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BACK

Upper extremity

Arthroscopy, Volume 36, Issue 3

Repair of Rotator Cuff Tendon Defects in Aged Rats Using a Growth Factor Injectable Gel Scaffold

Bo Han, Ph.D., Ian A. Jones, B.A., Zhi Yang, M.D., William Fang, B.S., M.S., C. Thomas Vangsness Jr., M.D.

Arthroscopy, Volume 36, Issue 3, Received: January 31, 2018; Accepted: September 6, 2019

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Purpose
To determine if the tendon-specific crosslinking gelatin (Col-Tgel) impregnated with growth factors promotes tendon healing at the bone interface and in a tendon window model.

Methods
Two different Col-Tgel formulations were first tested in vitro by evaluating cell morphology and tendogenic differentiation. After the optimum formulation was determined, the gel was mixed with either transforming growth factor-β3 (TGF-β3) or growth differentiation factor-7 (GDF-7) growth factor and prepared for injections. Window defects were induced in 12 animals, which were randomized into the following treatments: (1) sham, (2) empty Col-Tgel, (3) Col-Tgel containing TGF-β3, or (4) Col-Tgel containing GDF-7. Based on these results, the sham, empty Col-Tgel, and Col-Tgel containing TGF-β3 were applied to the supraspinatus repair interface. Tendons were analyzed biomechanically and histologically using hematoxylin and eosin and Masson's trichrome staining.

Results
In the window defect model, histologic scores were the best in rats treated with TGF-β3 containing Col-Tgel, followed by the empty Col-Tgel scaffold, and finally the sham control. The GDF-7 Col-Tgel was not further tested because occasional ectopic cartilage and bone formation was found in the prior window defect model. In the supraspinatus repair model, there was no statistical difference ($P > .05$) in the biomechanical strength among the 3 treatment groups, but load-to-failure ratio improved when TGF-β3 was added to the scaffold, suggesting improved tendon healing.

Conclusions
This pilot study evaluated the performance of an injectable gel tendon graft in a population of retired breeder rats. The results suggest that Col-Tgel containing TGF-β3 may be a useful adjunctive treatment for surgical repair of full-thickness rotator cuff tears. Histologic and biomechanical scores suggest that Col-Tgel containing TGF-β3 promotes tendon healing.

Clinical Relevance
The results of this study suggest that shoulders injected with Col-Tgel may be a useful adjunctive treatment for repair of rotator cuff tears.

BACK

Intravenous Administration of Tranexamic Acid Significantly Improved Clarity of the Visual Field in Arthroscopic Shoulder Surgery. A Prospective, Double-Blind, and Randomized Controlled Trial

Yuan-Fu Liu, M.D., Chih-Kai Hong, M.D., Kai-Lan Hsu, M.D., Fa-Chuan Kuan, M.D., Yueh Chen, M.D., M.Sc., Ming-Long Yeh, Ph.D., Wei-Ren Su, M.D., M.Sc.

Arthroscopy, Volume 36, Issue 3, Received: April 11, 2018; Accepted: October 16, 2019

https://doi.org/10.1016/j.arthro.2019.10.020

Purpose
To determine whether intravenous administration of tranexamic acid (TXA) before shoulder arthroscopic rotator cuff repair surgery can improve arthroscopy visual clarity.

Methods
This was a prospective, double-blind, randomized, and placebo-controlled study. From May 2016 to April 2018, patients requiring arthroscopic rotator cuff repair were enrolled and randomly assigned to either the TXA group. receiving 1000 mg of TXA intravenously 10 minutes before surgery. or the placebo group. receiving the same volume of plain saline. Patients with pre-existing liver/renal disease, coagulopathy, or concurrent use of anticoagulation medications were excluded. Visual clarity was rated using a Numeric Rating Scale from grade 1 (poor) to grade 3 (clear) every 15 minutes throughout the surgery. Secondary outcomes included estimated perioperative blood loss, operative time, degree of shoulder swelling, postoperative subjective pain score, inpatient duration, and associated comorbidities were recorded. Both parametric and nonparametric methods were used for the statistical analysis.

Results
In total, 72 patients were enrolled, 37 in the TXA group and 35 in the placebo group. The demographic data were similar between the 2 groups. Visual clarity was found to be significantly better in the TXA group, with a greater percentage of grade 3 vision clarity (53.7 ± 18.9 % vs 40.5 ± 22.1%, P = .036). The average visual score in the TXA group (2.5 ± 0.2) also was better than that of the control group (2.3 ± 0.3) (P = .048). The postoperative subjective pain score was significantly lower in the TXA group (3.0 ± 1.5) than in the control group (4.3 ± 2.0) (P = .009). In addition, postoperative analgesic usage was significant lower in the TXA groups (9.6 ± 9.7 morphine milligram equivalent) than in the control group (14.7 ± 13.4 morphine milligram equivalent) (P = .037). Other parameters, such as operative time, estimated perioperative blood loss, degree of shoulder swelling, and duration of inpatient stay were similar between the 2 groups. None of the patients developed complications after surgery.

Conclusions
Intravenous administration of TXA is an alternative way to improve visual clarity in arthroscopic shoulder surgery. It also reduces subjective pain and analgesic consumption in the early postoperative period without significant side effects.

Level of Evidence
Therapeutic studies level II.

BACK

The Effect of Delayed Injection of Leukocyte-Rich Platelet-Rich Plasma Following Rotator Cuff Repair on Patient Function: A Randomized Double-Blind Controlled Trial

Martyn Snow, F.R.C.S., Faisal Hussain, F.R.C.S., Joseph Pagkalos, F.R.C.S., Tomasz Kowalski, M.D., Ph.D., Marcus Green, F.R.C.S., Samir Massoud, F.R.C.S., Steven James, F.R.C.R.

Arthroscopy, Volume 36, Issue 3, Received: April 21, 2018; Accepted: September 13, 2019

https://doi.org/10.1016/j.arthro.2019.09.026

Purpose
To investigate the effect of delayed application of leukocyte-rich platelet-rich plasma (PRP) on rotator cuff repair results as assessed by outcome scores and imaging at one year.

Methods
Patients with a symptomatic rotator cuff tear awaiting arthroscopic repair were approached to take part in the study. Final eligibility for the study was confirmed at the time of surgery. A total of 97 patients were randomized to an ultrasound guided injection of leukocyte-rich PRP or normal saline between 10 and 14 days postsurgery. A total of 87 patients completed clinical evaluation and underwent magnetic resonance imaging imaging at 1 year. Outcome scores included the American Shoulder and Elbow Score, Constant score, Western Ontario Rotator Cuff Index, and the Disabilities of the Arm, Shoulder and Hand Score. Structural integrity of the repair was assessed according to the Sugaya grading. Muscle fatty infiltration was assessed on magnetic resonance imaging using the Goutallier classification.

Results
At 1 year postsurgery, there was no significant difference between the treatment groups on any of the patient-reported outcome measures or Constant score. On postoperative imaging analysis, there was no difference in the retear rates (Sugaya 4 and 5) between the groups (21% in control group vs 15.3% in PRP group). Fatty infiltration on postoperative imaging was found to be significantly higher in the normal saline group compared with the PRP group (Kendall's tau-b P = .032).

Conclusions
The delayed application of PRP postrotator cuff repair did not improve function as measured by patient-reported outcome measures and Constant score at 1 year postoperatively.

Level of Evidence
Level II, prospective randomized therapeutic trial.

BACK

Revision Arthroscopic Posterior Shoulder Capsulolabral Repair in Contact Athletes: Risk Factors and Outcomes

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Arthroscopy, Volume 36, Issue 3, Received: April 7, 2018; Accepted: October 11, 2019

https://doi.org/10.1016/j.arthro.2019.09.029

Purpose
To determine risk factors and outcomes of revision arthroscopic posterior capsulolabral repair in contact athletes.

Methods
Contact athletes with unidirectional posterior instability who underwent arthroscopic posterior capsulolabral repair from 2000 to 2014 with minimum 4-year follow-up were reviewed. Revision rate was determined and those who required revision surgery were compared with those who did not. Age, gender, labral and/or capsular injury, level of sport, and return to sport were compared. Pre- and postoperative American Shoulder and Elbow Surgeons, pain, function, stability, range of motion, strength, and satisfaction were also compared. Magnetic resonance imaging measurements of glenoid bone width, glenoid version, labral width, labral version, and cartilage version were also compared.

Results
A total of 149 contact athletes' shoulders met inclusion criteria. Eight shoulders required revision surgery (5.4%) at 13.0-year follow-up with 2.6 years between primary surgery and revision. Preoperative stability was significantly worse in those that required revision (0.008). Postoperative American Shoulder and Elbow Surgeons score was significantly worse in the revision group (75.1 vs 87.8, P = .03). The only significant risk factor for requiring revision surgery was decreased glenoid bone width (26.4 mm vs 29.1 mm, P = .005). Cartilage version, labral version, and bone version were not significantly different, nor was labral width. Sex, labral injury, capsule injury, both capsule and labrum injury, and level of sport were not risk factors. Both return to sport at the same level (revision = 16.7% vs nonrevision = 72.1%, P < .001) and overall return to sport (revision = 50.0% vs nonrevision=93.7%, P < .001) were significantly worse in the revision group.

Conclusions
Contact athletes underwent revision arthroscopic posterior capsulolabral repair at an incidence of 5.4% at minimum 4-year and average 13.0-year follow-up. The only significant risk factors for requiring revision surgery was smaller glenoid bone width and higher preoperative instability. Return to play after their subsequent surgery was significantly worse.

Level of Evidence
Level III, comparative study.

BACK

Establishment of a True En Face View in the Evaluation of Glenoid Morphology for Treatment of Traumatic Anterior Shoulder Instability

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Arthroscopy, Volume 36, Issue 3, Received: April 7, 2018; Accepted: October 11, 2019

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Purpose
To develop an accurate and reproducible method for establishment of a true en face view of the glenoid with a traumatic bone defect.

Methods
A total of 50 sets of computed tomography images of the glenoid were used for 3-dimensional reconstruction. Both a quantitative definition and a practical method were designed for creation of the true en face view of the glenoid with a traumatic bone defect. The accuracy and reliability of the quantitative definition and the practical method were evaluated by calculating the maximal projection area and the simulated bone defect size.

Results
The glenoid surface could be fit with a sphere with a radius of 26.11 ± 2.15 mm ($P < .001$, $R2 = 0.98$). The true en face view could be established with the quantitative definition, which resulted in the maximal projection area, whereas any tilt would lead to decreased values ($P < .05$). To establish the true en face view on the glenoid with a traumatic bone defect, a vector from the center of the best-fit sphere of the glenoid surface to the middle point of an arc connecting the supraglenoid and infraglenoid tubercles was generated, which served as a perpendicular for glenoid reorientation. Cases off the true en face view would result in less accurate estimation of the bone defect size ($P < .05$).

Conclusions
This study provided a quantitative definition and a practical method for generation of the true en face view in the presence of a traumatic bone defect based on the best-fit sphere of the glenoid surface as well as the anatomic landmark of the supraglenoid and infraglenoid tubercles. This study may improve the reliability of the quantification of traumatic bone defects of the glenoid.

Clinical Relevance
The practical method for establishment of the true en face view of the glenoid would be useful in decision making for the treatment of traumatic anterior shoulder instability.

BACK

Superior Capsule Reconstruction With Subacromial Allograft Spacer: Biomechanical Cadaveric Study of Subacromial Contact Pressure and Superior Humeral Head Translation

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Arthroscopy, Volume 36, Issue 3, Received: May 25, 2018; Accepted: September 26, 2019

https://doi.org/10.1016/j.arthro.2019.09.047

Purpose
To investigate the biomechanical effects of superior capsule reconstruction with subacromial allograft spacer on superior humeral head translation and subacromial contact pressure.

Methods
Eight cadaveric shoulder specimens were tested in 4 conditions: (1) intact rotator cuff, (2) supraspinatus tear and superior capsule excision, (3) superior capsule reconstruction with human dermal allograft, and (4) superior capsule reconstruction with subacromial resurfacing using human dermal allograft. In each condition, specimens were tested at 0, 30, 60, and 90° of shoulder abduction in balanced and unbalanced loaded states for subacromial contact pressure and superior humeral head translation. Statistical comparisons were made using a repeated-measures analysis of variance test, followed by a Tukey post hoc test for pairwise comparisons. A P value <.05 was set as statistically significant.

Results
Superior humeral head translation and subacromial contact pressure were increased after irreparable rotator cuff tear (P = .001). There was no significant difference between superior capsule reconstruction and intact cuff in regard to superior humeral head translation and subacromial contact pressure at all abduction angles. Superior capsule reconstruction with subacromial resurfacing decreased superior humeral head translation relative to intact (0°, P = .004; 30°, P = .02; 60°, P = .08; 90°, P = .01), superior capsule reconstruction (0°, P = .001; 30°, P = .003; 60°, P = .019; 90°, P = .001), and cuff-deficient states (P = .001). Superior capsule reconstruction with subacromial resurfacing resulted in nonsignificant increases in subacromial contact pressure relative to intact cuff at 0 to 90° abduction angles.

Conclusions
Superior capsule reconstruction with subacromial resurfacing using human dermal allograft results in decreased superior humeral head translation relative to superior capsule reconstruction with human dermal allograft only, while increasing subacromial contact pressure.

Clinical Relevance
Superior capsule reconstruction with subacromial resurfacing using human dermal allograft reduces superior humeral head translation while increasing subacromial contact pressure in a cadaveric model.

BACK

The Effect of Screw Design and Cortical Augmentation on Insertional Torque and Compression in Coracoid-Glenoid Fixation in a Sawbones Model

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Arthroscopy, Volume 36, Issue 3, Received: March 19, 2018; Accepted: October 1, 2019

https://doi.org/10.1016/j.arthro.2019.10.011

Purpose
To compare screw insertional torque and coracoid-glenoid compression from 4 fixation techniques with different screw design parameters and cortical augmentation for the Latarjet procedure.

Methods
Simulated Latarjet procedures were performed with 4 fixation techniques using laminated polyurethane blocks with dimensions similar to the coracoid-glenoid construct. The groups included DePuy Synthes Mitek 3.5-mm partially threaded screws with top hats, Arthrex 3.75-mm fully threaded screws with a 2-hole plate, Arthrex 3.75-mm fully threaded screws, and Smith & Nephew 4.0-mm partially threaded screws. Screws were inserted using a digital torque-measuring screwdriver to determine maximum insertional torque. Pressure-sensitive film was used to measure the maximum contact pressure and the effective pressure distribution (EPD) between the coracoid and glenoid; the EPD represents the percentage of the film's surface area that experienced pressure greater than 10 MPa. One-way analysis of variance and post hoc tests were used for statistical analysis.

Results
Significant differences were found between the 4 fixation groups for each variable measured. The 2 cortically augmented systems produced significantly higher maximum insertional torque than the non–cortically augmented systems ($P < .001$ for both). The 3.75-mm screws with a 2-hole plate yielded significantly higher contact pressures than the 4.0-mm screws ($P = .028$). This group also had a high EPD, with a mean value more than double the values of the non–cortically augmented systems ($P = .037$ and $P < .001$).

Conclusions
Cortically augmented fixation methods showed higher maximum insertional torque, maximum contact pressure, and EPD between the surfaces of the coracoid and glenoid in this Sawbones model.

Clinical Relevance
Various implants are available for the Latarjet procedure, but their biomechanical characteristics have not yet been fully elucidated. Graft fracture and nonunion represent 2 modes of failure that may be related to insertional torque and coracoid-glenoid compression. This study compared screw insertional torque and compression achieved using 4 fixation techniques with different screw design parameters and cortical augmentation in a Sawbones model.

BACK

The Double Krackow Suture Technique Does Not Offer a Significant Benefit Compared to the Krackow Suture Technique in Subpectoral Biceps Tenodesis Using a Double-Loaded Suture Anchor

Chih-Kai Hong, M.D., Kai-Lan Hsu, M.D., Fa-Chuan Kuan, M.D., Yueh Chen, M.D., M.Sc., Che-Chia Hsu, M.D., Ming-Long Yeh, Ph.D., Wei-Ren Su, M.D., M.Sc.

Arthroscopy, Volume 36, Issue 3, Received: May 23, 2018; Accepted: November 4, 2019

https://doi.org/10.1016/j.arthro.2019.11.097

Purpose
To compare the biomechanical properties of the double simple suture (DSS) technique, Krackow suture (KS) technique, and double Krackow suture (DKS) technique in subpectoral biceps tenodesis using a double-loaded suture anchor in a porcine tendon model.

Methods
A total of 30 artificial composite (polymer and glass fiber) humeri and porcine flexor profundus tendons with diameter of 4.5 mm were used. The sample size was determined based on the results of the pilot study. Metallic suture anchors with double-loaded No. 2 braided sutures were inserted at the subpectoral tenodesis site, 5 cm from the superomedial corner of the greater tuberosity. Three suture techniques were used to fix the tendons: a DSS used as the control, a KS, and a DKS, which is an alternative tendon graft fixation technique. A preload of 5 N was applied for 2 minutes, followed by cyclic loading for 500 cycles ranging from 5 to 70 N; next, a load-to-failure test at 1 mm/s was performed.

Results
The KS (283.5 ± 57 N) and DKS (270.4 ± 50 N) groups had significantly greater ultimate failure loads as compared with the DSS group (84.1 ± 6.4 N) ($P < .001$). Meanwhile, the peak displacement at failure loads in the KS group (9.3 ± 2.2 mm) and DKS group (7.8 ± 1.7 mm) were significantly smaller than that of the DSS group (11.3 ± 2.9 mm) ($P = .015$). Stiffness in the DSS group (36.4 ± 3.0 N/mm), KS group (39.6 ± 2.5 N/mm), and DKS group (36.9 ± 4.6 N/mm) was not significantly different ($P = .125$). All DSS constructs and 6 KS constructs failed with tendons being cut through by the sutures, whereas the other 4 KS constructs and all DKS constructs failed resulting from suture breakage.

Conclusions
In this subpectoral biceps tenodesis model, both the KS technique and the DKS technique had similar time 0 biomechanical properties that were better than those of the double simple suture technique.

Clinical Relevance
A sturdy suture-tendon structure could prevent clinical failure of a subpectoral biceps tenodesis using a suture anchor.

BACK

A Biomechanical Comparison of Different Suture Materials Used for Arthroscopic Shoulder Procedures

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Arthroscopy, Volume 36, Issue 3, Received: September 24, 2018; Accepted: October 16, 2019

https://doi.org/10.1016/j.arthro.2019.08.048

Purpose
To evaluate the viscoelastic properties of 4 commercially available cord-like sutures and 2 commercially available suture tapes when subjected to physiological loads, as well as to compare them with each other and to identify the clinically most desirable combination of suture material properties.

Methods
Six suture materials (Ethibond, FiberWire, FiberTape, Orthocord, Ultrabraid, and Ultratape) underwent creep testing (n = 7, 60 N, 10 minutes) to determine specimen stiffness, initial elongation at 60 N of load, static creep (during 10 minutes of loading), and relaxed elongation (material recovery 3 minutes after removal of load). Furthermore, cyclic testing (n = 7, 10-45 N, 0.5 Hz, 500 cycles) was carried out to determine dynamic creep, peak-to-peak displacement, and relaxed elongation. Mechanical testing was conducted on a material testing machine in 37°C phosphate-buffered saline solution.

Results
FiberTape showed the greatest stiffness (23.9 ± 3.2 N/mm, $P < .001$), the smallest amounts of static (0.38 ± 0.10 mm, $P < .001$) and dynamic (0.16 ± 0.09 mm, $P = .003$) creep, and the smallest peak-to-peak displacement (0.20 ± 0.02 mm, $P < .001$). FiberTape and FiberWire showed the smallest initial elongation (1.17 ± 0.17 mm and 1.63 ± 0.25 mm, respectively; $P < .001$). Ultrabraid showed the greatest relaxed elongation, both statically (4.73 ± 0.73 mm, $P < .001$) and dynamically (4.18 ± 0.83 mm, $P = .002$).

Conclusions
FiberTape consistently displayed less creep, greater stiffness, and less extensibility than the other suture types. Ultrabraid showed the largest amount of relaxed elongation on both static and dynamic testing.

Clinical Relevance
When considering high stiffness in combination with low initial extension and low static creep to be ideal parameters to achieve optimal initial construct stability and considering low dynamic creep in combination with low peak-to-peak displacement to be ideal conditions for the repetitive loading of the construct during the healing process, tapes seem to be superior to cord-like sutures for performing rotator cuff repair.

BACK

Arthroscopic Versus Open Bankart Repairs in Recurrent Anterior Shoulder Instability: A Systematic Review of the Association Between Publication Date and Postoperative Recurrent Instability in Systematic Reviews

Burke Gao, M.D., Steven DeFroda, M.D., Steven Bokshan, M.D., Lauren V. Ready, M.P.H., Kayleigh Sullivan, B.Sc., Christine Etzel, B.Sc., Brett D. Owens, M.D.

Arthroscopy, Volume 36, Issue 3, Received: September 24, 2018; Accepted: October 16, 2019

https://doi.org/10.1016/j.arthro.2019.10.022

Purpose
To systematically review the results of systematic studies regarding open versus arthroscopic Bankart repairs for recurrent anterior shoulder instability and quantitatively analyze the effect of primary-literature publication dates on reported outcomes in these systematic studies.

Methods
A systematic search was conducted to identify systematic studies reporting outcomes of both arthroscopic and open Bankart repairs for recurrent anterior shoulder instability. Patient-reported outcome measures, recurrent instability rates, definitions of instability, and procedure types reported by included study characteristics were qualitatively analyzed. Correlation coefficient analyses were performed to investigate if a systematic study's proportion of included primary literature published after 1999, 2000, 2001, or 2002 affected that study's reported mean difference in instability recurrence between open and arthroscopic procedures. The Assessment of Multiple Systematic Reviews criteria were used to assess the risk of bias of the included studies.

Results
Of 130 identified articles, 6 met the inclusion criteria. Patient-reported outcome measures were poorly reported. Among mean differences in instability recurrence rates, the results were indeterminate: Although 5 studies reported arthroscopic surgical procedures as having a higher recurrence rate, only 1 reported a statistically significant difference. Within the 5 included systematic reviews reporting the number of included studies, 37 of 56 observations were published after 2000. The proportion of studies published after 2000 (Pearson $r = 0.88$, $P = .052$) was positively associated with differences in instability recurrence rates between open and arthroscopic procedures.

Conclusions
Systematic studies that included newer studies (published after 2000) were associated with more favorable arthroscopic outcomes.

Level of Evidence
Level IV, systematic review of Level III and IV studies.

BACK

Journal of Shoulder and Elbow Surgery (JSES), Volume 28, issue 3

Surgery and physiotherapy were both successful in the treatment of small, acute, traumatic rotator cuff tears: a prospective randomized trial

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DOI: https://doi.org/10.1016/j.jse.2019.10.013

Background
Previous randomized trials on cuff repair have included mainly degenerative tears, but studies on acute traumatic tears are lacking. We aimed to compare early surgical repair with nonoperative treatment for traumatic supraspinatus tears.

Methods
We did a 2-center randomized controlled trial of patients with small rotator cuff tears mainly involving supraspinatus, comparing surgical repair (n = 32) and physiotherapy (n = 26). The primary outcome was a group difference in the Constant-Murley score at 12-month follow-up. Secondary outcomes were differences in the Western Ontario Rotator Cuff index, pain (Numerical Rating Scale 0-10), and Euro quality-of-life-visual analog scale. We used magnetic resonance imaging to assess retear rate, tear progression, fatty infiltration, and atrophy.

Results
The mean age was 59.7 years (range, 44-77 years), median sagittal tear size was 9.7 mm (range, 4-21 mm), and baseline characteristics were well balanced between the 2 groups. The repair group had a median Constant-Murley of 83 (25 quartile range [QR]) and the physiotherapy group 78 (QR, 22) at 12 months, with the between-group difference in medians of 4.5 (−5 to 9, 95% confidence interval; P = .68). The corresponding values for the Western Ontario Rotator Cuff index were 91% (QR, 24) vs. 86% (QR, 24), with the between-group difference of 5.0 (−4 to 9, 95% confidence interval; P = .62). There was no difference in Numerical Rating Scale or in Euro quality-of-life-visual analog scale. Retear was found in 6.5% of repaired patients and tear progression >5 mm in 29.2% of unrepaired patients.

Conclusions
We found no significant differences in clinical outcomes between cuff repair and nonoperative treatment at 12-month follow-up. Approximately one third of unrepaired patients had a tear enlargement of more than 5 mm.

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

BACK

Subacromial analgesia via continuous infusion catheter vs. placebo following arthroscopic shoulder surgery: a systematic review and meta-analysis of randomized trials

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DOI: https://doi.org/10.1016/j.jse.2019.11.010

Background
Subacromial analgesia (SAA) is hypothesized to reduce pain after arthroscopic shoulder surgery by delivering a continuous infusion of local anesthetic directly to the surgical site. The purpose of this systematic review and meta-analysis was to evaluate the efficacy of SAA vs. placebo for pain relief after arthroscopic subacromial shoulder procedures.

Methods
MEDLINE, Embase, PubMed, and the Cochrane Central Register of Controlled Trials were searched for randomized controlled trials comparing SAA with placebo after arthroscopic shoulder surgery. Outcomes collected included pain scores (converted to equivalent ordinal visual analog scores; minimal clinically important difference 1.4 cm), oral morphine equivalents used postoperatively, and catheter-related complications. Meta-analysis was performed via a random-effects model. Included trials underwent a risk of bias and quality of evidence assessment.

Results
Nine studies involving 459 participants were included. There were no clinically significant changes for pain scores in SAA at 6-, 12-, 24-, and 48-hour postoperative timepoints. Patients receiving SAA used less morphine equivalents of pain medication at 12 hours only (−0.37 mg, 95% confidence interval: −0.63 to −0.11), but there was no significant difference at 24 and 48 hours. There were no major complications (infection or reoperation). Included trials demonstrated a moderate risk-of-bias, and low to very low quality of evidence for primary outcomes.

Conclusion
Subacromial continuous infusion of local anesthetic does not provide a clinically significant benefit compared with placebo as part of a multimodal analgesia regime after arthroscopic subacromial surgical procedures. Future, high-quality trials are required to further assess the efficacy of SAA against placebo.

Level of evidence
Level II, Systematic Review/Meta-analysis

BACK

Risk factors for failure of eradicating infection in a single arthroscopic surgical procedure for septic arthritis of the adult native shoulder with a focus on the volume of irrigation

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DOI: https://doi.org/10.1016/j.jse.2019.07.014

Background
Septic arthritis of a native joint is relatively rare but is still a challenging and important orthopedic emergency. Most previous reports have focused on the clinical outcomes rather than the
risk factors for failure in arthroscopic surgery.

Methods
We retrospectively reviewed the records of patients with septic monoarthritis of the shoulder who underwent arthroscopic irrigation and debridement between January 2007 and January 2019. All
patients were divided into 2 groups according to recurrence after a single arthroscopic surgical procedure: eradicated group or recurred group. To identify risk factors affecting the recurrence of septic arthritis of the shoulder after arthroscopic surgery, the following parameters were considered: age; sex; involved side; presentation of rotator cuff tear; volume of irrigation; bacterial organism involved; preoperative erythrocyte sedimentation rate, C-reactive protein level, and white blood cell count in blood and joint fluid; diabetes mellitus; and hypertension. We compared the eradicated and recurred groups regarding the presence of potential risk factors.

Results
The study included 97 patients with a mean age of 61 years. Septic arthritis of the shoulder was eradicated completely with a single arthroscopic surgical procedure in 85 patients. However, a second arthroscopic surgical procedure was necessary in 12 patients (12.4%) because of infection
recurrence. No significant differences were found between groups except in the volume of irrigation
($P < .001$)

Conclusion
Most patients with septic arthritis (87.6%) of native shoulders were effectively treated with a single arthroscopic irrigation and debridement. The amount of irrigation may be the most important factor for preventing the need for additional surgical management.

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

BACK

Clinical and structural outcome 20 years after repair of massive rotator cuff tears

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DOI: https://doi.org/10.1016/j.jse.2019.07.031

Background:
Short- and mid-term outcomes after massive cuff tear repair are well reported, but there is no documentation of the clinical and structural outcomes at 20 years of follow-up. The hypothesis of the
present study was that at 20 years, deterioration of the shoulder would have occurred and led to a substantial number of reoperations.

Methods:
The authors retrospectively recalled all 127 patients operated for massive rotator cuff tears in 1994 at 6 different centers. At the 20-year follow-up, 26 patients died and 35 were lost to follow-up. Thirteen (10.2%) had been reoperated. This left 53 patients for personal clinical assessment. Forty-nine consented to standardized radiographic evaluation for assessment of osteoarthritis, 36 patients
underwent magnetic resonance imaging, allowing assessment of tendon healing, atrophy, and fatty infiltration (FI) of the cuff muscles.

Results:
The final Constant-Murley score (CS) was 68 17.7 (range, 8-91) vs. 44 15.3 (range, 13-74) preoperatively (P <.05). The final Subjective Shoulder Value (SSV) was 73% 23% (range, 0-100). Retears (Sugaya IV and V) were found in 17 cases (47%). Nine patients (17%) had cuff tear arthropathy (Hamada stage 4). The CS and SSV for the shoulders with FI stages III or IV were significantly inferior (53 19 points and 65% 14% respectively) than for those with FI stages 0-II (respectively, 71.6 6 points and 73% 4%) (P < .05).

Conclusions:
Twenty years after surgical repair of massive rotator cuff tears, the functional scores remain satisfactory, and the rate of revision is low.

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

BACK

Arthroscopic rotator cuff repair using a transosseous knotless anchor (ATOK)

M.J. Sandow, C.R. Schutz

DOI: https://doi.org/10.1016/j.jse.2019.07.017

Background:
This article reviews the clinical and radiographic outcomes in a noninferiority trial use of a transosseous knotless anchor to perform arthroscopic rotator cuff repairs in a patient cohort that have an increased incidence of osteoporosis.

Methods:
Patients aged over 60 with a documented rotator cuff tear and who failed a rehab program underwent repair using an arthroscopic transosseous knotless (ATOK) anchor. Patients were prospectively reviewed using shoulder functional assessments (age-adjusted Constant score, Oxford Shoulder Score, American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form [ASES], visual analog scale [VAS] pain scores), and underwent preoperative as well as 1-, 3-, and 12-month postoperative magnetic resonance imaging.

Results:
15 patients had undergone rotator cuff repair using the ATOK and were followed for a minimum of 24 months (range 24-30 months). From preoperative to 24 months post repair, median scores improved for ASES (61-89), Oxford (26-44), Constant (62-91), and VAS Pain (5-0.5). Four patients
developed a partial retear of their repair, but only 1 patient sustained a complete retear: Sugaya type
I, 10; type II, 1; type III, 2; type IV, 1; and type V, 1. No anchors were displaced, and there were no
osteolysis, neurologic, or technique-related complications.

Conclusions:
Arthroscopic rotator cuff repairs using a transosseous knotless technique has achieved a satisfactory outcome in this group of patients, who typically have poor bone quality, increasing the risk of antegrade anchor pullout. This approach would appear to combine the potential biomechanical
and biological advantages of a transosseous repair technique, with the benefits of the lower morbidity
arthroscopic surgical approach.

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

BACK

American Journal of Sports Medicine (AJSM), Volume 47, Issue 3

Delaminated Rotator Cuff Tears Showed Lower Short-term Retear Rates After Arthroscopic Double-Layer Repair Versus Bursal Layer–Only Repair: A Randomized Controlled Trial

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https://doi-org.vu-nl.idm.oclc.org/10.1177/0363546519897033

Background: The rotator cuff is known to consist of 2 macroscopically visible layers that have different biomechanical properties. Sometimes the inferior layer may be neglected during rotator cuff repair. However, it is controversial whether double-layer (DL) repair is superior to single-layer (SL) repair in terms of retear rate and outcome.

Purpose: To investigate whether DL as compared with SL repair could decrease retear rates after arthroscopic reconstruction of posterosuperior rotator cuff tears.

Study Design:
Randomized controlled trial; Level of evidence, 1.

Methods: A total of 70 patients were 1:1 randomized to receive an arthroscopic DL reconstruction (study group: DL suture-bridge repair) or SL reconstruction (control group: SL suture-bridge repair) for posterosuperior tears of the rotator cuff between 2.0 and 3.5 cm of the footprint detachment. Exclusion criteria were subscapularis tendon rupture (Lafosse >1°), fatty muscular infiltration >2°, and nondelaminated tendons. Tendon integrity according to Sugaya, fatty degeneration, and muscular atrophy were evaluated by magnetic resonance tomography. Pre- and postoperative evaluations included the Constant score, range of motion, American Shoulder and Elbow Surgeons score, Simple Shoulder Test, subjective shoulder value, and postoperative satisfaction with the procedure. Complications were monitored throughout the study.

Results: Ninety percent of patients (n = 34, DL; n = 29, SL) were followed-up. There were no significant group differences regarding baseline characteristics and pre- and postoperative fatty degeneration of the supraspinatus and atrophy of the supraspinatus and infraspinatus. The rate of magnetic resonance–verified intact repairs (Sugaya grades 1 + 2) was significantly higher in the DL group (70.6%) than in the SL group (44.8%; P = .045). One patient in the control group with a retear underwent revision. All functional and subjective scores improved significantly pre- to postoperatively in both groups (P < .05). No significant group differences were detected regarding postoperative Constant score, forward flexion, external rotation, American Shoulder and Elbow Surgeons score, Simple Shoulder Test, subjective shoulder value, and visual analog scale and between intact and retorn tendons. The majority of patients were very satisfied or satisfied with their arthroscopic procedure (DL, 94.1%; SL, 92.9%).

Conclusion: This randomized controlled trial showed significantly lower retear rates after DL repair as compared with SL repair in delaminated rotator cuff tears. Clinical short-term outcome was not different between the DL and SL repair groups.

BACK

Journal of Bone and Joint Surgery (JBJS), Volume 102, Issue 3 & 6

The changing incidence of arthroscopic subacromial decompression in Scotland

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https://doi.org/10.1302/0301-620X.102B3.BJJ-2019-0752.R2

Aims The aim of this study was to examine the recent trend in delivery of arthroscopic subacromial decompression (ASD) in Scotland and to determine if this varies by geographical location.

Methods Scottish Morbidity Records were reviewed retrospectively between March 2014 and April 2018 to identify records for every admission to each NHS hospital. The Office of Population Censuses and Surveys (OPCS-4) surgical codes were used to identify patients undergoing primary ASD. Patients who underwent acromioclavicular joint excision (ACJE) and rotator cuff repair (RCR) were identified and grouped separately. Procedure rates were age and sex standardized against the European standard population.

Results During the study period the number of ASDs fell by 649 cases (29%) from 2,217 in the first year to 1,568 in the final year. The standardized annual procedure rate fell from 41.6 (95% confidence interval (CI) 39.9 to 43.4) to 28.9 (95% CI 27.4 to 30.3) per 100,000. The greatest reduction occurred between 2017 and 2018. The number of ACJEs rose from 41 to 188 (a 3.59-fold increase). The number of RCRs fell from 655 to 560 (-15%). In the year 2017 to 2018 there were four (28.6%) Scottish NHS board areas where the ASD rate was greater than 3 standard deviations (SDs) from the national average, and two (14.3%) NHS boards where the rate was less than 3 SDs from the national average.

Conclusion There has been a clear decline in the rate of ASD in Scotland since 2014. Over the same period there has been an increase in the rate of ACJE. The greatest decline occurred between 2017 and 2018, corresponding to the publication of epidemiological studies demonstrating a rise in ASD, and awareness of studies which questioned the benefit of ASD. This paper demonstrates the potential impact of information from epidemiological studies, referral guidelines, and well-designed large multicentre randomized controlled trials on clinical practice.

BACK

Primary Arthroscopic Stabilization for a First-Time Anterior Dislocation of the Shoulder

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DOI: 10.2106/JBJS.19.00858

Background: The aim of this study was to evaluate the long-term efficacy of arthroscopic Bankart repair (ABR).

Methods: Eighty-eight patients with an age of ≤35 years who had sustained a primary anterior glenohumeral dislocation were enrolled in a single-center, double-blinded clinical trial. Subjects were randomized to receive either an arthroscopic washout (AWO) or ABR. Participants were reassessed after a minimum of 10 years postoperatively. Data regarding recurrent instability, revision surgery, satisfaction, and function (Disabilities of the Arm, Shoulder and Hand [DASH] and Western Ontario Shoulder Instability Index [WOSI]) scores were collected.

Results: Sixty-five patients (74%; 32 in the AWO group and 33 in the ABR group) were included and had an average follow-up of 14.2 years (range,12 to 16 years). The rate of recurrent dislocation was significantly higher in the AWO group than the ABR group (47% and 12%, respectively; $p = 0.002$). Kaplan-Meier curves were plotted for event-free survival using recurrent instability and/or revision surgery as clinical end points. This analysis demonstrated a sustained significant difference between the groups at 10 years after surgery (58% for the AWO group versus 79% for the ABR group; log-rank test [Mantel-Cox]; $p = 0.018$). Long-term WOSI scores were significantly better in the ABR group. The presence of recurrent instability was associated with significantly poorer WOSI and DASH scores.

Conclusions: This study demonstrates a long-term benefit in overall shoulder stability and functional outcome in high-risk patients who have undergone ABR for first-time anterior dislocation.

Level of Evidence: Therapeutic Level I. See Instructions for Authors for a complete description of levels of evidence.

BACK

Lower Extremity

Arthroscopy, Volume 36, Issue 3

The Top 50 Most Influential Articles in Hip Arthroscopy

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Arthroscopy, Volume 36, Issue 3, Received: April 11, 2019; Accepted: September 9, 2019

https://doi.org/10.1016/j.arthro.2019.09.031

Purpose
To identify the 50 most frequently cited publications related to hip arthroscopy.

Methods
The Clarivate Analytics Web of Knowledge database was used to search for publications relating to hip arthroscopy. The top 50 most cited articles that met the inclusion criteria were recorded and reviewed for various metrics.

Results
The top 50 publications were cited a total of 8,306 times, with an average of 437.2 total citations per year. Of the 50 articles identified, 44 had been published since 2000. Case series, expert opinion articles, and review articles were the most common study types.

Conclusions
The majority of the most influential articles on hip arthroscopy are case series and expert opinions; however, as hip arthroscopy continues to become more widely performed, higher-level articles should supplant some of the articles included in this analysis. As indications for hip arthroscopy have expanded, so has its body of literature, with the vast majority of articles identified in our study having been published since 2000. Elucidating the 50 most cited articles in hip arthroscopy will allow practicing physicians a quick reference to the highest-yield articles and will allow residency programs to guide their education on the topic.

Clinical Relevance
The top 50 list provides residents, fellows, and researchers with a comprehensive list of the major academic contributions to hip arthroscopy.

BACK

The Dancer's Hip: The Hyperflexible Athlete: Anatomy and Mean 3-Year Arthroscopic Clinical Outcomes

Christopher M. Larson, M.D., James R. Ross, M.D., M. Russell Giveans, Ph.D., Rebecca Stone McGaver, M.S., A.T.C., Katelyn N. Weed, M.S., Asheesh Bedi, M.D.

Arthroscopy, Volume 36, Issue 3, Received: April 24, 2019; Accepted: September 13, 2019

https://doi.org/10.1016/j.arthro.2019.09.023

Purpose
To report preoperative anatomy, patient-related outcomes measures, and return to dance rates in a cohort of competitive dancers undergoing an arthroscopic hip procedure.

Methods
Competitive dancers who underwent an arthroscopic hip procedure between 2008 and 2016 were included. Specific types of dance performed, morphology, and radiographic parameters were documented. Outcomes were evaluated with Modified Harris Hip Score (mHHS), the 12-Item Short Form Health Survey, visual analog scale, and Hip Disability and Osteoarthritis Outcome Scores (HOOS).

Results
There were 63 competitive dancers (77 hips) with a mean age 21.2 years in the current study. Specific types of dance performed included 57 studio dance and 41 high-kick dance, and 28 dancers (44%) were professional-level. Morphology included cam-type femoroacetabular impingement (95%), pincer-type femoroacetabular impingement (40%), anterior inferior iliac spine impingement (subspine) (83%), and mild (borderline) dysplasia (11%). Procedures performed included 95% labral repairs, 5% labral debridements, 99% femoral resections, 49% rim resections, 88% subspine decompressions, and 66% capsular plications. At mean 36 months' follow-up post-arthroscopy, the mean outcome improvements were 25.6 points (mHHS), 18.9 points (HOOS-activities of daily living), 29.9 points (HOOS-Sports), 8.7 points (12-Item Short Form Health Survey), and 3.7 points (visual analog scale) ($P < .01$ for each). Scores were significantly improved from preoperatively to most recent follow-up for mHHS (60.0 vs 85.6 points), HOOS-activities of daily living (72.5 vs 91.5 points), and HOOS-Sports (49.7 vs 79.6) ($P < .01$). Sixty-three percent of dancers returned to their previous level of competitive dance, 21% returned to limited or modified dance, and 16% were unable to return to dance, including 1 retirement.

Conclusions
A careful arthroscopic approach to address cam-type pathomorphology, highly prevalent subspine impingement, and capsular laxity in competitive dancers can achieve a modest rate of return to sport and good-to-excellent patient-reported outcomes at short- to mid-term (3-year) follow-up. Eighty-four percent of dancers ultimately returned to competitive dance, although only 63% returned to their preinjury competitive level.

Level of Evidence
IV, case series.

BACK

Defining Meaningful Functional Improvement on the Visual Analog Scale for Satisfaction at 2 Years After Hip Arthroscopy for Femoroacetabular Impingement Syndrome

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Arthroscopy, Volume 36, Issue 3, Received: May 28, 2019; Accepted: September 13, 2019

https://doi.org/10.1016/j.arthro.2019.09.028

Purpose
To (1) define Substantial Clinical Benefit (SCB), Patient Acceptable Symptomatic State (PASS), and Minimal Clinically Important Difference (MCID) for the visual analog scale (VAS) Satisfaction in patients undergoing hip arthroscopy for femoroacetabular impingement syndrome (FAIS), and (2) identify preoperative predictors of achieving each outcome end-point.

Methods
Data from consecutive patients who underwent primary hip arthroscopy between November 2014 and January 2017 were prospectively collected and retrospectively analyzed. Inclusion criteria consisted of patients with clinical and radiographic diagnosis of FAIS, who failed nonoperative treatment, underwent primary hip arthroscopy to address the FAIS, and had at minimum 2-year follow-up. Baseline data and postoperative patient-reported outcome scores were recorded at 2 years postoperatively. To quantify clinical significance of outcome achievement on the VAS)Satisfaction, we calculated MCID, PASS, and SCB for this outcome measure. A multivariate logistic regression analysis was used to identify preoperative predictors of achieving SCB, PASS, and MCID satisfaction.

Results
A total of 335 patients were included in the final analysis, with an average age and body mass index (BMI) of 32.8 (standard deviation ± 12.4) years and 25.2 (standard deviation ± 5.3), respectively, and the majority being female (69.3%). The values on the VAS satisfaction were identified to represent MCID, PASS, and SCB, respectively: 52.8, 80.9, and 89.7. The rates of achieving clinically significant improvement on the VAS Satisfaction was 85.6%, 68.1%, and 56.9% for MCID, PASS, and SCB, respectively. A larger preoperative alpha angle was predictive for achieving SCB (odds ratio [OR], 1.076; P = .046), whereas lower BMI (OR, 0.955; P = .047) and larger preoperative alpha angle (OR, 1.12; P = .025) were predictors for achieving PASS.

Conclusions
This study identified threshold VAS satisfaction scores of 52.8, 80.9, and 89.7 for achieving MCID, SCB, and PASS, respectively, at 2-year follow-up following hip arthroscopy for FAIS. Furthermore, preoperative variables including larger preoperative alpha angles and lower BMI are predictors of achieving superior clinical satisfaction.

Level of Evidence
Level IV, Case Series.

BACK

Depression and Anxiety Are Associated With Increased Health Care Costs and Opioid Use for Patients With Femoroacetabular Impingement Undergoing Hip Arthroscopy: Analysis of a Claims Database

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Arthroscopy, Volume 36, Issue 3, Received: April 19, 2019; Accepted: September 25, 2019

https://doi.org/10.1016/j.arthro.2019.09.048

Purpose
To determine if opioid use and health care costs in the year before and following hip arthroscopy for femoroacetabular impingement (FAI) differ between those with or without depression or anxiety.

Methods
Using the Truven Health Marketscan database, FAI patients who underwent hip arthroscopy between October 2010 and December 2015 were identified (Current Procedural Terminology codes 29914 [femoroplasty], 29915 [acetabuloplasty], and/or 29916 [labral repair]). Patients were excluded if they had incomplete coverage for 1 year either before or following surgery. The number of patients with 1 or more claims related to depression or anxiety during the year before surgery was quantified (International Statistical Classification Diseases and Related Health-9 codes 296, 298, 300, 309, 311). Health care costs in the year before and following hip arthroscopy were compared between those with or without depression or anxiety. We also compared the number of patients in each group who filled a narcotic pain prescription within 180 days before surgery as well as >60 or >90 days after hip arthroscopy.

Results
Depression or anxiety claims were seen in 5,208/14,830 patients (35.1%) before surgery. A significantly greater proportion of those with preoperative depression or anxiety filled opioid-related prescriptions in the 6 months before surgery (36.2% vs 25.6%, $P < .0001$) and both >60 days (31.3% vs 24.7%, $P < .0001$) and >90 days after surgery (29.5% vs 23.4%, $P < .0001$). The group with preoperative depression or anxiety had significantly greater health care costs both before ($8,775 vs $5,674, $P < .0001$) and following surgery ($5,287 vs $3,908, $P < .0001$).

Conclusions
Both before and following hip arthroscopy, opioid use and health care costs were significantly greater for FAI patients with comorbid depression or anxiety.

Level of Evidence
Level III, retrospective comparative therapeutic study.

BACK

Validity of Magnetic Resonance Imaging Measurement of Hip Labral Width Compared With Intraoperative Assessment

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Arthroscopy, Volume 36, Issue 3, Received: April 25, 2019; Accepted: September 15, 2019

https://doi.org/10.1016/j.arthro.2019.09.027

Purpose
To determine if magnetic resonance angiography (MRA) and/or magnetic resonance imaging (MRI) could accurately determine the width of the labrum.

Methods
Consecutively enrolled patients between the ages of 18 and 65 indicated for hip arthroscopy for femoroacetabular impingement were included between December 2017 and June 2018. Inclusion criteria for preoperative MRIs included: MRI availability in picture archiving and communication system; performance on a 1.5T or 3T MRI or 3T MRA; and adequate quality and lack of labrum ossification. Intraoperative labral width measurements were taken at standardized locations using an established acetabular “clockface” paradigm. Measurement was performed using a calibrated probe. The labral width was defined as the distance from the labrum extended laterally from the acetabular rim. MRI measurements were taken by 2 blinded musculoskeletal fellowship-trained radiologists at the same positions. Measurements were made at the 11:30 o’clock position (indirect rectus) on coronal proton density (PD) sequence, at 3 o’clock position (psoas-U) on axial oblique PD sequence, and at 1:30 (a point halfway between the 2) on sagittal fat-suppressed PD. The surgeons were blinded to the radiologists’ measurements and vice versa. Intraoperative and radiographic labral width measurements were compared using an intraclass correlation coefficients (ICC), absolute agreement, and 2-way random effects model. The 2 radiologists’ measurements were compared for interrater reliability using the same ICC model.

Results
Fifty-one patients were included (30 females, 26 right hips). Average labrum width at the 3:00, 11:30, and 1:30 o’clock positions by arthroscopic measurement were 5.8 mm (range; standard deviation, 2-8; ±1.4), 6.3 mm (2-10; ±1.5) and 6.0 mm (2-9; ±1.5), and by MRI were 6.3 mm (2-10; ±1.5), 6.7 mm (3-10; ±1.4), and 6.1 mm (2-9; ±1.6), respectively. When including all MRI modalities, ICC agreement between intraoperative assessment, and radiologist assessment at the 3:00 o’clock, 11:30, and point halfway between was 0.82 ($P < .001$), 0.78 ($P < .001$), 0.84 ($P < .001$), respectively. Radiologist interrater ICC agreement at the same points was 0.88 ($P < .001$), 0.93 ($P < .001$), and 0.88 ($P < .001$).

Conclusions
Strong agreement was found between radiologic and arthroscopic measurement of labrum width when using MRI, suggesting MRI is an accurate way to measure labral width. There was not a significant difference between different MRI modalities. Accurately measuring labral width preoperatively with MRI may aid in surgical decision making.

Level of Evidence
Level II, diagnostic study.

BACK

The Evolution of Hip Arthroscopy: What Has Changed Since 2008—A Single Surgeon's Experience

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Arthroscopy, Volume 36, Issue 3, Received: May 20, 2019; Accepted: October 3, 2019

https://doi.org/10.1016/j.arthro.2019.10.009

Purpose
To compare a single surgeon's first 200 cases of hip arthroscopy with the last 200 cases regarding patient demographic characteristics, indications for surgery, intraoperative findings, procedures performed, and patient-reported outcomes.

Methods
Data were reviewed for all patients undergoing primary hip arthroscopy between February 2008 and August 2016 performed by a single surgeon. Of the 3,319 patients who underwent hip-preservation surgery during the study period, the first 200 (group A) and last 200 (group B) eligible for minimum 2-year follow-up were included in our analysis.

Results
Follow-up was available for 187 of 200 patients (93.5%) and 189 of 200 patients (94.5%) in groups A and B, respectively. The groups were similar in age, sex, and body mass index ($P > .05$). Group A included significantly more patients with Tönnis grade 1 (37% vs 21%, $P < .001$). Group B consisted of significantly more ($P < .001$) labral reconstructions (10.2% vs 0%), capsular closures (72.7% vs 26.2%), and gluteus medius repairs (18.2% vs 3.2%). Femoroplasty was performed for smaller cam lesions in group B, resulting in smaller postoperative alpha angles (45.7° ± 7.9° vs 42.4° ± 6.3°, $P < .001$). Group B exhibited significantly higher patient-reported outcomes at minimum 2-year follow-up ($P < .05$). In addition, in group B, greater proportions of patients achieved the minimal clinically important difference and patient acceptable symptomatic state ($P < .05$).

Conclusions
This study shows the noteworthy evolution in the management of the prearthritic adult hip occurring between 2008 and 2016. This includes improvements in preoperative patient evaluation and patient selection. In addition, the proportion of patients undergoing labral reconstruction, capsular plication, and femoroplasty has increased significantly. These developments, as well as increased surgical experience, may have contributed to improved surgical outcomes.

Level of Evidence
Level III, retrospective comparative trial.

BACK

Evaluating for Tunnel Convergence in Anterior Cruciate Ligament Reconstruction With Modified Lemaire Tenodesis: What Is the Best Tunnel Angle to Decrease Risk?

Simone Perelli, M.D., Juan Ignacio Erquicia, M.D., Maximiliano Ibañez, M.D., Gianmarco Daesino, M.D., Pablo Eduardo Gelber, M.D. Ph.D., Xavier Pelfort, M.D. Ph.D., Juan Carlos Monllau, M.D., Ph.D.

Arthroscopy, Volume 36, Issue 3, Received: February 11, 2019; Accepted: August 14, 2019

https://doi.org/10.1016/j.arthro.2019.08.042

Purpose
The purpose of this study was to analyze postoperative computed tomography (CT) scan evaluations of patients who had undergone a combined anterior cruciate ligament (ACL) reconstruction and modified Lemaire anterolateral tenodesis (ALT) with femoral fixation through a bony tunnel.

Methods
Postoperative CT scans of 52 patients who had undergone combined ACL and ALT were prospectively evaluated. ACL femoral tunnels were drilled through an anteromedial portal in the center of the native footprint. An ALT fixation tunnel was drilled 5 mm proximal to the lateral epicondyle, aiming at an inclination of 30° proximally and 30° anteriorly. Two independent observers evaluated the CT scans measuring any degree of collision, the shortest distance between the tunnels, and the inclination of the ALT tunnels. Measurements were carried out at both the cortical level and on a plane passing 1 cm deeper in the lateral condyle.

Results
At the level of the cortex, no convergence of the tunnels was identified. In 14 of 52 cases (26.9%), the shortest distance between the tunnels was less than 5 mm. Tunnel collision occurred in 8 of 52 cases (15.4%), and the bone bridge between the tunnels was less than 5 mm in 11 cases (21.1%) when the measurements were made on the deeper plane. When the inclination on the axial plane was less than 15°, a collision always ($P < .001$) occurs. When it was more than 20°, no collision occurred ($P < .001$). No correlation between convergence and the inclination of the ALT tunnel on the coronal plane was detected.

Conclusions
To fix a modified Lemaire ALT through a femoral tunnel avoiding any interference with an anatomic femoral ACL tunnel, we recommend that the femoral tunnel be drilled with an inclination of at least 20° anteriorly.

Level of Evidence
IV, therapeutic case series.

BACK

The Influence of Physeal Status on Rate of Reoperation After Arthroscopic Screw Fixation for Symptomatic Osteochondritis Dissecans of the Knee

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Purpose
To determine if physeal status or other preoperative or intraoperative variables influence the failure rate after arthroscopic reduction and internal fixation of osteochondritis dissecans (OCD) lesions in the knee.

Methods
Consecutive patients undergoing screw fixation of osteochondral fragments from OCD by a single surgeon from 2005 to 2015 with a minimum 2-year follow-up were included. Demographic, preoperative imaging, and intraoperative data were analyzed to determine risk factors associated with failure, which was defined as the need for a revision reoperation or arthroplasty after initial OCD fixation.

Results
A total of 45 knees met the inclusion criteria, including 26 skeletally mature patients and 19 patients with incompletely closed physes on preoperative imaging. The mean ages of the skeletally mature and immature groups were 18.3 ± 2.5 years and 14.9 ± 2.2 years, respectively ($P < .001$), and the mean body mass index values were 24.3 ± 3.6 and 23.2 ± 4.0, respectively ($P = .432$). We excluded 10 patients from the survivorship analysis because they had less than 2 years' follow-up. No statistically significant difference in failure rates was found between skeletally mature and immature individuals (30% and 40%, respectively; $P = .721$). The only factor significantly associated with fixation failure was undergoing a prior surgical procedure to address the OCD lesion ($P = .038$). Kaplan-Meier analysis showed rates of overall survivorship from revision reoperations of 88.6% at 1 year and 68.8% at 5 years.

Conclusions
Outcomes after internal fixation of OCD fragments are guarded, with a fragment survival rate of 65.7% at a mean of 4.1 years' follow-up. No difference in fragment survival was noted in skeletally mature versus immature patients. The only independent risk factor identified for fixation failure was the number of previous operations.

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

BACK

Patients Forget About Their Operated Knee More Following Arthroscopic Primary Repair of the Anterior Cruciate Ligament Than Following Reconstruction

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Purpose
To assess the extent to which patients forget their operative knee joint on a daily basis following arthroscopic primary repair as compared with reconstruction of the anterior cruciate ligament (ACL) at short- to mid-term follow-up.

Methods
For this retrospective study, all patients undergoing ACL surgery between May 2012 and May 2017 were identified. All patients were treated with the algorithm of undergoing arthroscopic primary repair for proximal tears and reconstruction for nonrepairable tears. Patients were contacted to complete the Forgotten Joint Score-12 questionnaire between 2 and 5 years following surgery. A greater score represents a more favorable outcome indicating the patient's ability to "forget" the joint in everyday life, whereas lower scores indicate a less-favorable outcome. Data were analyzed using independent t-tests and $\chi 2$ tests, and multiple linear regression analysis was performed to correct for potential confounders.

Results
Eighty-three patients completed the questionnaire (57%). Patients who underwent primary repair thought about their operated knee less when compared with those patients who underwent reconstruction (85.3 ± 14.2 vs 74.3 ± 23.3, P = .022). These differences were significantly greater in patients older than 30 years (85.3 ± 12.9 vs 62.6 ± 24.9, P = .007), male patients (85.0 ± 13.6 vs 72.5 ± 24.7, P = .037), and patients with a body mass index greater than 25 (85.9 ± 14.5 vs 64.7 ± 25.6, P = .009). After we corrected for potential confounders, the overall difference remained significant (P = .045).

Conclusions
Based on the data in this study, patients undergoing arthroscopic primary ACL repair can expect to have less daily awareness of their operated knee at short- to mid-term follow-up as compared with patients undergoing ACL reconstruction.

Level of Evidence
Retrospective comparative study, level III.

BACK

Return to Work Following High Tibial Osteotomy With Concomitant Osteochondral Allograft Transplantation

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Purpose
To assess the timeline of return to work (RTW) following opening-wedge high tibial osteotomy (HTO) with concomitant osteochondral allograft transplantation (OCA) of the medial femoral condyle.

Methods
Consecutive patients undergoing HTO + OCA due to focal chondral deficiency and varus deformity were retrospectively identified and reviewed at a minimum of 2 years following surgery. Patients completed a subjective work questionnaire, a visual analog scale for pain, Single Assessment Numerical Evaluation, and a satisfaction questionnaire.

Results
Twenty-eight patients (average age: 36.0 ± 7.9 years) were included at 6.7 Math Eq 4.1 years postoperatively. Twenty-six patients were employed before surgery and 25 patients (96.2%) returned to work following HTO + OCA. However, only 88.5% of patients were able to return to the same level of occupational intensity by 3.5 ± 2.9 months postoperatively. The rate of RTW to the same occupational intensity for sedentary, light, medium, and heavy intensity occupations was 100%, 100%, 88.9%, and 80% (P = .8), whereas the duration of RTW was 9.0 ± 7.1 months, 1.7 ± 1.4 months, 2.7 ± 0.9 months, and 4.2 ± 1.9 months (P = .006), respectively. Two patients (7.7%) underwent knee replacement by 5.3 ± 3.1 years postoperatively due to progression of osteoarthritis in the medial compartment.

Conclusions
In patients with focal chondral deficiency and varus deformity, HTO + OCA provides a high rate of RTW (96.2%) by 3.5 ± 2.9 months postoperatively. However, patients with greater-intensity occupations may take longer to return to work than those with less physically demanding occupations.

Level of Evidence
IV, Retrospective Case Series

BACK

Subjective Knee Function and Risk of Failure Are Equivalent for Men and Women at 5 Years After Meniscus Repair

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Purpose
To determine whether subjective knee function or risk of repair failure differ between men and women at mean 5 years following meniscal repair with or without concomitant anterior cruciate ligament reconstruction.

Methods
A total of 235 patients (97 women, 138 men; mean age, 29.1 years; standard deviation, 11.3) were assessed for meniscus repair failure and postoperative knee function at mean 5.8 years follow-up. Knee symptoms were assessed with International Knee Documentation Committee Subjective (IKDC-S) scores. Postoperative activity scores were assessed with Marx activity score. Independent effects of patient age and activity level on meniscus failure risk and patient-reported outcomes were determined by multivariate analysis with adjustment for age, body mass index, anterior cruciate ligament status, tear pattern, and number of implants used at the time of surgery.

Results
Failures occurred in 18.9% of men and 21.0% of women with no difference in mean time to failure ($P = .75$) or risk of failure for men vs women ($P = .57$) in the univariate analysis. Male sex was not an independent risk factor for failure after adjustment for patient age, body mass index, concomitant anterior cruciate ligament status, tear pattern, or number of implants used ($P = .16$). Marx activity scores at follow-up were higher among men in multivariate analysis ($P = .009$). Men and women had similar IKDC-S scores at follow-up in the unadjusted ($P = .25$) and multivariate analyses ($P = .21$).

Conclusions
Following meniscus repair, both sexes report similar subjective knee function, though men have higher self-reported activity scores. Meniscus repair failure risk does not differ between men or women at mid-term follow up.

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

BACK

Opioid-Limiting Regulation: Effect on Patients Undergoing Knee and Shoulder Arthroscopy

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Purpose
To determine the effect prescription-limiting legislation passed in Rhode Island has had on opioids prescribed following arthroscopic knee and shoulder surgery at various time points, up to 90 days postoperatively.

Methods
All patients undergoing the 3 most common arthroscopic procedures at our institution (anterior cruciate ligament reconstruction, partial meniscectomy, and rotator cuff repair) were included. Patients were selected from 2 6-month study periods (prepassage and postimplementation of the law). The state's Prescription Drug Monitoring Program database was queried for controlled substances filled in the perioperative period (from 30 days preoperatively to 90 days postoperatively). Multiple logistic regressions were used to identify predictors of chronic (>30 days) opioid use.

Results
The morphine milligram equivalents (MMEs) prescribed in the initial postoperative script decreased from 319.04 (~43 5-mg oxycodone tablets) in the prepassage to 152.45 MMEs (~20 5-mg oxycodone tablets) in the postimplementation group ($P < .001$). The total MMEs filled in the first 30 days decreased from 520.93 to 299.94 MMEs (~70 to ~40 5-mg oxycodone tablets) ($P < .001$). MMEs filled between 30 and 90 days fell by 22.5% for all patients in this study; however, this change was not statistically significant ($P = .263$). Preoperative opioid use (odds ratio, 10.85; $P < .001$) and preoperative benzodiazepine use (odds ratio, 2.13; $P = .005$) predicted chronic opioid use postoperatively.

Conclusions
State opioid-limiting legislation reduced cumulative MMEs following arthroscopic knee and shoulder surgery in the first 30 days. Further research assessing the impact of this legislation on postoperative pain control, patient satisfaction, and functional outcomes following surgery is warranted.

Level of Evidence
Level III, case-control study.

BACK

Quantifying the Opportunity Cost of Resident Involvement in Academic Orthopaedic Sports Medicine: A Matched-Pair Analysis

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Purpose
To quantify the cost of resident involvement in academic sports medicine by examining differences in operative time, relative value units (RVUs) per case, and RVUs per hour between attending-only cases and cases with resident involvement.

Methods
A retrospective analysis of common sports medicine procedures identified by Current Procedural Terminology code was performed using data from the American College of Surgeons National Surgical Quality Improvement Program database from 2006 to 2015. Matched cohorts were generated based on demographic variables, comorbidities, preoperative laboratory values, and surgical procedures. Bivariate analysis examined mean differences in operative time, RVUs per case, and RVUs per hour between attending-only cases and cases with resident involvement. A cost analysis was performed to quantify differences in RVUs generated per hour in terms of dollars per case.

Results
A total of 14,840 attending-only cases and 2,230 resident-involved cases were used to generate 2 matched cohorts (N = 4,460). Resident cases had greater mean operative times than attending-only cases, with operative time increasing as residents became more senior ($P < .01$). Residents participated in cases with larger mean RVUs per case ($P < .01$). Cases with lone attendings showed greater RVUs per hour ($P < .01$). The cost of resident involvement increased nearly 8-fold from postgraduate year 1 to postgraduate year 6 residents ($25.70 vs $200.07).

Conclusions
In academic sports medicine, the involvement of resident physicians increases operative time. The associated decrease in attending physician efficiency in RVUs per hour equates to an average cost per case of $159.18, with costs increasing as residents become more senior.

Level of Evidence
Level III, retrospective comparative trial.

BACK

Surgical Techniques for Knee Cartilage Repair: An Updated Large-Scale Systematic Review and Network Meta-analysis of Randomized Controlled Trials

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Arthroscopy, Volume 36, Issue 3

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Purpose
The aim of this study was to investigate the most appropriate surgical interventions for patients with knee articular cartilage defects from the level I randomized clinical trials.

Methods
We searched five databases for level I randomized clinical trials. Treatments were compared if reported in more than one study using network meta-analysis to boost the number of included studies per comparison.

Results
We studied 21 articles that included 891 patients. Traumatic lesion was the most common cause in the included patients. There were significantly higher failure rates in the microfracture (MF) group compared to autologous chondrocyte implantation (ACI) group at 10-year follow-up. Moreover, osteochondral autograft transplantation (OAT) showed significantly more excellent or good results at > 3-year follow-up compared to MF, whereas MF showed significantly more poor results versus ACI and matrix-induced autologous chondrocyte implantation (MACI). Furthermore, OAT showed significantly more poor results than MACI at 1-year follow-up. Similarly, patients who underwent OAT had higher return-to-activity rates than those with MF. It is noteworthy that the Knee injury and Osteoarthritis Outcome Score was higher in patients who underwent characterized chondrocyte implantation or MACI compared to MF. Finally, there were no significant differences among the various interventions regarding reintervention, biopsy types or adverse events. According to the P scores for interventions ranking, there was a disagreement concerning the best intervention; however, MF was always ranked as the last.

Conclusions
Cartilage repair techniques, rather than MF, provide higher quality repair of tissue and have lower failure and higher return-to-activity rates. Moreover, OAT had significantly more excellent or good results compared to MF, whereas MF had significantly more poor results than ACI and MACI. Future studies need to have longer follow-up periods and more representative populations to investigate the efficacy and safety of these interventions.

Level of evidence
Level I: meta-analysis of Level I studies.

BACK

Platelet-Rich Plasma Versus Surgery for the Management of Recalcitrant Greater Trochanteric Pain Syndrome: A Systematic Review

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Purpose
To perform a systematic review of the outcomes of platelet-rich plasma (PRP) injections as an in-office procedure versus surgical treatment for recalcitrant greater trochanteric pain syndrome (GTPS).

Methods
The MEDLINE and Embase databases were searched in June 2019 following the Preferred Reporting Items for Systematic Reviews and Meta-analyses statement. Clinical studies on patients with recalcitrant GTPS treated with PRP or surgery were included. Demographic characteristics, patient-reported outcomes (PROs), and complications were compared. A qualitative analysis using the Methodological Index for Non-randomized Studies and Cochrane Risk of Bias Tool scores was performed.

Results
A total of 5 PRP and 5 surgery studies met the inclusion criteria, contributing 94 and 185 patients, respectively. The mean follow-up time was shorter for the PRP studies (range, 2-26 months) than with surgery (range, 12-70 months). The mean Methodological Index for Non-randomized Studies scores for the PRP and surgery groups were 11.25 and 11.4, respectively, and the only randomized trial had a low risk of bias. Two studies in the PRP group (n = 56) reported improvements in the modified Harris Hip Score at final follow-up (from 53.8 to 82.6 and from 56.7 to 74.2). The other PRP studies reported improvements using other measures. In the surgery group, 2 studies reported improvements in the Harris Hip Score (from 53.0 to 80 and from 53.3 to 88) whereas 3 used unique PROs (Oxford score, from 20.4 to 37.3; modified Harris Hip Score, from 54.9 to 76.2; and Merle d'Aubigné and Postel score, from 10.9 to 16.7). Although significant improvement was reported in all studies included, PRP showed a large effect size whereas surgery showed a moderate to large effect size. No major complications were associated with PRP treatment; however, the surgery group reported a higher rate of complications including recurrent external snapping hip, retears resulting from falls, trochanteric fracture, venous thrombosis, and wound-related problems.

Conclusions
Both PRP and surgical intervention for the treatment of recalcitrant GTPS showed statistically and clinically significant improvements based on PROs. Although not covered by most medical insurance companies, PRP injections for recalcitrant GTPS provides an effective and safe alternative after failed physical therapy. If surgery is indicated, endoscopy is safer than the open technique.

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

BACK

Associated Morbidity After the Percutaneous Release of the Medial Collateral Ligament for Knee Arthroscopy

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Purpose
To summarize available data on the morbidity associated with percutaneous release of the medial collateral ligament (MCL) of the knee during arthroscopy via a “pie-crusting” technique.

Methods
A search of the literature was performed using the MEDLINE and Web of Science databases to identify studies examining the morbidity of percutaneous MCL release during arthroscopy. Only English-language articles were included; technical articles and studies not focused on the use of this technique were omitted. Two independent reviewers performed the literature search, data extraction, and quality assessment. The outcomes analyzed included resultant knee instability, functional outcome scores, visual analog scale pain scores, and saphenous nerve or greater saphenous vein injury.

Results
Six studies met the eligibility criteria. The studies included a total of 234 knees undergoing MCL release, with a mean patient age of 41.1 years. This MCL release typically generated grade I MCL laxity, which usually diminished or resolved over time and did not require brace application. The functional outcome scores of patients undergoing MCL release did not differ from those of patients undergoing the same procedure without MCL release. Postoperative pain was not significantly different between patients who underwent MCL release and those who did not. There was a 0% incidence of injury to the saphenous nerve or greater saphenous vein with MCL release in the included studies.

Conclusions
Percutaneous MCL release during knee arthroscopy is a method of increasing the medial tibiofemoral joint space without causing any significant short- or long-term complications including residual valgus instability, pain, loss of function, or damage to surrounding structures.

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

BACK

What Are the Floor and Ceiling Effects of Patient-Reported Outcomes Measurement Information System Computer Adaptive Test Domains in Orthopaedic Patients? A Systematic Review

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Purpose
To perform a systematic review to answer the following: (1) What are the floor and ceiling (F/C) effects of the Patient-Reported Outcomes Measurement Information System (PROMIS) computer adaptive test (CAT) domains of physical function (PF), upper extremity physical function (UE), pain interference (PI), and depression (D) in adult orthopaedic patients? (2) Do the PROMIS-PF and PROMIS-PI domains have differing F/C effects depending on use in upper extremity, lower extremity, spine, neck, and back, or trauma patients?.

Methods
(Preferred Reporting Items for Systematic Review and Meta-Analyses guidelines were followed, the review was registered on PROSPERO, and the methodological index for non-randomized studies was used for this systematic review. Studies reporting the F/C effects of at least 1 of 4 PROMIS CAT domains in orthopaedic patient cohorts accessed through PubMed and Embase on October 30, 2018, were included. F/C effects for each study were reported within forest plots.

Results
Forty-three studies were included. Generally, varying cohorts demonstrated no F/C effects for PROMIS-PF (0%-9.0%), variable ceiling effects for PROMIS-UE (lower in v2.0; 0%-28.2%), variable floor effects for PROMIS-PI (0%-19.0%), and significant floor effects for PROMIS-D (0.4%-23.4%).

Conclusions
The orthopaedic literature demonstrated generally favorable floor and ceiling effects for PROMIS CAT domains, with the exception of variable ceiling effects for PROMIS-UE (the newer version exhibits only minor effects), variable floor effects for PROMIS-PI, and significant floor effects for PROMIS-D. In addition, the F/C effects of PROMIS-PF did not vary based on patient population. Although the floor effects of PROMIS-PI did vary based on patient population, the variability does not appear to be based solely on anatomic location. The PROMIS-PF and PROMIS-UE v2.0 demonstrate consistently low floor and ceiling effects. However, the PROMIS-PI and PROMIS-D may need modification before widespread adoption for clinical and research purposes.

Level of Evidence
III; systematic review of Level I-III studies.

BACK

Knee Surgery, Sports Traumatology, Arthroscopy (KSSTA), Volume 27, Issue 3

Microfracture for cartilage repair in the knee: a systematic review of the contemporary literature

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DOI https://doi.org/10.1007/s00167-019-05359-9

Purpose
To systematically review and evaluate novel clinical data following microfracture treatment of knee articular cartilage defects.

Methods
A systematic review was performed by searching PubMed, ScienceDirect, and Cochrane Library databases for clinical trials on microfracture treatment, published between 2013 and 2018. Titles, abstracts, and articles were reviewed, and data concerning patient demographics, study design, pre-, intra-, and postoperative findings were extracted. PRISMA guidelines were applied. The methodological quality of the included studies was analyzed by the modified Coleman Methodology Score (CMS), and aggregate data were generated.

Results
Eighteen studies including 1830 defects (1759 patients) were included. Of them, 8 (59% of patients) were cohort studies without a comparison group. Overall study quality was moderate (mean total CMS: 64 points), mainly due to low patient numbers, short follow-up periods, lack of control groups and structural repair tissue evaluation, and inhomogeneity in outcome parameters. Microfracture treatment of full-thickness articular cartilage defects (3.4 ± 2.1 cm2) was performed at 43.4 ± 68.0 months of symptom duration. Postoperative assessment at 79.5 ± 27.2 months revealed failure rates of 11–27% within 5 years and 6–32% at 10 years. Imaging analysis was conducted in 10 studies, second-look arthroscopies were reported twice (n = 205 patients) and revealed well integrated fibrocartilaginous repair tissue.

Conclusions
Microfracture provides good function and pain relief at the mid-term and clinically largely satisfying results thereafter. Standardized, high-quality future study designs will better refine optimal indications for microfracture in the context of cartilage repair strategies.

Level of evidence
This systematic review is based on studies with levels of evidence ranging between I and IV (see results section and Table). Therefore, and according to this journals Instructions for Authors (SYSTEMATIC REVIEWS AND META-ANALYSES are assigned a level of evidence equivalent to the lowest level of evidence used from the manuscripts analysed), level of evidence is IV

BACK

No effect of graft size or body mass index on risk of revision after ACL reconstruction using hamstrings autograft

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Purpose
The current study investigated the distribution of hamstrings graft size and body mass index and any potential effect on the risk of revision surgery in a large prospective cohort of patients undergoing ACL reconstruction. More specifically, the aim of the study was to investigate whether larger graft size or smaller BMI would decrease the risk of revision after ACL reconstruction.

Methods
A total of 4029 patients, prospectively registered in the Norwegian Knee Ligament Registry, were included in the study. Univariate Kaplan–Meier survival analyses (with log-rank tests) and the Cox proportional hazard (PH) regression model were applied to compare risk of revision between groups of patients. Mutual adjustment for gender, age, activity at the time of injury and fixation method of the graft was performed.

Results
Graft sizes spanned from 5.5 to 11.0 mm and the median of 8.0 mm was reported in 42% of patients in the cohort. BMI was reported from 15 to 57 with a median of 25. 46% of patients were classified as overweight (WHO standards), while 23% of patients were obese. At a median of 2.5 years after surgery, 150 patients had undergone revision surgery. Although certain effects were seen in the unadjusted analyses, neither graft size (diameter) nor patient BMI did affect the risk of undergoing revision surgery in the adjusted analyses.

Conclusions
Graft size and BMI was not found to be independent risk factors for undergoing ACL revision surgery. In contrast to other studies, graft size of 8 mm or larger did not have a better outcome than smaller graft sizes. A relatively large group of overweight patients undergoing ACL surgery reflects the general increase in weight seen in Western societies. Although the current study differs from previous findings, it might indicate that graft diameter is less important than previously stated.

Level of evidence
Cohort study, II.

BACK

Hamstring muscle activation and morphology are significantly altered 1–6 years after anterior cruciate ligament reconstruction with semitendinosus graft

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DOI: https://doi.org/10.1007/s00167-019-05374-w

Purpose
Harvest of the semitendinosus (ST) tendon for anterior cruciate ligament reconstruction (ACLR) causes persistent hypotrophy of this muscle even after a return to sport, although it is unclear if hamstring activation patterns are altered during eccentric exercise. It was hypothesised that in comparison with contralateral control limbs, limbs with previous ACLR involving ST grafts would display (i) deficits in ST activation during maximal eccentric exercise; (ii) smaller ST muscle volumes and anatomical cross-sectional areas (ACSAs); and (iii) lower eccentric knee flexor strength.

Methods
Fourteen athletes who had successfully returned to sport after unilateral ACLR involving ST tendon graft were recruited. Median time since surgery was 49 months (range 12–78 months). Participants underwent functional magnetic resonance imaging (MRI) of their thighs before and after the Nordic hamstring exercise (NHE) and percentage change in transverse (T2) relaxation time was used as an index of hamstring activation. Muscle volumes and ACSAs were determined from MRI and distal ST tendons were evaluated via ultrasound. Eccentric knee flexor strength was determined during the NHE.

Results
Exercise-induced T2 change was lower for ST muscles in surgical than control limbs (95% CI − 3.8 to − 16.0%). Both ST muscle volume (95% CI − 57.1 to − 104.7 cm3) and ACSA (95% CI − 1.9 to − 5.0 cm2) were markedly lower in surgical limbs. Semimembranosus (95% CI 5.5–14.0 cm3) and biceps femoris short head (95% CI 0.6–11.0 cm3) volumes were slightly higher in surgical limbs. No between-limb difference in eccentric knee flexor strength was observed (95% CI 33 N to − 74 N).

Conclusion
ST activation is significantly lower in surgical than control limbs during eccentric knee flexor exercise 1–6 years after ACLR with ST graft. Lower levels of ST activation may partially explain this muscle's persistent hypotrophy post ACLR and have implications for the design of more effective rehabilitation programs.

Level of evidence
IV.

BACK

Post-traumatic osteoarthritis diagnosed within 5 years following ACL reconstruction

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DOI https://doi.org/10.1007/s00167-019-05461-y

Purpose
The purpose was to calculate the incidence of osteoarthritis in individuals following Anterior Cruciate Ligament Reconstruction (ACLR) in a large, national database and to examine the risk factors associated with OA development.

Methods
A commercially available insurance database was queried to identify new diagnoses of knee OA in patients with ACLR. The cumulative incidence of knee OA diagnoses in patients after ACLR was calculated and stratified by time from reconstruction. Odds ratios were calculated using logistic regression to describe factors associated with a new OA diagnosis including age, sex, BMI, meniscus involvement, osteochondral graft use, and tobacco use.

Results
A total of 10,565 patients with ACLR were identified that did not have an existing diagnosis of OA, 517 of which had a documented new diagnosis of knee OA 5 years after ACL reconstruction. When stratified by follow-up time points, the incidence of a new OA diagnosis within 6 months was 2.3%; within a 1-year follow-up was 4.1%; within 2 years, follow-up was 6.2%, within 3 years, follow-up was 8.4%; within 4 years, follow-up was 10.4%; and within 5 years, follow-up was 12.3%. Risk factors for new OA diagnoses were age (OR 2.44, $P < 0.001$), sex (OR 1.2, $P = 0.002$), obesity (OR 1.4, $P < 0.001$), tobacco use (OR = 1.3, $P = 0.001$), and meniscal involvement (OR 1.2, $P = 0.005$).

Conclusion
Approximately 12% of patients presenting within 5 years following ACLR are diagnosed with OA. Demographic factors associated with an increased risk of a diagnosis of PTOA within 5 years after ACLR are age, sex, BMI, tobacco use, and concomitant meniscal surgery. Clinicians should be cognizant of these risk factors to develop risk profiles in patients with the common goal to achieve optimal long-term outcomes after ACLR.

Level of evidence
III.

BACK

Hop tests can result in higher limb symmetry index values than isokinetic strength and leg press tests in patients following ACL reconstruction

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Purpose
Quadriceps weakness is a common clinical sign following anterior cruciate ligament injury and reconstruction surgery (ACLR). The aim of this study was to compare strength deficits and the limb symmetry index (LSI) from three different types of functional tests: isokinetic dynamometry, hop test, and leg press.

Methods
A total of 26 subjects with ACLR (average 8.3 months post-operation) participated in the study. The peak knee extension torque was tested with isokinetic dynamometry at 60/180/300 °/s (ISO60/180/300). Hop distance was tested during single hop (SH) and triple hop (TH). Unilateral peak leg power (POWER) was tested during a bilateral leg press test. LSI was calculated as the ratio of the involved limb over the uninvolved limb values. Pearson correlation coefficients and paired t-tests were used to establish relationships among ISO60/180/300, SH/TH, and POWER values and compare these values between the limbs, respectively. Within-subject one-way analysis of variance (ANOVA) with post hoc analyses was used to compare LSI values among different tests.

Results
ISO60/180/300 values were significantly positively correlated with SH/TH and POWER ($P < 0.05$), while SH/TH and POWER values were not significantly correlated. Significant limb differences were found in all tests ($P = 0.001–0.008$). ANOVA revealed significant LSI differences among different tests. Specifically, post hoc analyses revealed that LSI during SH was significantly higher than LSI during ISO60. Similarly, LSI during TH was significantly higher than LSIs from ISO60, ISO180, and POWER tests.

Conclusions
Peak knee extension torque values were positively associated with hop distance and leg power during the leg press test. However, LSI values should be interpreted with caution as hop tests provided significantly higher LSI values than isokinetic testing. Both isokinetic dynamometry and unilateral leg press machine could be used to isolate and strengthen the quadriceps in the involved limb. The current “gold standard” isokinetic testing at slow speed (ISO60) provided the lowest LSI value among all functional tests; therefore, the current study supported a continued use of isokinetic testing when examining individual’s readiness and return-to-sport.

Level of evidence
III.

BACK

Younger age and hamstring tendon graft are associated with higher IKDC 2000 and KOOS scores during the first year after ACL reconstruction

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Purpose
Although reference values in healthy subjects have been published for both the International Knee Documentation Committee 2000 subjective knee form (IKDC 2000) and the Knee injury and Osteoarthritis Outcome Score (KOOS), data obtained during the first year after anterior cruciate ligament reconstruction (ACL-R) are sparse. The aim was to establish patient reference values for both questionnaires at different time points and depending on nine individual patient characteristics during the first year after ACL-R.

Methods
Prospectively recorded data from a hospital-based registry were retrospectively extracted from the database. IKDC 2000 and KOOS questionnaires were self-administered pre-operatively and 6 weeks, 3 months, and 6 and 12 months following primary ACL-R. Score values were compared according to nine individual patient criteria: gender, age, body mass index, level of activity, involvement in competition, previous contralateral knee injury and/or surgery, graft type, meniscal repair and/or cartilage lesions. The feature which had a significant and consistent impact on the outcomes was considered as main reference.

Results
Two-hundred and nighty-eight patients met the inclusion criteria. Overall, the score values increased over time after ACL-R. At 12 months, they were significantly greater than at any other time point ($p < 0.05$). The main individual feature influencing the IKDC 2000 score was age. Patients below 30 years of age had up to 9 points higher IKDC 2000 score values at all time points ($p < 0.05$). The main individual characteristic influencing the KOOS score was graft type. Patients with hamstring tendon grafts (STGR) had up to 15 points higher KOOS score values than patients with bone–patellar tendon–bone (BPTB) grafts during the first months after ACL-R ($p < 0.05$). At 12 months, no differences in KOOS score values could be identified anymore.

Conclusions
Younger age (< 30 years) and STGR grafts were related to higher IKDC 2000 and KOOS score values within the first year after primary ACL-R. The patient reference values adjusted to age and graft provided in this study may help to identify patients with lower outcomes within the first year after ACL-R.

Level of evidence
Level III.

BACK

Ramp lesions are frequently missed in ACL-deficient knees and should be repaired in case of instability

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Purpose
The aim of the current study was (1) to provide an overview of common definitions and classification systems of ramp lesions (RL) and (2) to systematically review the available literature with regard to the diagnosis and treatment of RLs in anterior cruciate ligament (ACL)-deficient knees.

Methods
ollowing the PRISMA guidelines, MEDLINE and Scopus were searched for articles (1) reporting on acute or chronic ACL injuries, (2) with concomitant medial meniscus injury, (3) located at the posterior meniscocapsular attachment site (and red–red zone). Ex vivo studies, reviews and technical notes were excluded.

Results
Twenty-seven studies were included based on the criteria mentioned above. RLs are common in ACL-deficient knees with a prevalence ranging from 9 to 24%. RLs should especially be suspected in younger patients, patients with an increased meniscal slope and in patients with prolonged time from injury to surgery. The sensitivity of MRI for the detection of RLs ranges from 48 to 86% at a specificity of 79–99%. For arthroscopy, RLs are easily missed through standard anterior portals (sensitivity 0–38%). RL repair leads to a significant improvement of subjective knee scores, regardless of the specific fixation technique. For stable RLs, the literature suggests equivalent postoperative stability for trephination and abrasion compared to surgical RL repair.

Conclusion
Ramp lesions are frequently missed in ACL-deficient knees on standard arthroscopy with anterior portals only. If a RL is suspected, exploration via an additional posteromedial portal is indicated. In case of instability, RL repair should be performed.

Level of evidence
IV.

BACK

Arthroscopic assessment of patella tracking correlates with recurrent patellar instability

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Purpose
For recurrent lateral patellar instability surgical algorithm, an arthroscopic assessment of patellar tracking can aid with the decision of adding a tibial tubercle transfer procedure based on knee flexion angle at which patella centrally engages in its groove. Tibial tubercle–trochlear groove distance is variable in normal values and has discrepancies between imaging modalities. The aims of our study were to assess correlation of arthroscopic patellar tracking technique with recurrent patellar instability, and to assess the accuracy and reproducibility of this technique.

Methods
157 patients were evaluated, 64 control patients with no patellar instability, and 93 patients with recurrent patellar instability. This included 57 consecutive knee arthroscopy procedures evaluated for accuracy and reproducibility of our technique. The technique involved low flow arthroscopy and anterolateral viewing portal. Patients' knees were extended from a flexed position of 120°, and paused when the patella disengaged from its groove. The KFA was then estimated by the primary surgeon, and compared with a goniometer measurement. The assisting surgeon, blinded to the primary surgeon measurements, repeated this process. For the primary outcome, goniometer readings for KFA from the primary surgeon were used to correlate with patellar instability diagnosis.

Results
Patients with patellar instability had a mean KFA of 118° compared to 44°for patients without patellar instability ($p < 0.001$). The mean difference between goniometer reading and estimation of KFA by each surgeon was 5° ($p < 0.001$) with intra-class correlation of 0.99. The mean difference between the two surgeons' goniometer readings was 8° ($p < 0.001$) with intra-class correlation of 0.99.

Conclusion
This study confirms arthroscopic assessment of patella tracking is accurate, reproducible, and a knee flexion angle of greater than 44° correlates with patellar instability diagnosis. Patella tracking can be used as an adjunct or an alternative assessment method to tibial tubercle–trochlear groove distance to determine the need for tibial tubercle transfer in patellar stabilisation surgery.

Level of evidence
Prospective Cohort Study, Level III.

BACK

ACL hamstring grafts fixed using adjustable cortical suspension in both the femur and tibia demonstrate healing and integration on MRI at one year

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Purpose
To present the clinical outcomes and magnetic resonance imaging (MRI) analysis of adjustable cortical suspensory fixation for the femur and tibia in hamstring autograft anterior cruciate ligament reconstruction.

Methods

A cohort of 233 sequential patients was analysed for graft failure rate and subjective IKDC, Tegner and Lysholm scores. 144 validated 1-year MRIs assessed and correlated graft healing and tunnel widening.

Results
At mean follow-up of 28 months ± 8.2 [median 26, range 12–49], the graft failure rate was 4.7%. Significant improvements were seen in all clinical scores ($p < 0.001$). MRI analysis showed 71% with fully integrated grafts in the tibia and 24% in the femur, with the remainder all showing greater than 50% integration. Graft signal was low and homogenous in 67% in the tibia, 29% in the intra-articular portion and 20% in the femur. One patient had greater than 50% high signal in the tibial graft and one in the intra-articular graft, all others demonstrated greater than 50% low signal. Both graft integration and signal were significantly better in the tibia than the femur ($p < 0.01$). Tunnel widening was 2.2 ± 1.4 mm and 2.7 ± 1.3 mm in the tibia and femur, respectively. Comparison of individual MRI appearances and overall clinical outcome at the same 12-month point demonstrated no consistent significant correlation.

Conclusion
Adjustable cortical suspensory fixation in both femoral and tibial tunnels provides good clinical outcomes and a low graft rupture rate. Grafts demonstrate healing with comparatively low tunnel widening. There was no consistent significant correlation between the appearances on MRI and clinical outcome.

Level of evidence
Case–control study, Level III.

BACK

The repair of horizontal cleavage tears yields higher complication rates compared to meniscectomy: a systematic review

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Purpose
Horizontal cleavage tears of the meniscus (HCTs) are primarily degenerative in nature, and, however, can be the result of trauma. Such tears account for 12–35% of all tear patterns and can be treated by partial meniscectomy or arthroscopic repair. The purpose of this review was to systematically assess the outcomes and complications for patients undergoing the surgical treatment of HCTs.

Methods
This review has been conducted according to the guidelines of Preferred Reporting Items for Systematic Reviews and Meta-analyses. The electronic databases PubMed, MEDLINE, and EMBASE were searched from data inception to December 30, 2018 for articles addressing the surgical treatment of HCTs. The Methodological Index for Non-randomized Studies was used to assess study quality. Data are presented descriptively.

Results
Overall, 23 studies were identified, comprising of 702 patients (708 knees) with a mean age of 36.6 ± 9.9 years and a mean follow-up of 33.6 ± 19.6 months. The majority of patients were treated with a partial meniscectomy (59.0%), followed by repair (32.8%) and total meniscectomy (8.2%). Both meniscectomy and repair patients had improvements which surpassed minimal clinically important differences with regard to clinical (e.g. pain, function, daily living) and radiographic outcomes. The overall complication rate was 5.1%, primarily involving patients undergoing meniscal repair (12.9% of all knees undergoing a repair).

Conclusion
Although meniscal repair theoretically may provide improvement in biomechanical loading, patients undergoing repair had higher complication rates than those undergoing partial meniscectomy. Clinicians should consider the available implants in determining which tear patterns to repair and future studies with long-term follow-up are needed to investigate complications (e.g. secondary meniscal procedures) as well as the potential for delay in the development of osteoarthritis.

Level of evidence
Level IV.

BACK

Arthroscopic gel-type autologous chondrocyte implantation presents histologic evidence of regenerating hyaline-like cartilage in the knee with articular cartilage defect

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Purpose
To investigate the clinical, radiological, and histological results of arthroscopic gel-type autologous chondrocyte implantation (GACI) in treating chondral defects of the knee.

Methods
This study prospectively examined five males and five females with a mean age of 40.3 ± 10.3 years who underwent arthroscopic GACI between March 2012 and February 2013. The gel comprised a mixture of 1 ml of fibrinogen plus 0.1–0.2 ml of thrombin. The mean size of chondral defect was 2.9 ± 1.2 cm2 (range 1.2–5.4 cm2). International knee documentation committee (IKDC) subjective score, knee injury and osteoarthritis outcome score (KOOS), knee society score, and visual analog scale (VAS) for pain were assessed preoperatively and during regular follow-up examinations performed for up to 5 years postoperatively. Serial magnetic resonance imaging was performed for up to 2 years after the surgery to observe healing, using the modified magnetic resonance observation of cartilage repair tissue (MOCART) score. In eight patients, second-look arthroscopy was performed at 1 year after the implantation to assess the status of treated cartilage, and a portion of regenerated cartilage was harvested for histologic evaluation.

Results
The mean VAS score ($p = 0.045$), IKDC subjective score ($p = 0.041$), KOOS pain ($p = 0.025$), KOOS activities of daily living ($p = 0.048$), and KOOS quality of life ($p = 0.029$) showed significant improvement at 5 years after the surgery. The modified MOCART evaluation showed that the scores were 59.5 ± 29.4 and 85.0 ± 8.0 at 12 weeks and 2 years after the operation, respectively. Histologic examination demonstrated a mean regenerated cartilage thickness of 3.5 ± 0.8 mm and a mean Oswestry score of 8.2 ± 1.8. Immunohistochemistry analysis showed that the expression of collagen type II was more evident and more evenly distributed than collagen type I in regenerated cartilage. There was a significant correlation between Oswestry score and change in VAS scale from postoperative 2–5 years.

Conclusions
Arthroscopic GACI produces satisfactory clinical and radiologic outcomes, and histologic evaluation confirms sufficient regeneration of hyaline-like cartilage that correlates with improved symptoms. Therefore, it is an acceptable, minimally invasive, and technically simple option for the restoration of cartilage defects of the knee.

Level of evidence
IV.

BACK

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Bilateral Hip Arthroscopy in High-Level Athletes: Results of a Shorter Interval Between Staged Bilateral Hip Arthroscopies

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Background: Hip arthroscopy is a safe and effective mechanism for treating femoroacetabular impingement symptoms in high level athletes. Bilateral symptoms occur in a subset of this population.

Purpose: To discuss outcomes of bilateral hip arthroscopy in high-level athletes and compare a standard staged timeline for bilateral hip arthroscopic surgery versus an accelerated timeline.

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

Methods: A retrospective review of all staged bilateral hip arthroscopies was performed on high-level athletes over a 3-year period. Patients were categorized into cohorts based upon when the second procedure was performed (4-6 weeks after the index procedure or >6 weeks after the index procedure). Exclusion criteria included any prior hip surgery, advanced arthritis, previous pelvic or femoral fracture, or inflammatory arthropathy. Demographics, radiographic measurements, operative reports of procedures performed, and patient-reported outcomes (Hip Outcome Score–Activities of Daily Living, Hip Outcome Score–Sport Specific Subscale, modified Harris Hip Score, return to sports, return to same level of play) were compared between groups at 6-month, 1-year, and 2-year intervals, with the Student t test used for continuous data and a chi-square test used for categorical data.

Results: 50 patients were identified: 22 in the accelerated surgery (AS) group and 28 in the standard surgery (SS) group. Age and number of collegiate participants were greater in the AS group, whereas the number of high school participants and the time away from sports were higher in the SS group. Preoperative alpha angles were significantly larger among the AS group, but no differences were found in postoperative alpha angles, center edge angles, or Tönnis grades. No significant difference was seen in patient-reported outcomes between the 2 groups at 6-month, 1-year, and 2-year follow-up.

Conclusion: Bilateral hip arthroscopy performed 4 to 6 weeks apart is a safe and effective treatment option for athletes with bilateral femoroacetabular impingement and labral tears; the procedures entail a high rate of return to sports, return to the same level of sports, and decreased time lost from sports. This information could be useful for an athlete deciding on whether to proceed with bilateral hip arthroscopy and deciding on the timing for the procedures.

BACK

An Intact Ligamentum Teres Predicts a Superior Prognosis in Patients With Borderline Dysplasia: A Matched-Pair Controlled Study With Minimum 5-Year Outcomes After Hip Arthroscopic Surgery

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Background: Hip arthroscopic surgery in patients with borderline dysplasia continues to be controversial. In addition, it has been suggested that ligamentum teres (LT) tears may lead to inferior short-term patient-reported outcomes (PROs) when compared with a match-controlled group.

Purposes: (1) To report minimum 5-year PROs in patients with borderline dysplasia and LT tears who underwent hip arthroscopic surgery and (2) to compare these PROs to those of a matched-pair control group of patients with borderline dysplastic hips without LT tears.

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

Methods: Data were prospectively collected for patients who underwent hip arthroscopic surgery between September 2008 and August 2013. Patients were included if they had a preoperative diagnosis of borderline dysplasia (lateral center-edge angle [LCEA], 18°-25°) and had preoperative and minimum 5-year postoperative modified Harris Hip Score (mHHS), Nonarthritic Hip Score (NAHS), and visual analog scale (VAS) for pain scores. Exclusion criteria were osteoarthritis of Tönnis grade >1, previous hip conditions, any previous ipsilateral hip surgery, or workers' compensation status. There were 2 borderline dysplastic groups created. An LT tear group was matched 1:1 to a control group (no LT tear) with similar age, sex, body mass index (BMI), and laterality via propensity score matching. Significance was set at $P < .05$.

Results: A total of 24 patients with an LT tear (24 hips) were matched to 24 patients without an LT tear (24 hips). There was no significant difference in age, sex, BMI, or laterality between groups. The mean age was 36.2 ± 17.2 and 34.9 ± 15.9 years for the control and LT tear groups, respectively ($P = .783$). There were 17 (70.8%) and 16 (66.7%) female patients in the control and LT tear groups, respectively, and the mean preoperative LCEA was 23.3° and 22.2° in the control and LT tear groups, respectively. No differences were observed between groups in baseline PROs, intraoperative findings, or surgical procedures. LT debridement was performed in 17 (70.8%) patients in the LT tear group compared with 0 (0.0%) in the control group. Also, 5-year postoperative PROs were comparable in both groups, with the control group exhibiting superior Veterans RAND 12-Item Health Survey (VR-12) mental ($P = .041$) and Short Form–12 (SF-12) mental ($P = .042$) scores. Finally, hips with an intact LT were significantly more likely ($P = .022$) to achieve the patient acceptable symptomatic state (PASS) for the mHHS (100.0% and 75.0%, respectively). No significant differences were present between the groups for the minimal clinically important difference (MCID) of the mHHS ($P = .140$), MCID of the Hip Outcome Score–Sport-Specific Subscale (HOS-SSS) ($P = .550$), or PASS of the HOS-SSS ($P = .390$).

Conclusion: After hip arthroscopic surgery, patients with borderline dysplasia and LT tears demonstrated favorable PROs at a minimum 5-year follow-up. Outcomes were similar to a matched-pair control group without LT tears, with the group with intact LTs showing higher VR-12 mental and SF-12 mental scores. Furthermore, patients with borderline dysplasia and intact LTs were significantly more likely to achieve the PASS for the mHHS.

BACK

Reduction of Postoperative Hip Arthroscopy Pain With an Ultrasound-Guided Fascia Iliaca Block: A Prospective Randomized Controlled Trial

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Background: Ultrasound-guided fascia iliaca blocks have been used for pain control after hip arthroscopy. There is little evidence regarding their effectiveness in comparison with other pain control modalities in patients who have undergone hip arthroscopy.

Purpose: To compare the efficacy of ultrasound-guided fascia iliac block with intra-articular ropivacaine in controlling pain after hip arthroscopy.

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

Methods: Between 2015 and 2017, patients (N = 95) undergoing hip arthroscopy were randomly assigned to 2 groups. The first group received an ultrasound-guided fascia iliaca block with 50 to 60 mL of 0.35% ropivacaine. The second group received an intra-articular injection of 20 mL of 0.5% ropivacaine at the completion of the surgical case. Primary outcomes were postoperative pain scores in the recovery room; at postanesthesia care unit (PACU) discharge; and at 2 weeks, 6 weeks, and 3 months. Secondary outcomes included intraoperative and PACU narcotic usage (converted to morphine equivalent use) as well as readmission rates, PACU recovery time, and postoperative nausea and vomiting.

Results: Postoperative pain across all points did not significantly differ between the groups. Intraoperative and PACU narcotics did not differ significantly between the groups. Readmission rates, PACU recovery time, and postoperative nausea and vomiting did not significantly differ between the groups. There were no associated complications in either group.

Conclusion: Ultrasound-guided fascia iliaca block for hip arthroscopy had no clinical advantage when compared with onetime intra-articular ropivacaine injection.

BACK