years undergoing labral repair with minimum 1-year follow-up with a contemporaneous group of 21 patients aged 18 to 55 years matched for sex, degree of chondral damage, and associated femoroacetabular impingement or dysplasia.

Results
Follow-up averaged 18.9 months (range, 12-24 months). The average age in the study group was 63.2 years (range, 61-71 years), and 20 patients had femoroacetabular impingement whereas 1 had dysplasia. Of these patients, 19 had acetabular articular damage (grade IV in 2, grade III in 11, grade II in 5, and grade I in 1) and 6 had femoral changes (grade IV in 1 and grade III in 5). The average age in the control group was 35.8 years (range, 20-54 years). We found average improvements of 28.1 points for the modified Harris Hip Score and 37.5 points for the International Hip Outcome Tool score within the study group and 21.2 points for the modified Harris Hip Score and 37.1 points for the International Hip Outcome Tool score within the control group. No statistically significant difference between the 2 groups was noted in the amount of improvement, with statistically and clinically significant improvements noted in both. Two study group patients underwent total hip arthroplasty (THA) at an average of 10 months, with 1 control group THA at 11 months. All 3 patients with conversion to THA had combined grade IV acetabular and grade III femoral damage. No repeated arthroscopies were performed and no complications occurred in either group.

Conclusions
Patients older than 60 years can benefit from arthroscopic labral repair with improved outcomes, a modest rate of conversion to THA, and a small risk of complications. The results are comparable to those of younger adults. Combined bipolar grade IV and grade III articular damage may be a harbinger of conversion to THA regardless of age.

Level of Evidence
Level III, comparative therapeutic trial.

BACK

Trends in Hip Arthroscopic Labral Repair: An American Board of Orthopaedic Surgery Database Study

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Arthroscopy, Volume 35, Issue 5, Received: July 21, 2018; Accepted: November 7, 2018

https://doi.org/10.1016/j.arthro.2018.11.016

Purpose
The purpose of this study is to evaluate the trends in labral repair in American Board of Orthopaedic Surgery Part II candidates performing hip arthroscopy.

Methods
Candidates who performed arthroscopic hip surgery between 2011 and 2015 during their American Board of Orthopaedic Surgery Part II board collection period were identified using Current Procedural Terminology codes (29860, 29861, 29862, 29863, 29914, 29915, 29916). The proportion of hip arthroscopy cases including labral repair (Current Procedural Terminology code 29916) were calculated for each year and analyzed by fellowship training experience. Trends in labral repair utilization were calculated using univariate and regression analyses, with significance set at $P < .05$.

Results
During the study period, 1,606 hip labral repair cases were performed, with a 35% increase in utilization between 2011 and 2015. Overall, labral repair was performed in 64.8% (1,606/2,480) of hip arthroscopy cases, with a significant increase between 2011 and 2015 (47.4% vs 79.2%; $P < .001$). Of the hip arthroscopy cases including labral repair, 80.4% (1,291/1,606) were performed by candidates with sports medicine fellowship training. The proportion of hip arthroscopy cases including labral repair was highest for surgeons with sports medicine fellowship training compared with those without sports medicine fellowship training (66.1% vs 59.8%; $P = .007$). Candidates with sports medicine training performing at least 1 labral repair each year increased from 68% to 89% over the study period ($P = .0007$). The average number of labral repairs per candidate increased significantly over the duration of the study period ($P = .0072$).

Conclusions
Labral repair utilization during hip arthroscopy procedures nearly doubled from 2011 to 2015 for American Board of Orthopaedic Surgery Part II candidates, reflecting a significant change in practice. Current data suggest that nearly 80% of hip arthroscopy procedures include labral repair. These trends may reflect the current practice patterns at academic institutions with sports medicine fellowships.

BACK

Performance and Return to Sport After Hip Arthroscopy for Femoroacetabular Impingement in Professional Athletes Differs Between Sports

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Arthroscopy, Volume 35, Issue 5, Received: July 17, 2018; Accepted: October 27, 2018

https://doi.org/10.1016/j.arthro.2018.10.153

Purpose
To determine (1) return-to-sport rates for National Football League, Major League Baseball, National Basketball Association, and National Hockey League (NHL) athletes after hip arthroscopy for femoroacetabular impingement syndrome, (2) postoperative return-to-sport rate differences between sports, (3) differences in postoperative career length and games per season, (4) differences in preoperative and postoperative performance, and (5) postoperative performance compared with that of matched control players.

Methods
Professional athletes who underwent hip arthroscopy for femoroacetabular impingement syndrome were identified. Matched control players were identified by position, age, experience, and performance. Return to sport was defined as playing in at least 1 game after surgery. Continuous variables for each group were compared by using a 2-tailed paired-samples Student t test or $\chi 2$ test. A Bonferroni correction was used to control for multiple comparisons with statistical significance defined by a P value < .002.

Results
One hundred seventy-two players (86.4%) (mean age, 28.8 ± 5.2 years) were able to return to sport at an average of 7.1 ± 4.1 months. Athletes played 3.5 ± 2.4 years after surgery without significant differences between sports (P > .002). NHL players who underwent surgery played significantly fewer years (4.4 vs 3.3 years) (P < .001) and fewer games per season (4 fewer games) (P <.001) after surgery compared with control players. NHL players also had a significant decrease in performance after surgery compared with their performance before surgery (P < .001). In National Football League, Major League Baseball, and National Basketball Association athletes, no significant differences were found in games per season, career length, or preoperative performance compared with postoperative performance and performance of matched control players (P > .002).

Conclusion
The RTS rate for professional athletes after surgery for femoroacetabular impingement syndrome is high. Only NHL athletes had significantly shorter careers and played significantly fewer games per season compared with matched control players, with no difference between sports. NHL athletes had significantly worse postoperative performance compared with preoperative performance, with all other sports demonstrating a career-related decline similar to that of matched control players.

BACK

Midterm Outcomes of Iliopsoas Fractional Lengthening for Internal Snapping as a Part of Hip Arthroscopy for Femoroacetabular Impingement and Labral Tear: A Matched Control Study

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Arthroscopy, Volume 35, Issue 5, Received: February 22, 2018; Accepted: November 21, 2018

https://doi.org/10.1016/j.arthro.2018.11.050

Purpose
To report minimum 5-year outcomes and rate of painful snapping resolution for patients who underwent iliopsoas fractional lengthening (IFL) as a part of hip arthroscopy for femoroacetabular impingement (FAI) and labral tear. In addition, to match this group to a group of patients who underwent hip arthroscopy for FAI and labral tear without internal snapping.

Methods
Patients were eligible for inclusion if they underwent hip arthroscopy for treatment of FAI and labral tear with concomitant IFL for painful snapping and had preoperative baseline scores for modified Harris Hip Score, Nonarthritic Hip Score, Hip Outcome Score-Sports Subscale, and visual analog scale for pain. The exclusion criteria for this study were preoperative Tönnis grade >0, active workers' compensation claims, or previous ipsilateral hip conditions. These patients were matched to a control group of patients who did not have snapping or undergo IFL but who otherwise satisfied the same inclusion and exclusion criteria.

Results
There were 57 eligible cases (80.3% follow-up). Mean follow-up time was 69.3 months (from 60.0 to 91.9). All patient-reported outcomes measures demonstrated statistically significant improvements between preoperative and latest follow-up scores for the following measures ($P < .001$): modified Harris Hip Score (from 64.3 to 84.9), Nonarthritic Hip Score (from 61.7 to 85.2), Hip Outcome Score-Sports Subscale (from 47.0 to 75.0), and visual analog scale (from 6.5 to 2.2). Mean satisfaction was 8.1 out of 10. Painful snapping was resolved in 80.7% of cases. Ten hips (17.5%) required secondary arthroscopy at a mean of 30.5 months. Three hips (5.3%) required total hip arthroplasty at a mean of 57.5 months. One case (1.8%) had minor postoperative complications. There were no statistically significant differences between the groups in outcomes, complications, and secondary surgeries.

Conclusions
IFL as part of hip arthroscopy for treatment of FAI and labral tears demonstrated similar favorable improvement, complication rates, and secondary surgeries, when compared with a control group that did not undergo IFL.

Level of Evidence
Level III, retrospective comparative study.

BACK

Patients With Unilateral Femoroacetabular Impingement Syndrome Have Asymmetrical Hip Muscle Cross-Sectional Area and Compensatory Muscle Changes Associated With Preoperative Pain Level

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Arthroscopy, Volume 35, Issue 5, Received: August 28, 2017; Accepted: November 21, 2018

https://doi.org/10.1016/j.arthro.2018.11.053

Purpose
To compare the symptomatic hip muscle cross-sectional area (CSA) in patients with unilateral femoroacetabular impingement syndrome (FAIS) with the asymptomatic-side hip muscle CSA and to determine whether correlations exist between the hip muscle CSA and preoperative pain level, preoperative symptom duration, and postoperative function.

Methods
We performed a retrospective review of magnetic resonance imaging data of patients who underwent hip arthroscopy from January 2012 through June 2015 for the treatment of unilateral FAIS and who had a minimum of 2 years' follow-up after hip arthroscopy for FAIS. A picture archiving and communication system workstation with an embedded region-of-interest tool was used to measure the muscle CSA of both the symptomatic and asymptomatic sides in FAIS patients. One-way repeated-measures analyses of variance were used to determine differences between symptomatic and asymptomatic hip muscle CSAs. Spearman rank correlations were used to determine relations between the symptomatic-side hip muscle CSA and preoperative pain level, preoperative symptom duration, and multiple validated patient-reported outcomes to quantify the level of function.

Results
A total of 50 patients met the inclusion criteria and were analyzed. The mean age of the patients was 34.22 ± 14.12 years, and 64% were women. Specific muscles of the symptomatic hip displaying significantly decreased CSAs compared with the asymptomatic hip included the gluteus maximus ($P = .007$), gluteus minimus ($P = .022$), and rectus femoris ($P = .028$). The tensor fascia lata ($\rho = 0.358$; $P = .011$), pectineus ($\rho = 0.369$, $P = .008$), adductor longus ($\rho = 0.286$, $P = .044$), and obturator externus ($\rho = 0.339$, $P = .016$) showed a moderate positive correlation with preoperative pain level on a visual analog scale in unilateral FAIS patients. No associations were found between the symptomatic-side hip muscle CSA in patients with unilateral FAIS and symptom duration or patient-reported function.

Conclusions
Patients with unilateral FAIS have a significantly decreased muscle CSA in the symptomatic hip compared with the asymptomatic hip. The symptomatic-side hip muscle CSA was correlated with the preoperative pain level on a visual analog scale. The association between the muscle CSA and preoperative pain level may represent a compensatory change in muscle function around the hip joint in patients with unilateral FAIS.

Level of Evidence
Level IV, therapeutic case series.

BACK

The Patient Acceptable Symptomatic State of the 12-Item International Hip Outcome Tool at 1-Year Follow-Up of Hip-Preservation Surgery

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https://doi.org/10.1016/j.arthro.2018.11.072

Purpose
To determine the patient acceptable symptomatic state (PASS) cutoff score for the 12-item International Hip Outcome Tool (iHOT-12) for patients after hip-preservation surgery.

Methods
A multicenter hip arthroscopy registry containing deidentified patient data was analyzed to discriminate patients who achieved satisfactory results from patients who did not. Patients eligible for inclusion in the study were between 18 and 75 years of age, consented to undergo elective hip arthroscopy, and completed preoperative patient-reported outcome questionnaires. A receiver operating characteristic analysis was performed to determine the PASS cutoff score for the iHOT-12 at 1 year after surgery based on the sensitivity and specificity of achieving satisfaction with surgery. A visual analog scale rating patient satisfaction 1 year after surgery was documented and compared between subjects who achieved the PASS score for the iHOT-12 and those who did not achieve it through an independent t test with an a priori α set at .05.

Results
A total of 647 subjects (66% women) aged between 18 and 73 years (mean, 36.5 years; standard deviation [SD], 12.0 years) were included in the study. A cutoff score of 75.2 for the iHOT-12 yielded a sensitivity of 0.91 and specificity of 0.81. Satisfaction averaged 89.5% (SD, 18.0%) for the patients with iHOT-12 scores greater than the PASS cutoff score versus 60.9% (SD, 30.61%) for those who did not achieve the PASS iHOT-12 score.

Conclusions
The PASS cutoff score of 75.2 for the iHOT-12 establishes a “minimal” target score at which the patient is highly likely to be satisfied with the physical state of his or her hip joint at 1 year after hip arthroscopy.

Level of Evidence
Level III, case-control study.

BACK

Outcomes of Grade III Medial Collateral Ligament Injuries Treated Concurrently With Anterior Cruciate Ligament Reconstruction: A Multicenter Study

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Arthroscopy, Volume 35, Issue 5, Received: July 3, 2018; Accepted: October 29, 2018

https://doi.org/10.1016/j.arthro.2018.10.138

Purpose
To evaluate differences in repair and nonoperatively managed grade III medial collateral ligament (MCL) injuries during anterior cruciate ligament (ACL) reconstruction.

Methods
Patients enrolled in a multicenter prospective longitudinal group who underwent unilateral primary ACL reconstruction between 2002 and 2008 were evaluated. Patients with concomitant grade III MCL injuries treated either operatively or nonoperatively were identified. Concurrent injuries, subsequent surgeries, surgical chronicity, and MCL tear location were analyzed. Patient-reported outcomes were measured at time of ACL reconstruction and 2-year follow-up.

Results
Initially, 3,028 patients were identified to have undergone primary ACL reconstruction during the time frame; 2,586 patients completed 2-year follow-up (85%). Grade III MCL tears were documented in 1.1% (27 of 2,586): 16 operatively managed patients and 11 nonoperatively treated MCLs during ACL reconstruction. The baseline Knee Injury and Osteoarthritis Outcome Score (KOOS) and International Knee Documentation Committee scores were lower in patients who underwent operative MCL treatment. Reoperation rates for arthrofibrosis were 19% after repair and 9% after conservative management (P = .48). At 2 years, both groups significantly improved; however, the nonoperative MCL group maintained superior patient-reported outcomes in terms of minimal clinically important differences, but these differences did not reach statistical significance (KOOS sports/recreation [88.2 vs 74.4, P = .10], KOOS knee-related quality of life [81.3 vs 68.4, P = .13], and International Knee Documentation Committee [87.6 vs 76.0, P = .14]). Tibial-sided MCL injuries were associated with clinically inferior baseline scores compared with femoral-sided MCL (KOOS knee-related quality of life, 34.4 vs 18.5, P = .09), but these differences resolved by 2 years. Surgical chronicity did not influence 2-year outcome.

Conclusions
Both operative and nonoperative management of MCL tears in our patient group demonstrated clinical improvements between study enrollment and 2-year follow-up. MCL surgery during ACL reconstruction was assigned to patients with worse symptoms at enrollment and was associated with worse outcomes at 2 years. A subset of patients with severe combined ACL and medial knee injuries may benefit from operative management; however, that population has yet to be defined.

Level of Evidence
Level III, retrospective cohort.

BACK

A Biomechanical Study of the Role of the Anterolateral Ligament and the Deep Iliotibial Band for Control of a Simulated Pivot Shift With Comparison of Minimally Invasive Extra-articular Anterolateral Tendon Graft Reconstruction Versus Modified Lemaire Reconstruction After Anterior Cruciate Ligament Reconstruction

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Arthroscopy, Volume 35, Issue 5, Received: May 8, 2018; Accepted: November 4, 2018

https://doi.org/10.1016/j.arthro.2018.11.011

Purpose
To determine whether the deep fibers of the iliotibial band (dITB) or the anterolateral ligament (ALL) provides more control of a simulated pivot shift and whether a minimally invasive anterolateral reconstruction (ALR) designed to functionally restore the ALL and dITB is mechanically equivalent to a modified Lemaire reconstruction (MLR).

Methods
Six matched pairs of cadaveric knees (N = 12) were subjected to a simulated pivot shift to evaluate anteroposterior translation; internal rotation; and valgus laxity at 0°, 30°, and 90° of flexion. The anterior cruciate ligament (ACL) was sectioned in all specimens, and retesting was performed. Within each pair, sequential sectioning of the ALL and dITB was performed, followed by testing; the contralateral knee was sectioned in reverse order. Knees underwent ACL reconstruction (ACLR) and repeat testing. Then, MLR (n = 6) or ALR (n = 6) was performed on matched pairs for final testing.

Results
Sectioning of the dITB versus ALL (after ACL sectioning) produced significantly more anterior translation at all flexion angles (P = .004, P = .012, and P = .011 for 0°, 30°, and 90°, respectively). The ACL-plus-dITB sectioned state had significantly more internal rotation at 0° versus ACL plus ALL (P = .03). ACLR plus ALR restored native anterior translation at all flexion angles. ACLR plus MLR restored anterior translation to native values only at 0° (P = .34). We found no statistically significant differences between ACLR plus ALR and ACLR plus MLR at any flexion angle for internal rotation or valgus laxity compared with the native state.

Conclusions
ALR of the knee in conjunction with ACLR can return the knee to its native biomechanical state without causing overconstraint. The dITB plays a more critical role in controlling anterior translation and internal rotation at 0° than the ALL. The minimally invasive ALR was functionally equivalent to MLR for restoration of knee kinematics after ACLR.

Clinical Relevance
The dITB is more important than the ALL for control of the pivot shift. A minimally invasive extra-articular tendon allograft reconstruction was biomechanically equivalent to a modified Lemaire procedure for control of a simulated pivot shift.

BACK

Effect of Autologous Platelet-Rich Plasma and Gelatin Sponge for Tendon-to-Bone Healing After Rabbit Anterior Cruciate Ligament Reconstruction

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Purpose
To investigate platelet-rich plasma (PRP) combined with gelatin sponge (GS) to improve tendon-bone interface healing and structure formation.

Methods
Characterization of the GS scaffold was performed with a scanning electron microscope, and the release curve after loading with PRP was evaluated. A real-time reverse transcription quantitative polymerase chain reaction assay was performed to test the levels of tendon-to-bone healing–related gene expression. Finally, 18 New Zealand white rabbits were randomly divided into 3 groups and underwent semitendinosus autograft anterior cruciate ligament reconstruction: autograft group without PRP, PRP group, and PRP-GS group. All rabbits were killed 8 weeks after the operation. Magnetic resonance imaging scans, biomechanical testing, and histologic evaluation were performed.

Results
An enzyme-linked immunosorbent assay and cell counting kit-8 assay showed that the GS could control the release of PRP and prolong its bioactivity time, as well as promote bone marrow mesenchymal stem cell proliferation. In the PRP-GS group, the levels of related genes were upregulated compared with the PRP group ($P < .05$). Lower signal in the magnetic resonance images indicated fibrocartilage formation in the 2 groups with PRP. In addition, histologic staining showed that the tendon-bone connection had a greater fibrocartilaginous transition region in the PRP-GS group, and the histologic scores were higher (vs the PRP group, $P = .039$). The maximum failure load and stiffness were higher in the PRP-GS group than in the other 2 groups.

Conclusions
GS loading with PRP could prolong the bioactivity time of PRP and promote bone marrow mesenchymal stem cell proliferation and osteogenic gene expression in vitro. It also promoted the early healing process at the tendon-bone junction in a rabbit anterior cruciate ligament reconstruction model.

Clinical Relevance
GS is a natural material and offers satisfactory biocompatibility. Using GS as a scaffold to control the release of bioactive factors in bone tunnels may be useful, but additional studies in human subjects will be necessary to evaluate its clinical prospects.

BACK

Repair Augmentation of Unstable, Complete Vertical Meniscal Tears With Bone Marrow Venting Procedure: A Prospective, Randomized, Double-Blind, Parallel-Group, Placebo-Controlled Study

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Purpose
To compare the effectiveness and safety of meniscal repair in 2 groups of patients: meniscal repair with biological augmentation using a bone marrow venting procedure (BMVP) of the intercondylar notch versus meniscal repair only.

Methods
This single-center, prospective, randomized, double-blind, placebo-controlled, parallel-arm study included 40 patients (21 menisci in control, 23 in BMVP group) with complete vertical meniscus tears. Patients underwent all-inside and outside-in meniscal repair and a concomitant BMVP of the intercondylar notch or meniscal repair alone during an index arthroscopy. The primary endpoint was the rate of meniscus healing in the 2 groups assessed during a second-look arthroscopy (at week 35). The secondary endpoints were changes in the International Knee Documentation Committee score, Knee Injury and Osteoarthritis Outcome Score, Western Ontario and McMaster Universities Osteoarthritis Index, and visual analog scale in the 2 groups at 30 months.

Results
After 36 weeks, the meniscus healing rate was significantly higher in the BMVP-treated group than in the control group (100% vs. 76%, P = .0035). Functional outcomes were significantly better 30 months after treatment than at baseline in both groups. The International Knee Documentation Committee, Knee Injury and Osteoarthritis Outcome Score, Western Ontario and McMaster Universities Osteoarthritis Index, and visual analog scale scores were significantly better in the BMVP-treated group than in the control group. No adverse events were reported during the study period.

Conclusions
Our blinded, prospective, randomized, controlled trial on the role of BMVP augmentation in meniscus repair, indicates that BMVP augmentation results in a significant improvement in the rate of meniscus healing (100% vs. 76%, P = .0035). The risk of adverse events related to augmentation with BMVP of the arthroscopic meniscal repair is very low.

Level of Evidence
Level I, randomized controlled trial.

BACK

Influence of Sutures on Cartilage Integrity: Do Meniscus Sutures Harm Cartilage? An Experimental Animal Study

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Purpose
To evaluate whether different suture materials in meniscal repair may harm cartilage.

Methods
A preloaded linear friction testing setup including porcine knees with porcine cartilage, porcine meniscus, and different suture materials (braided nonabsorbable, absorbable monofilament) was used. Five groups with different tribological pairs were tested: cartilage on meniscus (control), cartilage on cartilage (control No. 2), and cartilage on different meniscus sutures (3 groups). Cartilage integrity was analyzed macroscopically by the India ink method and histologically using Giemsa-eosin–stained undecalcified methyl methacrylate sections. Cartilage lesions were classified by using a quantitative scoring system.

Results
The control groups did not show cartilage damage, either macroscopically or histologically. Loading cartilage with sutured menisci led to significant damage of the superficial radial and transitional zones with braided nonabsorbable ($P = .03$) and absorbable monofilament ($P = .02$) sutures at final examination. Menisci sutured with braided nonabsorbable material resulted in deeper damage to the cartilage. However, there were no significant differences between the suture materials. Sutures oriented perpendicular to surface motion led to a larger defect than parallel-oriented sutures.

Conclusions
Braided nonabsorbable and absorbable monofilament suture materials cause significant damage to cartilage during long-term cyclic loading in vitro. The extent of damage depends on suture orientation.

Clinical Relevance
This study provides data on the extent to which different suture materials in meniscus repair may harm cartilage.

BACK

Iatrogenic Medial Collateral Ligament Injury by Valgus Stress During Arthroscopic Surgery of the Knee

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Purpose
To evaluate the radiographic and clinical follow-up results of iatrogenic medial collateral ligament (MCL) injuries caused by valgus stress during arthroscopic surgery of the knee.

Methods
This study retrospectively evaluated 15 knees in 15 patients (8 female and 7 male patients), with a mean age of 58 years (range, 45-66 years), with iatrogenic MCL injuries caused by valgus stress during arthroscopic surgery of the knee. All patients were treated conservatively without an immobilizer or brace. The mean follow-up period was 24 months (range, 18-51 months). Evaluations included magnetic resonance imaging immediately postoperatively, as well as physical examinations and valgus stress radiographs (at 0° and 30° of knee flexion) 6 weeks after surgery and at final follow-up.

Results
Postoperative magnetic resonance imaging in all patients showed increased signal intensity, swelling, and partial loss of continuity at the meniscofemoral portion of the MCL. Physical examination showed mild tenderness in only 1 patient after 6 weeks and none at final follow-up. Valgus stress tests and valgus stress radiographs showed no significant differences between the injured and uninjured knees at 6 weeks postoperatively and at final follow-up ($P > .05$).

Conclusions
Iatrogenic MCL injuries during arthroscopic knee surgery could be treated successfully without a splint or brace.

Level of Evidence
Level IV, prognostic case series.

BACK

Age of 40 Years or Older Does Not Affect Meniscal Repair Failure Risk at 5 Years

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Purpose
To compare meniscal repair failure rates in patients aged 40 years or older versus patients younger than 40 years.

Methods
A total of 276 patients underwent meniscal repair surgery by a single sports medicine fellowship–trained surgeon between 2006 and 2012 and were eligible for study inclusion. Patients were followed up for meniscal repair failure, defined as meniscectomy, repeated meniscal repair, or total knee arthroplasty. Logistic regression analysis was used to determine the risk of failure while controlling for potential confounding variables including body mass index, sex, anterior cruciate ligament status, time from injury to surgery, number of implants used, tear pattern, and chondral status at the time of the repair.

Results
Among the 276 eligible patients, 221 (80%) were successfully contacted for follow-up at an average of 5 years after surgery. Of these patients, 56 were aged 40 years or older (mean, 47.2 years; standard deviation [SD], 5.3 years) and 165 were younger than 40 years (mean, 24.7 years; SD, 6.7 years). The overall meniscal repair failure rate over a 5-year period was 20%. Among patients aged 40 years or older, the failure risk was 18% versus 21% in patients younger than 40 years. After adjustment for confounding variables, age of 40 years or older was not associated with increased failure risk (adjusted odds ratio, 0.83; 95% confidence interval, 0.36-1.81; P = .65). The mean time to failure tended to be shorter in older patients, at 16.9 months (SD, 10.2 months) versus 28.5 months in the group younger than 40 years (SD, 23.3 months) (P = .04).

Conclusions
Age of 40 years or older is not associated with an increased risk of meniscal repair failure at 5 years, although a shorter time to failure was noted in this age cohort.

Level of Evidence
Level III, retrospective comparative study.

BACK

Midterm Outcomes of Arthroscopic Reduction and Internal Fixation of Anterior Cruciate Ligament Tibial Eminence Avulsion Fractures With K-Wire Fixation

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Purpose
To determine the clinical and radiological outcomes of patients who underwent arthroscopic reduction and internal fixation of a tibial eminence avulsion fracture with Kirshner wires (K-wires) at a mean of 8 years following surgery.

Methods
This was a retrospective study with prospectively collected data. Inclusion criteria consisted of patients who underwent arthroscopic reduction and internal fixation of tibial eminence fracture with K-wires between 1989 and 2015 at a minimum of 18 months follow-up. Assessment included the International Knee Documentation Committee Ligament Evaluation, Lysholm Knee Score, and clinical outcomes. Magnetic resonance imaging (MRI) was performed to evaluate the anterior cruciate ligament (ACL) and evidence of osteoarthritis.

Results
A total of 48 participants met the inclusion criteria, and 32 were reviewed at a mean of 8 years (range, 18-260 months) after surgery. The mean age at the time of surgery was 24.5 years (10-55 years). Subsequent ACL injury occurred in 5 participants (10.4%) on the index knee and in 1 participant also on the contralateral knee; 86% had a normal examination, and no patients had >5-mm side-to-side difference on instrumented testing. The mean International Knee Documentation Committee subjective score at 8 years was 86 (range, 40-100). On MRI scan assessment for osteoarthritic changes at final follow-up, 82% of participants had no evidence of chondral wear on the medial compartment and 73% had no changes in the lateral compartment according to Magnetic Resonance Image Osteoarthritis Knee Score classification. On MRI scan qualitative assessment of ACL and tibial eminence, 7 participants (32%) were found to have high signal at the fracture site. The mean medial tibial eminence height was 9.2 mm (range, 6.3 mm to 1.31 cm) and the lateral tibial eminence height was an average of 6.7 mm (range, 0.38-0.97 mm). Significant kneeling pain was reported by 8 participants (25%).

Conclusions
This study indicates that internal fixation with K-wires is an acceptable approach to reduce tibial eminence avulsion fractures, providing excellent clinical and radiological outcomes at a minimum of 18 months of follow-up.

Level of Evidence
Level IV, therapeutic case series.

BACK

A Biomechanical Comparison of Alternative Graft Preparations for All-Inside Anterior Cruciate Ligament Reconstruction

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Purpose
To biomechanically compare alternative graft constructs for all-inside anterior cruciate ligament (ACL) reconstruction in the event that the semitendinosus harvested is too narrow or too short to make a graft larger than 8 mm.

Methods
Bovine extensor tendons were used to make 6 different 9-mm-diameter grafts: traditional 4-strand, anastomosis 4-strand, 6-strand, 3-strand, button-fixation 4-strand, and loop-and-tack 4-strand grafts. The grafts were then subjected to cyclic biomechanical testing followed by failure loading. Force at 3 and 5 mm of displacement and ultimate force were recorded for all grafts.

Results
Compared with the traditional 4-strand graft, the only graft that showed significant biomechanical differences during the cyclic phase of testing was the button-fixation 4-strand graft, which was characterized by lower force at 3 mm of displacement (74 ± 34 N vs 122 ± 13 N, P = .004) and 5 mm of displacement (122 ± 35 N vs 172 ± 3 N, P = .006). During failure loading, ultimate force was significantly lower for both the 6-strand graft (491 ± 186 N, P = .041) and button-fixation 4-strand graft (326 ± 27 N, P < .001) than for the traditional 4-strand graft (778 ± 176 N). All other grafts were equivalent for the parameters tested.

Conclusions
The anastomosis 4-strand, 3-strand, and loop-and-tack 4-strand grafts do not biomechanically differ in cyclic loading and ultimate force from traditional 4-strand grafts. This study supports the use of anastomosis 4-strand, 3-strand, or loop-and-tack 4-strand grafts in the event that a traditional all-inside 4-strand graft cannot be prepared from a harvested semitendinosus tendon in ACL reconstruction.

Clinical Relevance
This study tests and describes alternatives to the traditional 4-strand semitendinosus autograft for all-inside ACL reconstruction in the event that the harvested tendon is not adequate.

BACK

Proximity of the Neurovascular Bundle During Posterior-Lateral Meniscal Repair: A Comparison of the Transpatellar, Anteromedial, and Anterolateral Portals

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Purpose
To compare the neurovascular proximity of the transpatellar portal with that of the medial and lateral portals and to determine the safe penetration depth for an all-inside device for use on the posterior horn lateral meniscus.

Methods
Dissection of the popliteal fossa was performed in 10 cadaveric knees to identify all structures. Arthroscopy was performed using penetration depths of 10, 12, 14, and 16 mm with the all-inside system through the anteromedial, anterolateral, and transpatellar portals. Penetrations were made 5 and 10 mm lateral to the posterior horn root at the meniscocapsular junction. Needle-tip distances were measured from the popliteal artery and vein, tibial nerve, and common peroneal nerve.

Results
Among 240 trials, the average distance to the popliteal neurovascular bundle using the medial, transpatellar, and lateral approaches was 6.9 mm, 6.5 mm, and 3.1 mm, respectively. The transpatellar-portal needle had a larger distance from the neurovascular bundle than the lateral portal ($P = .001$), with no statistical difference compared with the medial portal ($P = .58$). Compared with the position at a 10-mm distance from the root, the position at a 5-mm distance from the root was closer to the neurovascular bundle in all approaches ($P = .001$). The transpatellar approach set to 14 mm had a 5% rate of capsular underpenetration and 10% rate of gastrocnemius penetration. The transpatellar and medial portals had no neurovascular penetrations, whereas the lateral approach had a 14% rate of penetration ($P < .05$).

Conclusions
The transpatellar portal and anteromedial portal are in less proximity to the neurovascular bundle compared with the anterolateral portal for all-inside meniscal repair of the posterior horn lateral meniscus. Low rates of neurovascular penetration, gastrocnemius muscle penetration, and capsular underpenetration occurred with a depth setting of 14 mm.

Clinical Relevance
This study shows the utility of medial and transpatellar portals when using all-inside devices to repair posterior horn lateral meniscal tears and neurovascular proximity based on penetration depth.

BACK

Factors Associated With Clinically Significant Patient-Reported Outcomes After Primary Arthroscopic Partial Meniscectomy

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Purpose
The purpose of this study was to establish minimal clinically important difference (MCID), substantial clinical benefit (SCB), and patient-acceptable symptom state (PASS) after meniscectomy and factors associated with achieving these goals.

Methods
A prospectively maintained institutional registry was retrospectively reviewed for all patients undergoing isolated arthroscopic partial meniscectomy from 2014 through 2017. MCID, SCB, and PASS were calculated for the International Knee Documentation Committee (IKDC) and Knee Injury and Osteoarthritis Outcome Score (KOOS) subscores by using the anchor-based methodology and nonparametric receiver operating characteristic curves. Subscores included joint replacement (JR), physical function (PF), symptoms (Sx), pain, activities of daily living (ADL), sport, and quality of life (QOL).

Results
A total of 269 patients were analyzed in the study, which reported outcomes between 6 and 7 months after surgery. The average age of our population was 48.9 ± 12.4 years. Twenty patients reported no change, 53 reported minimal improvement, and 137 reported substantial change after surgery; whereas 59 patients reported worse outcomes. One hundred seventy-seven patients were satisfied and 92 were not satisfied with the outcome of surgery. Established MCID/SCB/PASS for the IKDC, KOOS JR, KOOS PF, KOOS Sx, KOOS Pain, KOOS ADL, and KOOS QOL were 10.6/25.3/57.9, 10.7/13.2/68.3, -8.2/-11.3/26.2, 8.9/7.1/71.4, 9.7/22.2/76.4, 11.0/16.9/89.0, 12.5/27.5/55.6, and 15.6/34.4/46.9, respectively. Higher preoperative scores were associated with reduced odds of achieving MCID and SCB but greater odds of achieving PASS for nearly all scores ($P < .05$). Workers' compensation status, degenerative tears, medial-sided tears, and root tears were associated with reduced odds of achieving 2 or more clinically meaningful outcomes in 2 or more scores ($P < .05$).

Conclusions
Clinically meaningful outcomes were established by patient self-assessment. Variables associated with achieving these outcomes include preoperative score (positively correlated with MCID/SCB, negatively correlated with PASS); workers' compensation; degenerative, medial-sided tears; and root tears (remaining negatively correlated with MCID/SCB/PASS). These variables should be accordingly measured for confounding in future outcome reporting.

BACK

What Are the Primary Cost Drivers of Anterior Cruciate Ligament Reconstruction in the United States? A Cost-Minimization Analysis of 14,713 Patients

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Purpose
To analyze the individual costs associated with anterior crucial ligament reconstruction (ACLR), accounting for patient demographics, perioperative decision making, and location of the surgical procedure (hospital vs ambulatory surgery center), utilizing a cost-minimization analysis in a large national database.

Methods
Univariate analysis and multiple linear regression were performed to determine which patient and surgical variables were the largest cost drivers for ACLR in the United States according to the State Ambulatory Surgery and Services Database.

Results
The average cost for ACLR (n = 14,713) was $24,707 (standard deviation, $15,644). When patient variables were considered, younger age ($P < .001$), male sex ($P < .001$), Hispanic ethnicity ($P < .001$), number of chronic medical conditions ($P < .001$), Medicare insurance ($P < .001$), and quartile of household income ($P < .001$) were all associated with higher costs after ACLR. For operative variables, time spent in the operating room ($P < .001$), meniscal repair ($P < .001$), and use of general anesthesia alone ($P < .001$) were all associated with higher costs for ACLR. There was no significant difference between cost of surgery performed at a private surgery center and cost at a hospital-owned center. In the multivariate regression, the 3 variables with the greatest influence on cost of ACLR were use of isolated general anesthesia (associated with an increase of $2,049), Hispanic ethnicity ($1,828), and >1 chronic medical condition ($1,749). Male sex, time in operating room, and older age also significantly increased ACLR cost.

Conclusions
The greatest contributor to cost of ACLR was the use of general anesthesia alone. Time spent in the operating room increased ACLR cost by $108 per minute. Patient factors included greater age, male sex, Hispanic ethnicity, number of chronic medical conditions, Medicare insurance, and annual income. Meniscal repair and regional nerve block did not significantly affect cost as determined by multivariate regression.

BACK

Identification of Normal and Injured Anterolateral Ligaments of the Knee: A Systematic Review of Magnetic Resonance Imaging Studies

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Arthroscopy, Volume 35, Issue 5, Received: June 22, 2018; Accepted: October 25, 2018

https://doi.org/10.1016/j.arthro.2018.10.120

Purpose
To identify the normal and injured magnetic resonance imaging appearance of the anterolateral ligament (ALL).

Methods
A systematic review was performed using PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The PubMed and Cochrane Library electronic databases were used to search for studies that reported the imaging outcomes of the appearance of the ALL. Two authors performed the searches in duplicate up to April 30, 2018, and interobserver agreement was calculated. The methodologic quality of included articles was assessed using an adaptation of the Arrivé methodologic quality scale for clinical studies of radiologic examinations.

Results
From the original 270 records, a total of 24 studies ($\kappa = 0.94$) comprising 2,427 knees in 2,388 patients (mean age, 33.3 years; 66% male patients; 63% with anterior cruciate ligament [ACL] injury) were included. The ALL appeared in 51% to 100% of all assessed knees (71%-100% in ACL-injured knees and 64%-97% in uninjured knees) and was injured in 11% to 79% of ACL-injured knees. Reliability rates varied considerably (0.04-1.0 for intraobserver and 0.143-1.0 for interobserver agreement), and the entire portion of the ligament was often not seen. The tibial insertion was seen in 21% to 96% of cases, followed by the meniscal (range, 0%-100%) and femoral (range, 0%-90%) insertions. The mean methodologic quality score was 5.1 ± 1.8 out of a possible score of 9.

Conclusions
High variability was found in the identification of normal and injured ALL definition methods and the respective magnetic resonance imaging findings. Reliability rates varied considerably, and the entire portion of the ligament was often not seen.

Level of Evidence
Level IV, systematic review of Level II to IV studies.

BACK

Systematic Review of Medial Patellofemoral Ligament Reconstruction Techniques: Comparison of Patellar Bone Socket and Cortical Surface Fixation Techniques

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Arthroscopy, Volume 35, Issue 5, Received: June 12, 2018; Accepted: October 30, 2018

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Purpose
To compare patellar bone socket and cortical surface fixation techniques for isolated medial patellofemoral ligament (MPFL) reconstruction and determine whether there was a difference in (1) complication rates, including fracture of the patella; (2) redislocation rates; or (3) patient-reported outcomes.

Methods
A literature search was conducted following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. We included patients who underwent isolated MPFL reconstruction for recurrent patellar instability. Patients with confirmed concomitant or prior ipsilateral knee procedures, multiligament injury, or less than 3 months of follow-up were excluded. Risk-of-bias assessment was performed using the Methodological Index for Non-randomized Studies (MINORS) system. Studies were classified by surgical technique (patellar bone socket group [group S] vs cortical fixation group [group F]), and complications, redislocations, and patient-reported outcomes were collected.

Results
A total of 29 studies yielded 981 patients with MPFL reconstruction for inclusion. Of the patients, 620 underwent a patellar bone socket technique and 361 underwent a cortical fixation technique. Patients ranged in age from 11 to 68 years. Patellar fracture rates ranged from 0% to 17% in group S and were 0% in all group F studies. Mean Kujala scores ranged from 83.5 to 93.6 in group S and from 84.4 to 94.5 in group F. Mean Lysholm scores ranged from 84.6 to 91.7 in group S and from 83.5 to 95 in group F. Redislocation rates ranged from 0% to 21% in group S and from 0% to 13% in group F. Although heterogeneous in nature, complication rates ranged from 0% to 28% in group S and from 0% to 4% in group F.

Conclusions
MPFL reconstruction techniques with patellar bone sockets showed a larger range of complication rates than cortical fixation techniques, although overall, complications remained uncommon. Clinically, the bone socket group had comparable postoperative redislocation rates and patient outcomes to the group treated with cortical fixation techniques.

Level of Evidence
Level IV, systematic review of Level I through IV studies.

BACK

Knee Surgery, Sports Traumatology, Arthroscopy, May 2019, Volume 27, Issue 5, pp 1514–1519

Distal femur morphology affects rotatory knee instability in patients with anterior cruciate ligament ruptures

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Purpose
Distal femur morphology has been shown to influence knee joint kinematics and may affect rotatory knee laxity. The purpose of this study was to determine the relationship between rotatory knee laxity and distal femoral morphology in patients with complete anterior cruciate ligament (ACL) rupture. It was hypothesized that increased posterior femoral condylar depth on standard lateral radiographs, quantified as the “lateral femoral condyle ratio” would correlate with increased rotatory knee laxity, measured by a quantitative pivot shift test.

Methods
Consecutive patients who underwent ACL reconstruction from 2014 to 2016 were retrospectively reviewed. A standardized pivot shift test was performed preoperatively on both knees and quantified using tablet technology. Using standard lateral radiographs of the knee, the ratio of posterior condylar distance over total condylar distance was defined as the lateral femoral condyle ratio.

Results
Data sets were obtained for 57 patients. The mean anterior translation of the lateral knee compartment during a quantitative pivot shift test was found to be 4.0 ± 2.4 mm and 1.3 ± 0.9 mm for the injured and uninjured knees, respectively. The mean lateral femoral condyle ratio on X-ray was 63.2 ± 4.5%. There were significant correlations between the lateral femoral condyle ratio and the absolute quantitative ($\rho = 0.370$, $p < 0.05$) and side-to-side differences in anterior translation of the lateral knee compartment ($\rho = 0.419$, $p < 0.05$).

Conclusion
The most important finding from this study is that increased posterior femoral condylar depth, quantified as a lateral femoral condyle ratio, is associated with increased rotatory knee laxity in ACL-deficient patients. This suggests that distal femur morphology may influence rotatory knee laxity. This study may assist clinicians in evaluating ACL injuries and identifying patients at greater risk for persistent increased rotatory knee laxity after ACL reconstruction.

Level of evidence
III.

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Five-Year Outcomes and Return to Sport of Runners Undergoing Hip Arthroscopy for Labral Tears With or Without Femoroacetabular Impingement

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Background
Recent evidence has demonstrated a high rate of return to running after hip arthroscopy for femoroacetabular impingement at short-term follow-up. The midterm outcomes and rates of continued running of these patients are unknown.

Purpose
To evaluate midterm rates of return to running and outcomes after hip arthroscopy.

Study Design
Case series; Level of evidence, 4.

Methods
Data were prospectively collected for patients who underwent hip preservation surgery between July 2008 and November 2011. Patients were excluded for preoperative Tönnis osteoarthritis grade ≥2, previous ipsilateral hip conditions or hip surgery, or workers' compensation status. All patients who participated in mid- to long-distance running before their surgery and intended on returning after their operation were considered for inclusion. Preoperative and minimum 5-year postoperative measures for the following patient-reported outcome scores (PROs) were necessary for inclusion in the final cohort: the modified Harris Hip Score, Non-arthritic Hip Score, Hip Outcome Score–Sports Specific Subscale, and visual analog scale (VAS) for pain. All patients were counseled about the risks of continued running after hip arthroscopy.

Results
Sixty patients (62 hips) were eligible for inclusion, of which 50 (83.3%; 52 hips) had minimum 5-year follow-up. There were 10 male hips and 42 female hips. Mean ± SD age at surgery was 32.4 ± 12.4 years (range, 14.9-62.4), and mean body mass index was 22.9 ± 3.2 (range, 17.7-30.1). Latest follow-up was recorded at a mean 69.3 ± 8.5 months (range, 60.0-92.1 months). Level of competition included 39 recreational, 7 high school, 4 collegiate, and 2 professional athletes. There were significant improvements in all PROs and VAS scores preoperatively to latest follow-up. Mean modified Harris Hip Score improved from 67.5 to 88.2; mean Non-arthritic Hip Score, from 65.9 to 88.3; mean Hip Outcome Score–Sports Specific Subscale, from 49.5 to 81.0; and mean VAS, from 5.2 to 1.5. At latest follow-up, patient satisfaction was 8.4. Thirty-nine patients (78.0%, 41 hips) had returned to running postoperatively. When stratified by level of competition, 79% (31 of 39) of recreational, 100% (7 of 7) of high school, 50% (2 of 4) of collegiate, and 50% (1 of 2) of professional athletes returned to running.

Conclusion
Hip arthroscopy for all levels of runners is associated with a significant increase in PROs and a low risk of complications. The rate of return to running is moderately high after hip arthroscopy at

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midterm follow-up. Hip arthroscopy may be considered for runners presenting with symptoms of femoroacetabular impingement that fail nonoperative treatments. Patients should be educated on the rate of return to running over time and the risks of continued running after hip arthroscopy.

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Clinical Orthopaedics and Related Research (CORR), Volume 477, Issue 5

What Is the Association Between Articular Cartilage Damage and Subsequent THA 20 Years After Hip Arthroscopy for Labral Tears?

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Background
Few studies have examined long-term outcomes for patients after arthroscopic treatment for intraarticular hip conditions, and none have done so beyond 10 years postarthroscopy. Examining outcomes beyond 10 years is necessary to determine factors that contribute to conversion to THA in patients undergoing hip arthroscopy for labrochondral damage.
Questions/purposes (1) What is hip survivorship free from THA in patients who underwent arthroscopic labral débridement, with or without chondroplasty at least 15 years before? (2) What factors are associated with conversion to THA after arthroscopic labral débridement, with or without chondroplasty? (3) Can these data be used to estimate the risk of conversion to THA based on patient- and hip-related factors?

Methods
Between 1989 and 2000, one surgeon performed 552 arthroscopic hip procedures for symptomatic labral tears, with or without associated articular cartilage damage. Of these, the hip status was known in 404 hips (73%) at a minimum of 15 years after the index procedure, with 20 of those patients having died during the followup period. During the study period, patients were offered hip arthroscopy for labral tears with mechanical symptoms, with or without underlying articular cartilage damage. Patient age, sex, acetabular and femoral head Outerbridge grade at surgery, and presence of labral tear were recorded. We determined survivorship free from THA using a Kaplan-Meier survivorship estimator. A stepwise multivariable logistic regression analysis was conducted to determine factors associated with the eventual conversion to THA after hip arthroscopy for labrochondral injuries. Odds ratios (OR) and 95% confidence intervals (95% CI) were calculated for all significant independent factors. Odds ratios for combinations of significant factors were used to create a risk assessment.

Results
The survivorship free from conversion to THA at 20 years was 59% (95% CI, 53–64. Factors that affected survival included age ≥ 40 years and the presence of combined femoral head and acetabular chondral damage. After controlling for confounding factors, we found that age ≥ 40 years (OR, 2.0; 95% CI, 1.2–3.4; $p = 0.011$), the absence of all chondral damage (OR, 0.1; 95% CI, 0.03–0.32; $p < 0.001$), the presence of acetabular damage with severe femoral head damage (OR, 5.0; 95% CI, 2.4–10.3; $p < 0.001$), and the presence of severe acetabular damage with femoral head damage (OR, 3.7; 95% CI, 2.0–6.8; $p < 0.001$) were associated with conversion to THA at long-term followup. Based on the calculated ORs, the probability of conversion to THA by 20 years postarthroscopic treatment for labrochondral injuries ranged from 12% (95% CI, 8–17) for a patient younger than 40 years with a Grade 0-II femoral and acetabular Outerbridge grade to 92% (95% CI, 86–95) for a patient older than 40 years with a Grade III-IV femoral and acetabular Outerbridge grade.

Conclusions
Our study revealed that survivorship free from THA at 20 years after arthroscopic labral débridement was associated with both patient age at time of index procedure and, more importantly, the presence of combined femoral head and acetabular chondral damage. Patients

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should be counseled as to the increased probability of conversion to THA, depending on the health of their articular cartilage after surgery. Future studies should examine survivorship free from THA or clinical symptoms in patients undergoing hip arthroscopy with bone reshaping procedures or with labral repair or reconstruction up to and exceeding 20 years.

Level of Evidence
Level III, therapeutic study.

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