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Issue 63.3, Arthroscopy, November 2019

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Upper extremity

Arthroscopy, Volume 35, Issue 11

Examining the Potency of Subacromial Bursal Cells as a Potential Augmentation for Rotator Cuff Healing: An In Vitro Study

Daichi Morikawa, M.D., Ph.D., Jeremiah D. Johnson, M.D., Cameron Kia, M.D., Mary Beth R. McCarthy, B.S., Craig Macken, B.S., Nicholas Bellas, B.S., Joshua B. Baldino, Pharm.D., Mark P. Cote, D.P.T., M.S., Augustus D. Mazzocca, M.S., M.D.

Arthroscopy, Volume 35, Issue 11, Received: January 3, 2019; Accepted: May 12, 2019

https://doi.org/10.1016/j.arthro.2019.05.024

Purpose
To compare the potency of mesenchymal stem cells between the cells derived from the subacromial bursa to concentrated bone marrow aspirate (cBMA) taken from patients undergoing rotator cuff (RC) repair.

Methods
Subacromial bursa and cBMA were harvested arthroscopically from 13 patients (age 57.4 ± 5.2 years, mean ± standard deviation) undergoing arthroscopic primary RC repair. Bone marrow was aspirated from the proximal humerus and concentrated using an automated system (Angel System; Arthrex). Subacromial bursa was collected from 2 sites (over the RC tendon and muscle) and digested with collagenase to isolate a single cellular fraction. Proliferation, number of colony-forming units, differentiation potential, and gene expression were compared among the cells derived from each specimen.

Results
The cells derived from subacromial bursa showed significantly higher proliferation compared with the cells derived from cBMA after 5, 7, and 10 days ($P = .018$). Regarding colony-forming units, the subacromial bursa had significantly more colonies than cBMA ($P = .002$). Subacromial bursal cells over the RC tendon produced significantly more colonies than cells over both the RC muscle and cBMA ($P = .033$ and $P = .028$, respectively). Moreover, when compared with cBMA, cells derived from subacromial bursa showed significantly higher differentiation ability and higher gene expression indicative of chondrogenesis, osteogenesis, and adipogenesis.

Conclusion
The subacromial bursa is an easily accessible tissue that can be obtained during RC repair, with significant pluripotent stem cell potency for tendon healing. Compared with cBMA taken from the proximal humerus, bursal cells showed significantly increased differentiation ability and gene expression over time.

Clinical Relevance
Failed RC repairs have been partly attributed to a poor healing environment. Biologic augmentation of the repair site may help increase healing potential and incorporation of the cuff at the tendon–bone interface.

BACK

How Much Will High Tension Adversely Affect Rotator Cuff Repair Integrity?

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Arthroscopy, Volume 35, Issue 11, Received: January 18, 2019; Accepted: May 23, 2019

https://doi.org/10.1016/j.arthro.2019.05.049

Purpose
To suggest a cutoff value of tension related to retear of a repaired chronically contracted rotator cuff and to analyze the correlation between predictive factors and integrity of repair in large to massive contracted rotator cuff tears (RCTs).

Methods
We analyzed arthroscopic rotator cuff repairs for large to massive (>3 cm) contracted RCTs, not amenable to complete repair by standard means with meticulous release, with a minimum of 1 year follow-up. An intraoperative procedure was designed for the estimation of repair tension using a tensiometer. Clinical and radiological findings were compared between the healed group and the retear group, and magnetic resonance imaging was performed ∼1 year postoperatively for the evaluation of integrity of the repair site. The receiver operating characteristic curve was used to identify the cutoff value of the independent factors. Factors affecting postoperative retear were examined with multivariate analysis.

Results
Fifty patients were enrolled in this study and divided into the healed group (31 patients) and the retear group (19 patients) according to the follow-up magnetic resonance imaging findings. Significant results showed that tension (5.13 < 95% confidence interval [CI] < 58.15, P < .001) and acromiohumeral interval (AHI) (1.13 < 95% CI < 33.10, P = .013) were important factors for the integrity of rotator cuff repair. The cutoff value of tension was 35 N, and an AHI <6.6 mm may also be considered a predictor of retear. An occupation ratio of the tension >35 N was the strongest predictor of retear, with an area under the curve of 0.799, sensitivity of 84.2%, and specificity of 67.7% (accuracy = 76.0%).

Conclusions
The integrity of a large to massive rotator cuff repair is strongly related to the tension to reach the articular margin of the footprint and AHI. We found that the possibility of retear increases when tension ≥35 N is required. AHI <6.6 mm may also be considered a predictor of retear.

Level of Evidence
Level III, retrospective cohort design.

BACK

Anterior Capsule Reconstruction Versus Pectoralis Major Transfer for Irreparable Subscapularis Tears Involving the Anterior Capsule: A Comparative Biomechanical Cadaveric Study

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Arthroscopy, Volume 35, Issue 11, Received: May 21, 2018; Accepted: May 23, 2019

https://doi.org/10.1016/j.arthro.2019.05.046

Purpose
To compare the biomechanical effectiveness of human dermal allograft (HDA) anterior capsular reconstruction (ACR) and pectoralis major tendon transfer (PMTT) for treating irreparable subscapularis tears with capsular insufficiency in human cadaver shoulders.

Methods
Glenohumeral rotational range of motion and translation were measured in 6 cadaveric shoulders under the following 5 conditions: intact, deficient subscapularis/anterior capsule, ACR using HDA, HDA ACR with concomitant PMTT, and PMTT alone.

Results
The deficient subscapularis/anterior capsule condition significantly increased external and total rotational range of motion at 0° ($P < .001$, $P < .001$) and 30° ($P = .005$, $P = .002$) abduction as well as anterior-inferior translation ($P \leq .001$ to .03). HDA ACR, both with and without PMTT, restored anterior-inferior stability to that of the intact condition; however, PMTT alone did not restore anterior-inferior translation or rotational range of motion.

Conclusions
HDA ACR for treating irreparable subscapularis tears with capsular insufficiency restored anterior-inferior glenohumeral translation and rotational range of motion at time 0 in human cadaver shoulders.

Clinical Relevance
Anterior capsule reconstruction may be a viable option for treating massive irreparable subscapularis tears with capsular insufficiency.

BACK

Timing and Risk Factors for Venous Thromboembolism After Rotator Cuff Repair in the 30-Day Perioperative Period

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Arthroscopy, Volume 35, Issue 11, Received: February 4, 2019; Accepted: May 26, 2019

https://doi.org/10.1016/j.arthro.2019.05.045

Purpose
To analyze the American College of Surgeons National Surgical Quality Improvement Program database to evaluate the incidence of deep venous thrombosis and pulmonary embolism in patients undergoing rotator cuff repair surgery. In addition, we aim to identify risk factors associated with the development of thromboembolic events following rotator cuff repair.

Methods
A retrospective review of the American College of Surgeons National Surgical Quality Improvement Program database was performed. Current Procedural Terminology codes were used to identify patients who underwent rotator cuff repair between 2005 and 2017. The presence of deep venous thrombosis or pulmonary embolism during the 30-day perioperative period were the primary outcomes assessed. Logistic regression analysis was performed to identify risk factors for postoperative venous thromboembolic events (VTEs).

Results
In total, 39,825 rotator cuff repairs (RCRs) were performed and 117 (0.3%) VTE events occurred. VTE was identified at a mean of 11.5 ± 7.4 days. A total of 31,615 RCRs were performed arthroscopically. There was no significant difference of VTE between groups comparing arthroscopic RCR VTE 0.3% (94) with open RCR 0.3% (23) (P = .81). RCR in patients with an American Society of Anesthesiologists classification of III or IV was associated with >1.5-fold increase risk of VTE (odds ratio [OR] 1.68, 95% confidence interval [CI] 1.14-2.45). Increased risks of VTE included surgery >80 minutes (OR 2.10, 95% CI 1.42-3.15), performed under general anesthesia (OR 4.38, 95% CI 1.18-36.6), and in the outpatient setting (OR 6.09, 95% CI 1.06-243.7), male sex (OR 1.53, 95% CI 1.01-2.33), bleeding disorders (OR 2.87, 95% CI 1.17-7.05), or dyspnea (OR 1.51, 95% CI 1.02-2.23). The biggest risk for VTE was unplanned reoperation OR 16.6 (95% CI 5.13-53.5).

Conclusions
Venous thromboembolism is a rare complication following rotator cuff repair 0.3%. Understanding the risk factors: duration of surgery >80 minutes, male sex, body mass index >30 kg/m2, ASA III or IV, RCR as an inpatient under general anesthesia, bleeding disorder, or dyspnea may be useful in guiding treatment to prevent VTE. The largest risk for VTE is a patient with unplanned reoperation. RCR surgery performed in an outpatient setting resulted in a significantly lower incidence of VTE.

Level of Evidence
III Retrospective Comparative Study.

BACK

Arthroscopic and Open or Mini-Open Rotator Cuff Repair Trends and Complication Rates Among American Board of Orthopaedic Surgeons Part II Examinees (2007-2017)

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Arthroscopy, Volume 35, Issue 11

https://doi.org/10.1016/j.arthro.2019.06.022

Purpose
To ascertain trends and reported complication rates of arthroscopic and open or mini-open rotator cuff repairs (RCRs) reported by American Board of Orthopaedic Surgery (ABOS) Part II examinees between 2007-2017.

Methods
The ABOS database was queried for both arthroscopic RCR (International Classification of Diseases code 29827) and open or mini-open RCR (International Classification of Diseases codes 23410 and 23412) performed by Part II examinees from 2007-2017. A comparison between overall procedure rates, as well as reported complications (anesthetic, medical, surgical, reoperations, and readmissions) associated with the respective repair technique, was performed.

Results
From 2007-2017, a total of 31,907 RCRs were reported by Part II examinees. Of those, 85.2% (n = 27,189) were arthroscopic whereas 14.8% (n = 4,718) were open or mini-open. The rate of arthroscopic RCR increased from 73% (n = 2,138) in 2007 to 90% (n = 2,031) in 2017, whereas the rate of open or mini-open RCR decreased from 27% (n = 771) to 10% (n = 234) during the same period. Rates of reported annual complications were significantly lower for arthroscopic RCR (7.4%-16.2%) than for open or mini-open RCR (12.9%-30.3%) for each of the past 6 years (2012-2017) ($P < .001$). Arthroscopic RCR had an overall lower cumulative occurrence of complications than open or mini-open RCR over the past decade (2007-2017) ($P < .001$). The relative risk of complications for arthroscopic RCR compared with open RCR was 0.71 (95% confidence interval, 0.66-0.77).

Conclusions
ABOS Part II examinees reported an increased practice of arthroscopic RCR in comparison with open or mini-open RCR over the past 10 years. Reported annual complication rates have been significantly lower for arthroscopic RCR over the past 6 years, with an overall lower cumulative rate from 2007-2017.

Level of Evidence
Level III, retrospective cohort study.

BACK

The Relationship Between the Critical Shoulder Angle and the Incidence of Chronic, Full-Thickness Rotator Cuff Tears and Outcomes After Rotator Cuff Repair: A Systematic Review

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Arthroscopy, Volume 35, Issue 11

https://doi.org/10.1016/j.arthro.2019.05.044

Purpose
To summarize the available evidence and examine the relationship between the critical shoulder angle (CSA) and (1) the incidence of chronic full-thickness rotator cuff tears (RCTs) and (2) outcomes after rotator cuff repair (RCR).

Methods
A comprehensive search of MEDLINE, Embase, and CINAHL was completed. Comparative studies were included and the influence of the CSA on either the incidence of chronic, full-thickness RCTs, or outcomes following RCR was evaluated. Demographic variables and outcomes were collected.

Results
Seven comparative studies analyzed the influence of the CSA on the incidence of chronic, full-thickness RCTs (the control group constituted patients with a normal rotator cuff). High heterogeneity limited pooling of studies, but the majority concluded that a greater CSA significantly increased the likelihood of a chronic, full-thickness RCT. Conversely, 5 comparative studies analyzed the influence of CSA on outcomes following RCR, and although a greater CSA was associated with a greater re-tear rate, the majority reported that CSA did not significantly influence postoperative functional outcomes, including patient-reported outcome measures (PROMs), range of motion (ROM), and strength.

Conclusions
Based on the available evidence, there appears to be a relationship between a greater CSA and the presence of a chronic, full-thickness RCT. Furthermore, a greater CSA may be associated with a greater re-tear rate following RCR; however, CSA does not appear to influence functional outcomes following RCR. Despite these observations, the available evidence is of poor quality, and the clinical utility and role of the CSA in the diagnosis and surgical management of a chronic, full-thickness RCT remains in question.

Level of Evidence
Level IV: Systematic review of Level II-IV studies.

BACK

Journal of Shoulder and Elbow Surgery (JSES), Volume 28, issue 11

Long-term outcomes of the arthroscopic Bankart repair: a systematic review of studies at 10-year follow-up

Alison I. Murphy, Eoghan T. Hurley, Daire J. Hurley, Leo Pauzenberger, Hannan Mullett

DOI: https://doi.org/10.1016/j.jse.2019.04.057

Background
Very limited information exists about factors affecting direct clinical costs of rotator cuff repair surgery. The purpose of this study was to determine the direct cost of outpatient arthroscopic rotator cuff repair surgery using a unique value-driven outcomes tool and to identify patient- and treatment-related variables affecting cost.

Background
The purpose of this study was to systematically review the evidence in the literature to ascertain the functional outcomes and recurrences rates, as well as subsequent revision rates, following arthroscopic Bankart repair at a minimum of 10 years' follow-up.

Methods
Two independent reviewers performed a literature search based on Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines, using the Embase, MEDLINE, and Cochrane Library databases. Studies were included if they were clinical studies on arthroscopic Bankart repair with a minimum of 10 years' follow-up. Statistical analysis was performed using SPSS software.

Results
Our review found 9 studies including 822 shoulders meeting our inclusion criteria. The majority of patients were male patients (75.5%), the average age was 28.0 years (range, 15-73 years), and the mean follow-up period was 149.4 months. The most commonly used functional outcome score was the Rowe score, with a weighted mean of 87.0. Overall, 77.6% of athletes were able to return to sports postoperatively. The overall rate of recurrent instability was 31.2%, with 16.0% of patients having recurrent dislocations, and the overall revision rate was 17.0%. Evidence of instability arthropathy was found in 59.4% of patients, with 10.5% of patients having moderate to severe arthropathy.

Discussion and conclusion
Arthroscopic Bankart repair for anterior shoulder instability has been shown to result in excellent long-term functional outcomes despite a relatively high rate of recurrent instability necessitating revision surgery. In addition, the high rate of instability arthropathy is a concern following arthroscopic Bankart repair in the long term.

Level of evidence:
Level IV, Systematic Review

BACK

Open versus modified arthroscopic treatment of acute acromioclavicular dislocation using a single tight rope: randomized comparative study of clinical outcome and cost-effectiveness

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DOI: https://doi.org/10.1016/j.jse.2019.06.007

Purpose:
The purpose of this study was to compare clinical outcome and cost-effectiveness between arthroscopic and open repair using TightRope in acromioclavicular joint dislocation III and IV.

Patients and methods:
Fifty-two patients with acute acromioclavicular joint dislocation type III and IV were included. Patients were randomly allocated to either of 2 groups: Arthroscopic Repair Group (ARG) and Open Repair Group (ORG). Constant-Murley Score (CMS), visual analog scale (VAS) score, and coracoclavicular (CC) distance were measured preoperatively and 3 months, 6 months, 1 year, and 2 years postoperatively.

Results:
CMS increased from 40.68 for the ARG and 40.70 for the ORG preoperatively to 84.18 and 84.45 after 2 years from operation. VAS score decreased from 60.59 for the ARG and 64.50 for the ORG 1 day after surgery to 18.04 and 17.87 respectively after 6 months. CC distance decreased from 29.27 mm in the ARG and 28.16 mm in the ORG preoperatively to 9.86 mm in the ARG and 10.54 mm in the ORG on postoperative day 1. Rewidening of the CC distance occurred after 6 months (13.27 mm for the ARG and 13.62 mm for the ORG) and 1 year postoperatively (15.77 for the ARG and 15.41 for the ORG) but remained stable at final follow-up. There was a significant difference in surgical time (80.00 minutes in the ARG compared to 52.79 minutes in the ORG) and cost of consumables (US$1729.95 in the ARG compared to US$851.87 in the ORG).

Conclusion:
Open and arthroscopic repair of acute acromioclavicular joint dislocation yielded good clinical results, yet the arthroscopic technique is more expensive and has a longer surgical time.

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

BACK

Preoperative corticosteroid joint injections within 2 weeks of shoulder arthroscopies increase postoperative infection risk

Sarah Bhattacharjee, Wonyong Lee, Michael J. Lee, Lewis L. Shi

DOI: https://doi.org/10.1016/j.jse.2019.03.037

Background
There is currently no consensus regarding the safe timing interval between corticosteroid shoulder injections and future shoulder arthroscopies. Our study assessed the relationship between preoperative corticosteroid injection timing and shoulder arthroscopy infectious outcomes.

Methods
We used an insurance database to identify and sort all shoulder arthroscopy patients by corticosteroid shoulder injection history within 6 months before surgery. Patients who received injections were stratified by the timing of their most recent preoperative injection. The overall infection rate and rate of severe infections requiring treatment through intravenous antibiotics or surgical débridement in the 6-month postoperative period were compared using χ^2 tests between the injection cohorts and a control group of patients defined as those with no injection history.

Results
We identified 50,478 shoulder arthroscopy patients, of whom 4115 received injections in the 6-month preoperative period. We found a significant increase in both the overall infection rate ($P < .0001$) and severe infection rate ($P < .0001$) in patients who received injections within 2 weeks before surgery (n = 79; 8.86% and 6.33%, respectively) compared with those who received no injections in the 6-month preoperative period (n = 46,363; 1.56% and 0.55%, respectively). No other significant differences were observed.

Conclusions
Our results suggest that in patients who have received corticosteroid injections, shoulder arthroscopic procedures may be safely performed after at least 2 weeks has passed since the most recent injection to minimize the risk of postoperative infection. In addition, procedures performed within 2 weeks of an injection may increase the risk of postoperative infection.

Level of evidence:
Level III, Retrospective Cohort Comparison Using Large Database, Treatment Study

BACK

Arthroscopic rotator cuff repair: magnetic resonance arthrogram assessment of tendon healing

Craig M. Ball

DOI: https://doi.org/10.1016/j.jse.2019.02.024

Background
Many poor outcomes after arthroscopic rotator cuff (RC) repair relate to failure of tendon healing. The purposes of this study were to provide a better understanding of the magnetic resonance arthrography (MRA) characteristics of the RC tendon repair site after arthroscopic RC repair and to examine how these findings influence patient-reported outcome measures (PROMs) and the presence of persistent symptoms.

Methods
We reviewed 48 shoulders (13 female and 35 male patients; average age, 53.8 years) at a minimum of 6 months (average, 11.4 months) after arthroscopic RC repair (average tear size, 2.2 cm). All patients completed PROMs and underwent MRA assessment. Detailed analysis of the RC repair site was undertaken, with findings correlated with clinical outcomes and PROMs.

Results
The average preoperative American Shoulder and Elbow Surgeons (ASES) score of 39.5 improved to 92.8 ($P < .001$). All but 6 patients (87.5%) had increased signal intensity of the involved tendon, with interstitial splits and/or delamination in 65.6%. These changes had no effect on PROMs or patient satisfaction. Significant partial-thickness tears (>50%) were observed in 7 patients (14.6%), with no effect on outcomes (average ASES score of 95.2 and satisfaction score of 9). There were 2 recurrent full-thickness tears (4.2%), and 4 patients (8.3%) had a failure in continuity. The average ASES score in these 6 cases of failure was 76 ($P < .001$).

Conclusions
Structural abnormalities on MRA are common after RC repair but do not always result in clinical failure. However, our results suggest that an ASES score of less than 80 may be useful when considering postoperative imaging, especially in a patient with ongoing pain more than 6 months after surgery.

Level of evidence:
Level IV, Case-Control Design, Diagnostic Study

BACK

Arthroscopic repair of isolated subscapularis tears: clinical outcome and structural integrity with a minimum follow-up of 4.6 years

Anita Hasler, Glenn Boyce, Alex Schallberger, Bernhard Jost, Sabrina Catanzaro, Christian Gerber

DOI: https://doi.org/10.1016/j.jse.2019.03.024

Background
After isolated subscapularis repair, improvement in shoulder function has been reported at short-term review. The purpose of this study was to determine whether arthroscopic subscapularis repair provides durable improvement in objective and subjective shoulder function with a low structural retear rate.

Methods
All patients treated with arthroscopic repair of an isolated subscapularis tear between August 2003 and December 2012 with a minimum follow-up period of 4.6 years were identified from our database. A number of patients in our study cohort underwent a prior complete midterm assessment, which allowed a subgroup analysis to detect changes in structural integrity and corresponding function. Clinical and radiographic outcomes, including outcomes on conventional radiography and magnetic resonance imaging or ultrasound, were assessed.

Results
The study enrolled 36 shoulders with a mean patient age of 57.7 years (range, 31-75 years; standard deviation, 10.6 years). The mean follow-up period was 8.6 years (range, 4.6-13.9 years; standard deviation, 2.44 years). Internal rotation to the thoracic vertebrae was achieved in 94% of cases and was significantly improved ($P < .001$) compared with the preoperative situation. The mean relative Constant score improved from 68% preoperatively to 93% at final follow-up ($P < .001$). Magnetic resonance imaging evaluation showed a rerupture rate of 2.7% (1 of 36 shoulders). Twenty patients underwent previous complete midterm assessment (mean, 2.9 years; range, 1-4.5 years), with comparisons between midterm and long-term follow-up showing comparable results without statistically significant deterioration.

Conclusions
Functional and subjective improvements in shoulder function are maintained at a mean follow-up of more than 8 years after isolated subscapularis repair and are associated with a low structural failure rate of the repair.

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

BACK

Arthroscopic visualization of the medial collateral ligament of the elbow

Jae-Man Kwak, Erica Kholinne, Yucheng Sun, Jin-Young Park, Kyoung-Hwan Koh, In-Ho Jeon

DOI: https://doi.org/10.1016/j.jse.2019.04.040

Background
This study aimed to determine the extent to which the medial collateral ligament (MCL) can be visualized during a standard posterior arthroscopic view of the elbow.

Methods
Eight fresh human cadaveric elbows were placed in a simulated lateral decubitus position. Standard elbow arthroscopy was performed on each specimen using a standard posterior portal for visualization with a 30° arthroscope. The most distal borders of the visible part of the MCL were marked using a spinal needle and tagged using nylon sutures. Subsequently, the elbow was dissected. The overall surface area of the entire MCL and that defined by the suture tags were calculated for each specimen.

Results
The mean area of the visible part of the MCL represented 48% of the mean overall area. The arthroscopically tagged part of the posterior band of the MCL represented <50% of the entire MCL. Arthroscopic visualization was not available for most of the posterior bands of the MCL.

Conclusions
Less than half of the MCL is visible with a 30° arthroscope from standard posterior portal. Thus, sole reliance on arthroscopic visualization with this manner is not enough to release of the MCL. The variable effort is required to improve the limited visualization during the procedure. Moreover, the individual attention is essential to protect the ulnar nerve because the ulnar nerve is very close to the MCL especially to the anterior band.

Level of evidence:
Anatomy Study, Arthroscopy and Cadaver Dissection

BACK

American Journal of Sports Medicine (AJSM), Volume 47, Issue 13

The Effect of Preexisting and Shoulder-Specific Depression and Anxiety on Patient-Reported Outcomes After Arthroscopic Rotator Cuff Repair

Brian C. Lau, MD, Melissa Scribani, MPH, Jocelyn Wittstein, MD

First Published October 4, 2019; pp. 3073–3079

https://doi.org/10.1177/0363546519876914

Background: Few studies have considered the potential effect of depression or anxiety on outcomes after rotator cuff repair.

Purpose: To evaluate the effect of a preexisting diagnosis of depression or anxiety, as well as the feeling of depression and anxiety directly related to the shoulder, on the American Shoulder and Elbow Surgeons (ASES) score.

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

Methods: This study is a retrospective review of prospectively collected data on patients who underwent arthroscopic rotator cuff repair and were evaluated by the ASES score preoperatively and at a minimum 12 months postoperatively as part of the senior author's shoulder registry. Preexisting diagnoses of depression and/or anxiety were recorded, and questions from the Western Ontario Rotator Cuff Index directed at feelings of depression or anxiety related to the shoulder were also evaluated. The Wilcoxon rank sum test was used to compare ASES scores between patients with and without anxiety and/or depression. Spearman correlation was used to correlate questions on depression and anxiety with ASES scores.

Results: A total of 187 patients (63 females, 124 males; mean age, 58.6 years, SD, 8.7 years) undergoing arthroscopic rotator cuff repair were evaluated with a mean follow-up of 47.5 months (SD, 17.4 months; range, 12-77 months). Fifty-three patients (mean age, 60 years; SD, 8.6 years) had preexisting diagnoses of depression and/or anxiety and 134 patients (mean age, 58.1 years; SD, 8.7 years) did not. Patients with depression and/or anxiety had significantly lower preoperative and postoperative ASES scores (60.7 vs 67.8, $P = .014$; and 74.6 vs 87.1, $P = .008$, respectively). The change in ASES scores from preoperative to postoperative, however, was not significantly different (18.0 vs 14.9). A higher score of depression or anxiety related to the shoulder had a negative correlation with the preoperative ($r = -0.76$, $P < .0001$; and $r = -0.732$, $P < .0001$, respectively) and postoperative ($r = -0.31$, $P = .0001$; and $r = -0.31$, $P = .0003$, respectively) ASES scores, but a positive correlation ($r = 0.50$, $P < .0001$; and $r = 0.43$, $P < .0001$, respectively) with the change in ASES scores.

Conclusion: Patients with a history of depression and/or anxiety have lower outcome scores preoperatively and postoperatively; however, they should expect the same amount of relief from arthroscopic rotator cuff repair as those without a history of depression or anxiety. Stronger feelings of depression or anxiety directly related to the shoulder correlated with lower preoperative and postoperative outcome scores, but a greater amount of improvement from surgery. The results from this study suggest that a preexisting diagnosis of depression or anxiety, as well as feelings of depression or anxiety directly related to the shoulder, should be considered during the management of patients with rotator cuff tears.

BACK

Changes of Supraspinatus Muscle Volume and Fat Fraction After Successful or Failed Arthroscopic Rotator Cuff Repair

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First Published September 19, 2019; pp. 3080–3088

https://doi.org/10.1177/0363546519876289

Background: Muscle atrophy and fatty infiltration are limiting factors for successful rotator cuff (RC) repair. Quantitative data regarding these hallmarks of degenerative muscle changes after RC repair in humans are scarce. By utilizing a new application of the 6-point Dixon magnetic resonance imaging technology, 3-dimensional volume and fat fraction analysis of the whole RC muscle have become possible.

Purpose: Quantitative analysis of atrophy and fatty infiltration of the supraspinatus muscle after healed and failed RC tendon-to-bone repair.

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

Methods: Muscle volume and fat fraction were measured preoperatively and at 3 and 12 months postoperatively in 19 failed and 21 healed arthroscopic supraspinatus tendon repairs, with full muscle volume segmentation and magnetic resonance Dixon sequences.

Results: In both groups, the muscle volume initially decreased 3 months after RC repair by –3% in intact (P = .140) and –10% in failed repair (P = .004) but recovered between 3 and 12 months to 103% (P = .274) in intact and 92% (P = .040) in failed repairs when compared with the preoperative volume (difference of change between groups, preoperative to 12 month: P = .013). The supraspinatus muscle's fat fraction did not significantly change after successful repair (6.5% preoperative, 6.6% after 3 months, and 6.7% after 12 months; all nonsignificant). There was, however, a significant increase from 7.8% to 10.8% at 3 months (P = .014) and 11.4% at 12 months (P = .020) after failed repair (difference between groups at 3- and 12-month follow-up: P = .018 and P = .001, respectively).

Conclusion: After successful arthroscopic repair, RC tendon tear–induced fatty infiltration can be almost stopped, and muscle atrophy can even be slightly reversed. In case of a failed repair, however, these changes are further pronounced during the first 3 postoperative months but seem to stabilize thereafter.

BACK

Lower Extremity

Arthroscopy, Volume 35, Issue 11

Histologic Analysis of 2 Alternative Donor Sites of the Ipsilateral Elbow in the Treatment of Capitellar Osteochondritis Dissecans

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Arthroscopy, Volume 35, Issue 11

https://doi.org/10.1016/j.arthro.2019.06.027

Purpose
To compare the histologic features of the cartilage from the capitellum with 2 proposed alternative donor sites from the ipsilateral elbow in the treatment of capitellar osteochondritis dissecans (OCD): the nonarticulating part of the radial head and the nonarticulating lateral side of the olecranon tip.

Methods
Ten human cadaveric elbow specimens with macroscopically normal articular surfaces were used to obtain 5-mm osteochondral grafts: 10 from the capitellum (60° anteriorly relative to the humeral shaft), 10 from the radial head (nonarticulating part at 80°), and 4 from the olecranon (lateral side of the olecranon tip). Grafts were fixated in formalin (4% formaldehyde), decalcified, and processed into standard 8-μm-thick hematoxylin and eosin–and Toluidine Blue–stained sections. These were assessed for cartilage thickness, shape of articular surface, and 13 histologic parameters of the International Cartilage Repair Society II. Olecranon scores were excluded from statistical analysis.

Results
Mean cartilage thickness was 1.5 ± 0.22 mm at the capitellum; 1.3 ± 0.34 mm at the radial head; and 1.9 ± 1.0 mm at the olecranon. There was no difference in cartilage thickness between the capitellum and radial head (P = .062). All grafts demonstrated a convex articular surface. International Cartilage Repair Society II scores ranged from 82 to 100 for the capitellum, from 81 to 100 for the radial head, and from 67 to 87 for the olecranon tip. There was less chondrocyte clustering at the capitellum (84 ± 14) than in the radial head (94 ± 3.2; P = .019). Mid/deep zone assessment of the capitellum scored higher (97 ± 6.7) than the radial head (91 ± 4.6; P = .038).

Conclusions
This study demonstrates appropriate histologic similarities between the cartilage from the capitellum and 2 alternative donor sites of the ipsilateral elbow in the treatment of capitellar OCD: the nonarticulating part of the radial head and the nonarticulating lateral side of the olecranon tip.

Clinical Relevance
From an histologic point of view, there seem to be no obstacles to use grafts from these alternative donor sites for reconstruction of the capitellum when performing osteochondral autologous transplantation.

BACK

Does Femoral Retroversion Adversely Affect Outcomes After Hip Arthroscopy for Femoroacetabular Impingement Syndrome? A Midterm Analysis

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Arthroscopy, Volume 35, Issue 11, Received: August 13, 2018; Accepted: March 19, 2019

https://doi.org/10.1016/j.arthro.2019.03.046

Purpose
To report 5-year outcomes of arthroscopic treatment of femoroacetabular impingement syndrome in patients with femoral retroversion compared with a control group of patients with normal femoral anteversion.

Methods
Data were prospectively collected and retrospectively reviewed for all patients who underwent hip arthroscopy between August 2008 and April 2013. Patients were included in analysis if they underwent hip arthroscopy during this period and had femoral version ≤0° calculated using magnetic resonance imaging. Exclusion criteria included prior ipsilateral hip conditions/surgeries or Tönnis grade >1. These patients were pair matched with patients having femoral anteversion between 10° and 20° based on gender, body mass index ± 10, and age ± 10 years. Patient-reported outcomes (PROs) were collected at 3 months and 1 year postoperatively and annually thereafter. An a priori power analysis was performed.

Results
A total of 59 patients were identified as the experimental group out of 69 eligible for inclusion (86%). All 59 patients were matched, with a mean age of 37.4 years and mean body mass index of 26.9. Twenty patients were female, and 39 were male. These patients demonstrated significant improvement from their preoperative state in all patient-reported outcomes and visual analog score scores ($P < .001$). Thirty-eight patients met the threshold for minimal clinically important difference, and 35 achieved patient acceptable symptomatic state for the modified Harris Hip Score questionnaire. Seven patients converted to total hip replacement. No differences were noted between retroverted and control patients in any of the outcome measures collected, in pain or satisfaction ratings, in the frequency of or duration to secondary surgeries or in complication rate ($P > .05$).

Conclusions
Patients with femoral retroversion demonstrated significantly higher outcomes at minimum 5-year follow-up after undergoing arthroscopic hip surgery. These outcomes were not different from those of patients with normal femoral version. While femoral retroversion should not be considered a contraindication to hip arthroscopy, it should be carefully considered as a factor in patient selection and surgical planning.

Level of Evidence
Level III, retrospective comparative study.

BACK

Preoperative Predictors of Achieving Clinically Significant Athletic Functional Status After Hip Arthroscopy for Femoroacetabular Impingement at Minimum 2-Year Follow-Up

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Arthroscopy, Volume 35, Issue 11, Received: January 21, 2019; Accepted: May 10, 2019

https://doi.org/10.1016/j.arthro.2019.05.022

Purpose
To identify predictors of achieving clinically significant sport function in athletic patients undergoing hip arthroscopy for femoroacetabular impingement syndrome (FAIS).

Methods
Data were analyzed for all patients who treated for FAIS between 2012 to 2016 and reported being athletes, including recreational and competitive athletes. All patients had a minimum of 2-year follow-up with patient-reported athletic function in the form of the Hip Outcome Score–Sport Specific (HOS-SS), visual analog score–pain, and patient satisfaction. Achieving clinically significant sports function was defined as either reaching the minimally clinical important difference (MCID) or the patient acceptable symptomatic state (PASS) for HOS-SS at 2-year follow-up. An exploratory factor analysis was used to determine specific domains for the predictor variables and to reduce the redundancy in these variables. A ogistic regression analysis was used to identify significant predictors of achieving clinically significant sports function.

Results
Of 780 qualifying patients, 626 completed the 2-year minimum follow-up (80%), with a mean age and body mass index of 31.6 ± 11.9 years and 24.6 ± 8.6, respectively. A total of 500 patients (86.5%) achieved high functional status, with 77.9% achieving MCID HOS-SS and 68.7% achieving PASS HOS-SS. Logistic regression analysis identified increased the α angle (odds ratio [OR] 0.976; P = .027), preoperative pain duration (OR 0.729; P = .011), and body mass index (BMI) (OR 0.919; P = .018), as well as the presence of femoral chondral defects (OR 0.769; P = .013), as negative predictors for achieving MCID. Negative predictors for achieving PASS HOS-SS included the presence of a preoperative limp (OR 0.384; P = .013), anxiety or depression (OR 0.561; P = .041), and increased BMI (OR 0.945; P = .018) and preoperative pain duration (OR 0.987; P < .001).

Conclusions
Several predictors of achieving clinically significant sport function performance exist, including a history of anxiety or depression, BMI, preoperative α angle, limp, femoral chondral damage, *and preoperative symptom duration. Our results suggest there are both modifiable and nonmodifiable preoperative factors that have the potential to predict achieving high athletic function after hip arthroscopy for FAIS.

Level of Evidence
IV, Case Series.

BACK

Assessment of Acetabular Morphology Using the Acetabular Anterior Center-Edge Angle on Modified False-Profile Radiographs

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Arthroscopy, Volume 35, Issue 11

https://doi.org/10.1016/j.arthro.2019.05.048

Purpose
To compare radiographic parameters of acetabular morphology between standard and modified false-profile (FP) radiographs.

Methods
Standard and modified FP radiographs were obtained in 225 hips in 200 consecutive patients evaluated for hip pain and suspected femoroacetabular impingement. Radiographs were retrospectively reviewed by 2 readers to determine the anterior center-edge angle (ACEA), as assessed to the sourcil and to the bone edge. Inter-rater reliability of radiographic measurements was assessed using the intraclass correlation coefficient. Measurements were evaluated for normality with the Shapiro-Wilk test, averaged between the 2 readers, and compared between views using the paired Wilcoxon test.

Results
The intraclass correlation coefficient values for standard and modified FP views were 0.923 and 0.932, respectively, measuring to the sourcil and 0.867 and 0.896, respectively, measuring to the lateral bone edge. The median difference in ACEA measurements to the sourcil was 1° between the standard and modified FP view (45° vs 44°, $P < .001$). The median difference in ACEA measurements to the bone edge was 2° (34° vs 32°, $P < .001$).

Conclusions
Thirty-five degrees of femoral internal rotation for a modified FP hip radiographic view provides similar clinical information regarding acetabular morphology to that of the standard FP view. Given that the modified FP view also provides better visualization of the anterosuperior head-neck junction cam lesion, the modified FP view may be preferred over the standard FP view in evaluation of hip pain in the young patient.

Level of Evidence
Level III, retrospective comparative study.

BACK

Soft Tissue Fixation Strategies of Human Quadriceps Tendon Grafts: A Biomechanical Study

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Arthroscopy, Volume 35, Issue 11, Received: January 30, 2019; Accepted: May 13, 2019

https://doi.org/10.1016/j.arthro.2019.05.025

Purpose
To evaluate the effects of different stitching methods and suture diameters on the graft fixation of soft tissue human quadriceps tendon grafts for anterior cruciate ligament (ACL) reconstruction.

Methods
The Krackow locking stitch (K), whipstitch (W), and baseball stitch (B) were combined with either a 2× no. 2 (#2) or a 1× no. 5 (#5) braided composite suture for graft fixation of 36 human quadriceps tendons in 6 groups. Biomechanical testing was performed using a cyclic protocol with loads between 0 and 100 N. The maximum load until failure, cyclic elongation, and failure mode were recorded.

Results
The highest mean maximum load to failure was observed in the 2 Krackow stitch groups. The K#2 group had significantly higher load to failure values compared with those of the W#2 and B#2 groups (K#2, 553 ± 82 N vs W#2, 392 ± 107 N, P = .0349; K#2 vs B#2 366 ± 118 N, P = .0129). The mean cyclic elongation was lowest in the Krackow groups (K#2, 10.59 ± 2.63 mm; K#5, 13.66 ± 2.3 mm). The regular failure mode was the rupture of the suture for the Krackow stitch (8 of 12) and suture pullout for the whipstitch (11 of 12) and baseball stitch groups (12 of 12).

Conclusions
The double Krackow stitch with no. 2 braided composite suture exhibits a high maximum load to failure combined with a low amount of elongation in a biomechanical study for human quadriceps tendon soft tissue graft fixation. Unlike the whipstitch and the baseball stitch, it can solidly prevent suture pullout.

Clinical Relevance
A safe soft tissue graft fixation technique is especially important for quadriceps tendon grafts with their laminar anatomical structure and physiologically varying diameter. Unlike other grafts for ACL replacement, it fully relies on the soft tissue suture fixation to resist the pullout force.

BACK

Clinical and Radiologic Outcomes of Patients With Lax Healing After Medial Meniscal Root Repair: Comparison With Subtotal Meniscectomy

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Arthroscopy, Volume 35, Issue 11, Received: January 11, 2019; Accepted: May 23, 2019

https://doi.org/10.1016/j.arthro.2019.05.051

Purpose
To compare radiologic and clinical outcomes between patients who underwent medial meniscus posterior root tear (MMPRT) repair and were subsequently classified as having lax healing based on second-look arthroscopy and patients who underwent subtotal meniscectomy for an MMPRT.

Methods
The patients who received pullout repair or subtotal meniscectomy due to MMPRT between January 2011 and December 2014 were retrospectively reviewed. Among the patients who underwent MMPRT repair, those whose lax healing of the repair site was confirmed by second-look arthroscopy (repair/lax healing group) and among the patients who received subtotal meniscectomy, those who have varus deformity of <5° and a Kellgren–Lawrence grade of ≤2 (meniscectomy group) were included in the study population. Medial joint space width, Kellgren–Lawrence grade, International Knee Documentation Committee Subjective Knee Evaluation Form score, and Lysholm Knee score were used for radiologic and clinical assessment.

Results
The meniscectomy group included 24 patients (average follow-up, 37.2 months), and the repair/lax healing group included 21 patients (average follow-up, 39.2 months). The 2 groups showed improved patient-reported outcomes postoperatively ($P < .001$). However, medial joint space width ($P < .001$) became narrow and Kellgren–Lawrence grade ($P = .002$ and $P = .005$, respectively) worsened. Comparison of the radiologic outcomes between the 2 groups revealed that the repair/lax healing group had less Kellgren–Lawrence grade progression than the meniscectomy group ($P = .014$). The grade progressed by ≥2 grades in 4 patients (16.7%) and 0 patients in the meniscectomy and repair/lax healing groups, respectively ($P < .001$).

Conclusions
Although the repair/lax healing group showed improved functional outcomes on short-term follow-up, arthritic change progressed radiologically. Nevertheless, the repair/lax healing group showed better radiologic outcomes than the meniscectomy group, despite lax healing of the repair site. However, because of the small number of cases in this study, the results of this study could be associated with potential for type II or β errors.

Level of Evidence
Level III, retrospective comparative study.

BACK

Return to Sport and Work After High Tibial Osteotomy With Concomitant Medial Meniscal Allograft Transplant

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Arthroscopy, Volume 35, Issue 11

https://doi.org/10.1016/j.arthro.2019.05.053

Purpose
(1) To examine the timeline of return to sport (RTS) and return to work (RTW) after high tibial osteotomy (HTO) with concomitant medial meniscal allograft transplant (MAT), (2) to evaluate the degree of function on RTS and RTW, and (3) to identify reasons patients do not return to sport- or work-related activity.

Methods
Patients undergoing HTO plus MAT were reviewed retrospectively at a minimum of 2 years postoperatively. The exclusion criterion was any concomitant procedure except cartilage restoration for focal full-thickness medial femoral condylar defects. Patients completed a subjective sport and work questionnaire, a visual analog scale for pain, the Single Assessment Numeric Evaluation, and a satisfaction questionnaire.

Results
Twenty-two patients (aged 35.1 ± 8.1 years) were included at 9.3 ± 3.7 years postoperatively. Sixteen patients participated in sports within 3 years before surgery, and 14 patients (87.5%) returned to sport by 9.7 ± 3.8 months postoperatively. Only 7 patients (43.8%) returned to their preinjury status. Eighteen patients were employed within 3 years before surgery, and all patients returned to work; however, only 16 patients (88.9%) returned at the same occupational intensity by 3.1 ± 2.4 months. The rates of RTW for light-, medium-, and heavy-intensity occupations were 100%, 75.0%, and 85.7%, respectively, whereas the duration of RTW was 2.1 months, 2.3 months, and 4.8 months, respectively. Of the patients, 20 (90.9%) reported at least 1 complaint postoperatively, with 13 patients (59.1%) returning to the operating room for recurrent symptoms, including 1 patient who received a knee replacement at 7.75 years postoperatively.

Conclusions
In patients with medial meniscal deficiency and varus deformity, HTO plus MAT provided high rates of RTS (87.5%) and RTW (100%) by 9.7 months and 3.1 months, respectively. It is imperative that clinicians manage expectations because patients may RTS and RTW after HTO plus MAT; however, return to high-intensity activities or occupations may be unlikely or delayed.

Level of Evidence
Level IV, retrospective case series.

BACK

Is Lateral Posterior Tibial Slope Correlated With Clinical Outcomes of Lateral Meniscus Allograft Transplantation?

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Arthroscopy, Volume 35, Issue 11

https://doi.org/10.1016/j.arthro.2019.05.050

Purpose
To investigate (1) the correlation between lateral posterior tibial slope (PTS) and clinical outcomes of lateral meniscus allograft transplantation (MAT) and (2) the difference of lateral PTS between the extrusion and nonextrusion groups or between the failure and nonfailure groups in lateral MAT.

Methods
Between January 2001 and February 2016, we retrospectively evaluated 61 patients (mean age, 29.1 ± 12.2 years) who underwent postoperative magnetic resonance imaging (MRI) and were followed for a minimum of 2 years after primary lateral MAT. The lateral PTS and graft extrusion in the coronal and sagittal planes were assessed by using MRI performed at 1 year postoperatively. Clinical scores and graft failure were evaluated at the last follow-up visit. The correlation between lateral PTS and clinical outcomes (clinical scores, graft extrusion) was analyzed. Lateral PTS was compared between the extrusion and nonextrusion groups and between the failure and nonfailure groups.

Results
Mean lateral PTS on MRI was 6.6° ± 3.1° (range, 0.8° to 15.7°). A significant correlation was not identified between lateral PTS and clinical outcomes (clinical scores, graft extrusion in the coronal and sagittal planes). A significant difference in lateral PTS was not identified between the extrusion and nonextrusion groups in the coronal (6.2° ± 2.5° vs 7.0° ± 3.4°, P = .400) and sagittal (anterior horn, 6.5° ± 2.3° vs 6.7° ± 3.7°, P = .988; posterior horn, 6.8° ± 3.5° vs 6.5° ± 2.7°, P = .771) planes. Moreover, a significant difference was not identified between the failure and nonfailure groups (7.5° ± 3.3° vs 6.4° ± 3.0°, P = .388).

Conclusions
A significant correlation between lateral PTS and clinical or radiologic outcomes of lateral MAT was not identified.

Level of Evidence
Level IV, therapeutic case series with subgroup analysis.

BACK

Outcomes of Anterior Cruciate Ligament Reconstruction Using Biologic Augmentation in Patients 21 Years of Age and Younger

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Arthroscopy, Volume 35, Issue 11, Received: January 4, 2019; Accepted: May 23, 2019

https://doi.org/10.1016/j.arthro.2019.05.047

Purpose
To report on the outcomes of a subset of patients ≤21 years of age after anterior cruciate ligament (ACL) reconstruction coupled with biologic augmentation using platelet-rich plasma (PRP) and a porous collagen carrier.

Methods
A cohort of patients was retrospectively reviewed after ACL reconstruction with hamstring autograft tendon. All reconstructive surgeries combined biologic augmentation in which the ACL graft was coupled with PRP contained within porous collagen membrane. Patients were included if they maintained a minimum follow-up period of 24 months. Outcomes were assessed through patient-reported questionnaires and physical examination in the clinical setting. Patient-reported outcomes including International Knee Documentation Committee (IKDC), Lysholm, Tegner, and Single Assessment Numeric Evaluation (SANE) scores were collected. ACL stability was evaluated using Lachman and KT-1000 testing. Patients were also evaluated for return to play at the same level of competition, family history of ACL injury, and time to complete rehabilitation.

Results
A total of 194 patients were initially eligible; 143 (74%) patients with 151 knees were ultimately evaluated. The average patient age was 16 years; 79 patients were female and 64 were male. Follow-up duration averaged 52 months. IKDC and Lysholm scores averaged 91 and 91; the average SANE score was 94. The KT-1000 side-to-side difference averaged 1.2 mm. The average time to complete physical therapy was 22 weeks, and 132 patients (92%) returned to their preinjury level of competition. There were 23 cases of contralateral ACL injury (15%) and 7 cases of ACL reinjury necessitating revision surgery (5%).

Conclusions
Biologic augmentation with hamstring autograft in ACL reconstruction shows a decreased rate of second ACL injury, specifically with regard to ACL revision surgery. The patients in this study also show higher return to preinjury level of competition at a faster rate than other studies have shown.

Level of Evidence
Level IV, Therapeutic Case Series.

BACK

Comparative Effectiveness of Different Nonsurgical Treatments for Patellar Tendinopathy: A Systematic Review and Network Meta-analysis

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Arthroscopy, Volume 35, Issue 11

https://doi.org/10.1016/j.arthro.2019.06.017

Purpose
To investigate the functional improvement and pain reduction of different nonsurgical treatments for patellar tendinopathy (PT), a systematic review with network meta-analysis was performed.

Methods
Studies were comprehensively searched for without language restrictions in the CENTRAL, MEDLINE, EMBASE, Web of Science, Physiotherapy Evidence Database, and SPORTDiscus databases from inception to May 2018. Randomized controlled trials about nonsurgical treatments for PT were included. The outcome measurements were the Victorian Institute of Sports Assessment (VISA) scale and pain scores (such as the visual analog scale or Numerical Rating Scale). Study quality was evaluated using the Physiotherapy Evidence Database score. Direct comparisons were performed using pairwise meta-analysis, whereas network meta-analysis was performed using a frequentist method in a multivariate random-effects model.

Results
Eleven studies with 430 affected patellar tendons were included in the systematic review. The summary mean difference of improvement in the VISA scale versus the control group for corticosteroid injection was –23.00 (95% confidence interval [CI] –36.73 to -9.27), for leukocyte-rich platelet-rich plasma (LR-PRP) was 13.22 (95% CI 2.37-24.07), for focused extracorporeal shockwave therapy (ESWT) was –1.28 (95% CI –6.25 to 3.68), for radial ESWT was –6.68 (95% CI –20.20 to 6.84), for ultrasound was –0.70 (95% CI –11.23 to 9.83), for autologous blood injection was –0.60 (95% CI –9.30 to 8.10), for dry needling was 17.51 (95% CI –2.57 to 37.60), for topical glyceryl trinitrate was –0.90 (95% CI –13.07 to 11.27), and for skin-derived tendon-like cells was 10.40 (95% CI –1.59 to 22.39). LR-PRP (Surface Under the Cumulative Ranking curve [SUCRA] = 87.5%) or dry needling (SUCRA = 90.5%) was most likely to be ranked the best in terms of improvement on the VISA scale. Compared with the control group, the summary mean difference of the change in pain score for corticosteroid injection was 0.80 (95% CI –3.48 to 5.08), for LR-PRP was –1.87 (95% CI –3.28 to –0.46), for focused ESWT was 0.13 (95% CI –0.68 to 0.93), for radial ESWT was 0.03 (95% CI –1.92 to 1.98), for ultrasound was –0.20 (95% CI –1.49 to 1.09), for autologous blood injection was 0.60 (95% CI –0.73 to 1.93), for dry needling was –0.37 (95% CI –2.71 to 1.97), and for topical glyceryl trinitrate was –0.50 (95% CI –2.55 to 1.55). The treatment most likely to be ranked the best in terms of change in pain score was LR-PRP (SUCRA = 94.9%).

Conclusions
The network meta-analysis demonstrated that LR-PRP has the greatest functional improvement and pain reduction for PT compared with other treatment options. However, the treatment effect estimates can be biased by the possible intransitivity and should not be overestimated.

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

BACK

Factors Predicting Failure Rates and Patient-Reported Outcome Measures After Arthroscopic Meniscal Repair

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Arthroscopy, Volume 35, Issue 11

https://doi.org/10.1016/j.arthro.2019.06.016

Purpose
To identify factors that affect patient-reported outcome measures (PROMs) and failure rates after arthroscopic meniscal repair.

Methods
Embase, Embase Classic, and MEDLINE were searched on August 7, 2015, December 23, 2016, and March 11, 2018, for factors associated with PROMs and failure rates after arthroscopic meniscal repair. We excluded studies that (1) were non–English language, (2) did not use human patients, (3) were nonclinical, (4) did not analyze for factors that predicted PROMs or failure rates, and (5) were below Level IV evidence. Studies were graded into higher and lower quality using the Downs and Black scale.

Results
A total of 34 articles met our criteria, and 32 were graded. We identified 16 articles as higher quality. Among higher-quality studies, factors that significantly predicted reduced failure rates were concurrent anterior cruciate ligament reconstruction (ACLR) (n = 6) and reduced tear complexity (n = 4). Factors that did not significantly impact failure rates were side of repair (n = 8), sex (n = 7), time from injury to surgery (n = 7), age (n = 7), rim width (n = 6), and tear length (n = 5). Factors predicting better PROMs were time from injury to surgery of less than 3 months (n = 1), Outerbridge scores below grade 3 or 4 (n = 2), and reduced varus alignment (n = 2). Factors that did not significantly impact PROMs were equipment used (n = 3) and concurrent ACLR (n = 1).

Conclusions
Factors affecting failure rates and PROMs after arthroscopic meniscal repair were identified. However, more and higher-quality studies supported concurrent ACLR and less complex tears as predictors of lower failure rates. PROMs were negatively affected by a longer time from injury to surgery, higher Outerbridge scores, and greater varus alignment before surgery.

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

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Knee Surgery, Sports Traumatology, Arthroscopy (KSSTA), Volume 27, Issue 11

Arthroscopic centralization restores residual knee laxity in ACL-reconstructed knee with a lateral meniscus defect

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DOI: 10.1007/s00167-019-05366-w

Purpose
This study aimed to determine the influence of femoral tunnel orientation on long-term clinical outcome and osteoarthritis in patients undergoing ACL reconstruction and to test the reliability of the implemented radiographic measurement methods. It was hypothesized that a more horizontal femoral tunnel would correlate with superior clinical outcome.

Methods
A cohort of 193 patients who underwent non-anatomic ACL reconstruction was examined. In this specific study, non-anatomic is defined by the surgeons' pursuit of optimal isometry, not to emulate the native ACL anatomy. At follow-up, the Lachman test, the KT-1000, the pivot-shift test, the one-leg-hop test and the IKDC-2000 were evaluated. Osteoarthritis was evaluated radiographically. Posteroanterior and lateral radiographs were used to determine the position of the femoral tunnel in the coronal and sagittal planes and the angle of the tunnel in the coronal plane. A method for determining femoral rotation on the lateral radiographs was developed and its reliability was evaluated. The femoral tunnel orientation was analyzed to examine its influence on clinical outcome and osteoarthritis.

Results
A total of 101 patients were analyzed at a mean of 16.4 (± 1.3) years postoperatively. The reliability of the measurement methods was regarded as good to excellent (ICC 0.57-0.97). The mean coronal femoral tunnel angle was 9.6° (± 9.4°). The coronal femoral tunnel was positioned at a mean of 43% (± 3.5%) of the distance measured from lateral to medial. The mean sagittal femoral tunnel position, measured using the quadrant method, was 40% (± 6.4%) from posterior to anterior. No significant associations were found between tunnel orientation and the clinical outcome variables.

Conclusions
The orientation of the femoral tunnel did not predict the long-term subjective outcome, functional outcome or the development of osteoarthritis in patients undergoing non-anatomic ACL reconstruction. The method for determining femoral rotation on lateral radiographs was found to be reliable.

Level of evidence
Retrospective cohort study, level of evidence IV.

BACK

American Journal of Sports Medicine (AJSM), Volume 47, Issue 13

Femoroacetabular Impingement Patients With Decreased Femoral Version Have Different Impingement Locations and Intra- and Extraarticular Anterior Subspine FAI on 3D-CT–Based Impingement Simulation: Implications for Hip Arthroscopy

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First Published September 20, 2019; pp. 3120–3132

https://doi.org/10.1177/0363546519873666

Background: It remains unclear whether decreased femoral version (FV) causes anterior intra- or extra-articular femoroacetabular impingement (FAI). Therefore, we evaluated symptomatic hips with decreased FV, with and without cam and pincer FAI, by using computed tomography (CT)–based virtual 3-dimensional (3D) impingement simulation and compared this group with patients with normal FV and with asymptomatic hips.

Purpose: To investigate (1) the osseous range of motion, (2) the osseous femoral and acetabular impingement zones, and (3) whether hip impingement is extra- or intra-articular in symptomatic hips with FAI.

Study Design: Cross-sectional study; Level of evidence, 3.

Methods: An institutional review board–approved, retrospective comparative analysis was performed on a total of 84 hips in 68 participants. Of these, 37 hips in 24 symptomatic patients with FAI had decreased FV. These hips were compared with 21 hips of 18 symptomatic patients with anterior FAI with normal FV (10°-25°) and 26 asymptomatic hips with no FAI and normal FV. All patients with FAI were symptomatic and had anterior hip pain and a positive anterior impingement test. They underwent pelvic CT scans to measure FV. Decreased FV was defined as FV less than 5°. The 37 hips with decreased FV presented both with and without cam and pincer FAI. All 84 hips were evaluated by use of CT-based 3D models and a validated 3D range of motion and impingement simulation. Asymptomatic hips were contralateral normal hips imaged in patients undergoing total hip arthroplasty.

Results: Hips with FAI combined with decreased FV had a significantly ($P < .001$) lower mean flexion (114°± 8° vs 125°± 13°) and internal rotation (IR) at 90° of flexion (18°± 6° vs 32°± 9°, $P < .001$) compared with the asymptomatic control group. Symptomatic patients with FAI and normal FV had flexion of 120°± 16° and IR at 90° of flexion of 23°± 15°. In a subgroup analysis, we found a significantly ($P < .001$) lower IR in 90° of flexion in hips with FV less than 5° combined with mixed-type FAI compared with hips with FV less than 5° without a cam- or pincer-type deformity. The maximal acetabular impingement zone for hips with decreased FV was located at the 2-o'clock position and ranged from 1 to 3 o'clock. In hips with decreased FV, most of the impingement locations were intra-articular but 32% of hips had combined intra- and extra-articular FAI in internal rotation in 90° of flexion. During the flexion-adduction-IR test performed in 10° and

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20° of adduction, extra-articular subspine FAI had significantly ($P < .001$) higher prevalence (68% and 84%) in hips with decreased FV compared with normal hips.

Conclusion: Hips with FAI and decreased FV had less flexion and internal rotation in 90° of flexion compared with the asymptomatic control group. The majority of hip impingement due to low FV was intra-articular, but one-third of samples had combined intra- and extra-articular subspine FAI. Anterior extra- and intra-articular hip impingement can be present in patients who have FAI with decreased FV. This could be important for patients undergoing hip arthroscopy.

BACK

How Can We Define Clinically Important Improvement in Pain Scores After Hip Arthroscopy for Femoroacetabular Impingement Syndrome? Minimum 2-Year Follow-up Study

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First Published October 11, 2019; pp. 3133–3140

https://doi.org/10.1177/0363546519877861

Background: Patient postoperative pain is being increasingly reported in the field of hip preservation surgery. The visual analog scale (VAS) for pain is one of the most commonly utilized measures for perioperative pain assessment. Currently, there is limited understanding of clinically significant improvement in VAS pain.

Purpose: (1) To define the substantial clinical benefit (SCB), patient acceptable symptomatic state (PASS), and minimal clinically important difference (MCID) for the VAS pain score in patients undergoing hip arthroscopy for femoroacetabular impingement syndrome after 2 years from surgery and (2) to identify preoperative predictors of achieving each outcome endpoint.

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

Methods: Data from consecutive patients who underwent primary hip arthroscopy between November 2014 and March 2017 were collected and analyzed. Baseline data and postoperative patient-reported outcome scores were recorded at 2 years postoperatively. To quantify clinical significance of outcome achievement for the VAS pain score, the MCID, PASS, and SCB were calculated.

Results: A total of 976 patients were included in the final analysis. The VAS pain score threshold for achieving the MCID was defined as a decrease of 14.8; the PASS was defined as achieving a 2-year postoperative score of 21.6 points; and the SCB was defined as a decrease of 25.5 or a score of 15.4 points at 2 years. The rates of achieving the MCID, PASS, and SCB were 97.6%, 66.4%, and 71.2%, respectively. Regression analysis demonstrated that sports involvement, low body mass index, smaller preoperative alpha angle, and absence of articular damage and chondromalacia were predictive of achieving the PASS (all $P < .05$). Preoperative predictors for achieving the SCB included being male, no smoking history, smaller alpha angle, higher modified Harris Hip Score, and lower VAS pain score (all $P < .05$).

Conclusion: This study identified scores for VAS pain that can be used to define clinically significant outcome after arthroscopic treatment of femoroacetabular impingement syndrome. Specifically, a decrease in pain score of 14.8 was a clinically important improvement in VAS pain, while an absolute score <15.4 or a change of 25.5 represented the upper threshold of VAS pain improvement. Additionally, there were both modifiable and nonmodifiable factors that predicted achieving clinically significant levels of postoperative pain improvement.

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Defining Minimal Clinically Important Difference and Patient Acceptable Symptom State After Isolated Endoscopic Gluteus Medius Repair

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First Published October 16, 2019; pp. 3141–3147

https://doi.org/10.1177/0363546519877179

Background: Endoscopic surgical repair has become a common procedure for treating patients with gluteus medius tears. However, meaningful clinical outcomes after the procedure have not been defined.

Purpose: To (1) define the minimal clinically important difference (MCID) and patient acceptable symptomatic state (PASS) in patients undergoing endoscopic gluteus medius repair and (2) determine correlations between preoperative patient characteristics and achievement of MCID/PASS.

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

Methods: A retrospective review was performed of prospectively collected data from all patients undergoing primary endoscopic repair of gluteus medius tears between January 2012 and February 2017 with a minimum 2-year follow-up. Patient data collected included patient characteristics, radiographic parameters, preoperative clinical function scores, and postoperative patient-reported outcomes (PROs). Paired t tests were used to compare the differences in 2-year PROs. The MCID and PASS for each PRO were calculated and Spearman coefficient analysis was used to identify correlations between MCID, PASS, and preoperative variables.

Results: A total of 60 patients were included in the study. A majority of patients were female (91.7%), with an average age and body mass index of 57.9 ± 9.91 years and 27.6 ± 6.1, respectively. The MCIDs of the Activities of Daily Living (ADL) and Sport-Specific (SS) subscales of the Hip Outcome Score (HOS) and the modified Harris Hip Score (mHHS) were calculated to be 15.02, 14.53, and 14.13, respectively. The PASS scores of HOS-ADL, HOS-SS, and mHHS were calculated to be 81.32, 67.71, and 77.5, respectively. In addition, 76.7% of patients achieved either MCID or PASS postoperatively, with 77.8% and 69.0% reaching at least 1 threshold score for achieving MCID and PASS, respectively, and 48.3% achieving both MCID and PASS. Smoking had a negative and weak association with achieving PASS ($r = -0.271$; $P = .039$). No other patient characteristic variables were found to correlate with achieving MCID or PASS.

Conclusion: In patients undergoing endoscopic gluteus medius repair, our study defined MCID and PASS for HOS-ADL, HOS-SS, and mHHS outcome scores. A large percentage of patients (76.7%) achieved meaningful clinical outcomes at 2 years after surgery.

BACK

Can the FEAR Index Be Used to Predict Microinstability in Patients Undergoing Hip Arthroscopic Surgery?

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First Published October 11, 2019; pp. 3158–3165

https://doi.org/10.1177/0363546519876105

Background: Atraumatic hip instability, or microinstability, is a challenging diagnosis for clinicians to make. Several radiographic parameters have been proposed to help identify patients with instability as a means to direct treatment. The Femoro-epiphyseal Acetabular Roof (FEAR) index was recently offered as a parameter to predict instability in a borderline dysplastic population.

Purpose: To evaluate the FEAR index in a series of predominantly nondysplastic patients undergoing hip arthroscopic surgery to determine if it can accurately predict patients with diagnosed microinstability at the time of surgery.

Study Design: Cohort study (diagnosis); Level of evidence, 2.

Methods: A consecutive series of 200 patients undergoing hip arthroscopic surgery were evaluated for microinstability intraoperatively. Microinstability was diagnosed based on previously published criteria. Retrospectively, radiographic parameters were measured including the lateral center edge angle of Wiberg (LCEA), Tönnis angle, physeal scar angle, and FEAR index. Patients were excluded if they previously had any type of bony procedures performed, underwent prior open hip surgery or total hip arthroplasty of the ipsilateral hip, had osteoarthritis (Tönnis grade >1), or had any radiographic features of moderate-to-severe acetabular dysplasia including an LCEA <18°.

Results: After applying exclusion criteria, 167 hips in 150 patients were analyzed. Based on an intraoperative assessment, 96 hips (57.5%) were considered stable, and 71 hips (42.5%) had signs of microinstability (unstable group). Patients in the unstable group had fewer radiographic findings of femoroacetabular impingement and higher rates of borderline dysplasia. All 4 measured angles were found to have excellent interobserver agreement. The FEAR index was significantly more positive in the unstable group compared with the stable group (−7.8° vs −11.3°, respectively; P = .004). A more positive FEAR index was also found in patients meeting intraoperative criteria for instability, with the exception of chondral wear pattern. Unstable nondysplastic patients (LCEA ≥25°, Tönnis angle ≤10°) also were found to have higher FEAR index values (−9.0° vs −12.0°, respectively; P = .012). A FEAR index cut-off of −5.0° was associated with a specificity of 92.4% and accuracy of 69.4% for predicting instability in a nondysplastic population.

Conclusion: The FEAR index was validated to improve the recognition of unstable patients preoperatively across a population with both borderline dysplastic and nondysplastic features.

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