Posterior glenohumeral joint line pain with extreme shoulder abduction and external rotation that is relieved with a relocation maneuver suggests internal impingement of the shoulder.

**Objective:** To review internal impingement of the shoulder.

**Design:** Review article. **Anatomic & Biomechanical Factors:** Internal impingement is typically understood to be the impingement of the cuff on the posterior-superior labrum, with shoulder abduction and external rotation, a position seen in overhead athletes. While pinching of the cuff on the posterior labrum can be seen in normal subjects, repetitive and forceful maneuvers of overhead athletes can lead to a cascade of pathologic findings. Internal impingement of the shoulder, fraying of the posterior cuff and/or posterior-superior labral fraying, and tearing are rarely isolated conditions. Associated factors and perhaps causative factors include anterior glenohumeral instability, superior labrum anterior and posterior lesions, posterior glenohumeral internal rotation deficit (GIRD), and “sick scapular syndrome.” **Presentation:** Patients present typically with posterior glenohumeral joint line pain with shoulder abduction and external rotation, the position of late locking with pitching. A detailed history and physical exam will likely produce associated conditions of GIRD, anterior instability, and scapular dyskinesis. Symptoms that localize to the posterior joint line in abduction and external rotation are termed “internal impingement signs.” If this posterior pain is relieved with a relocation maneuver, it is very suggestive of internal impingement. **Imaging:** Plain imaging may reveal exostosis of the posterior-inferior glenoid rim, sclerosis at the greater tuberosity, rounding of the posterior glenoid rim, and osteochondral lesions of the posterior humeral head. MRI is essential in evaluating for internal impingement. MRI typically reveals undersurface cuff tears and posterior and/or superior labral tears. Contrast material is typically used. The authors caution that many of these imaging findings can be found in asymptomatic throwers and should be understood in the context of the history and physical exam. **Treatment:** Many throwers can be treated nonoperatively. After a period of rest and medications, a comprehensive rehabilitation program is initiated to stretch the tight posterior structures associated with GIRD, and to strengthen rotator cuff muscles and scapular stabilizers to improve scapular mechanics. If nonoperative treatment fails, surgical management should be considered. While essential lesions appear to be the posterior-superior labral tearing or fraying and cuff fraying, the literature suggests to correct all other associated pathology, in particular anterior instability. **Conclusions:** Shoulder internal impingement in the overhead athlete is a complex multifactorial condition that is associated with GIRD, scapular dyskinesis, and anterior shoulder laxity.

**Reviewer’s Comments:** This well-written article deals with a complex and poorly understood condition. Using an extensive bibliography, the authors present a comprehensive evolution of the understanding of internal impingement. They provide an algorithm that simplifies the approach and management of internal impingement. More images would have helped in understanding some of the complex concepts presented. I strongly encourage all physicians taking care of overhead athletes to read this article. (Reviewer- John H. Wilckens, MD).

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Keywords: Shoulder, Internal Impingement

Print Tag: Refer to original journal article
Linear displacement measurement of the patella on a Merchant view correlates with traditional congruence angle measurements.

**Background:** Congruence angle as measured on a standardized Merchant view of the patella provides reliable information for management of patellar dislocations. New digital radiography software makes it more difficult to measure these angles.

**Objective:** To determine the reliability of linear patellar displacement in patients with patellar instability.

**Design:** Cohort study.

**Participants/Methods:** Over a 6.5-year period, the authors operated on 93 patients for patellar instability; of these, 31 had injury to only 1 knee and had preoperative and postoperative standardized Merchant views of the patellofemoral joint (study group). The control group comprised 100 patients without a history of patellar dislocation who had a similar Merchant view prior to anterior cruciate ligament (ACL) surgery. In addition to the congruence angle, a linear patella displacement was measured. To obtain this measurement, a reference line was drawn from lateral to medial trochlea facets. To this reference line, a perpendicular line was made from the sulcus of the trochlea and from the posterior patellar spine. The distance on the reference line between these 2 lines is the axial linear displacement. Each measurement was done twice at separate sessions to test intra-rater reliability.

**Results:** In the control group, the mean congruence angle was -3.0°, median was -5.4°, standard deviation was 7.2, and intra-rater reliability was 0.90. Mean linear displacement for these same patients was 6.2 mm, median was 0.9 mm, standard deviation was 1.2 mm, and intra-rater reliability was 0.91. In the study group, the preoperative patellar dislocation mean congruence angle was 33.5°, compared to 16.2° in the nonoperative knee, and 11.2° in the postoperative period. Using the new linear displacement measurement, the mean preoperative measurement was 12.1 mm compared to 5.7 mm in the opposite knee, and 4.0 mm in the postoperative knee. The intra-rater reliability was 0.90.

**Conclusions:** Axial linear displacement measurements made on standardized Merchant views are easy to make, with good reliability and correlation with the traditional congruence angle measurement.

**Reviewer's Comments:** This very useful article simplified the process of measuring the patellofemoral joint on Merchant views. In the study group, the non-involved knee had a greater congruence angle and linear patellar displacement than did control knees. The study group might be better categorized as a patellar malalignment and instability. In fact, the authors performed a distal realignment surgery on this group. It would be interesting to compare these measurements in patients with normal alignment and traumatic dislocation. While one may not operate on these patients, what are their measurements, and how do they change with the healing process? It would also be interesting for the authors to publish this new linear patellar displacement measurement in other patellofemoral maladies. (Reviewer-John H. Wilckens, MD).

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Keywords: Axial Linear Patellar Displacement, Patellofemoral Measurements

Print Tag: Refer to original journal article
Adolescent Overuse Injuries Usually Resolve Quickly With Rest

Peri-Epiphyseal and Overuse Injuries in Adolescent Athletes.
Frush TJ, Lindenfeld TN:

Sports Health 2009; 1 (May/June): 201-211

Peri-epiphyseal and overuse injuries in adolescent athletes resolve quickly with 4 weeks of immobilization.

Objective: To review peri-epiphyseal overuse injuries in adolescent athletes.
Design: Review article. Etiology: During adolescence, within the physis, there is hypertrophy and weakening of the hypertrophic zone of cartilage. In addition, adolescence sees the greatest participation in sports. These open growth plates lead to 3 unique types of peri-epiphyseal injuries. Apophysitis is a traction injury on an apophysis. Epiphysitis is a shear or compression injury of the epiphysis, and epiphyseolysis is a widening of the growth plate. Weight bearing with the wrist in extension seems to be the inciting activity. In competitive gymnastic groups, the incidence is >80%. With early diagnosis and immobilization, symptoms can resolve in 4 weeks. Delay in diagnosis and incomplete treatment can lead to severe involvement and may take >6 months to heal. Baseball Peri-Epiphyseal Injuries: Because of valgus extension overload of the elbow, the lateral joint undergoes compression and the medial aspect traction. The most common lateral elbow injury is osteochondritis dissecans. This should be treated with rest for 4 to 8 months. Left untreated, it may result in an unstable fragment requiring surgery. Medial-sided injuries include medial epicondylar apophysitis. This injury responds to 4 to 6 weeks of rest. If apophysis avulses, most would fix. Olecranon apophysitis can be seen in baseball throwers and gymnasts, and it usually responds to 4 to 6 weeks of rest. Proximal humeral epiphysitis is the result of overthrowing, with distraction and torsion of the proximal epiphysis. Rotational stress of this physis results in increased external rotation seen in throwers. Sclerosis and widening of the physis is seen on x-ray. Rest until pain free with a resumption of gradual throwing program is the treatment. Spine: Spondylolysis represents a stress fracture of the pars interarticularis. Etiology includes a loaded spine in extension. If there are bilateral fractures, in a skeletally immature patient, this can lead to spondylolisthesis. Spinous process epiphysitis has similar presentation to spondylolysis. Pain is with back extension, but it is midline and does not go to one side or the other. Side bending will aggravate spondylolysis, but typically not spinous process epiphysitis. Foot: Apophysitis of the calcaneus and the fifth metatarsal presents with localized pain at the involved apophysis. Four weeks of immobilization provides resolution of symptoms and return to activity.
Conclusions: Peri-epiphyseal overuse injuries in the adolescent athlete are best treated with early diagnosis and a short period of complete rest or immobilization.
Reviewer's Comments: This is an excellent review article of overuse injuries in the adolescent athlete. Bone scan is not very helpful in these injuries. Exam and x-rays will typically make the diagnosis. MRI may be helpful in managing refractory cases. It seems paradoxical, but in these adolescent athletes, complete rest and/or immobilization is the quickest route to recovery and return to play. (Reviewer-John H. Wilckens, MD).

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Keywords: Adolescent Overuse Injuries

Print Tag: Refer to original journal article
Resist the temptation to apply traction to metacarpophalangeal joint dislocations as this will convert a simple dislocation into an unreducible complex dislocation.

**Objective:** To review anatomy, pathophysiology, and management of metacarpophalangeal (MCP) joint dislocations.

**Design:** Review article. **Anatomy & Pathophysiology:** Collateral ligaments reinforce the capsule of the MCP. They are tight in flexion, whereas accessory collateral ligaments, located ulnar to collateral ligaments proper, are tighter in extension. A thick fibrous cartilaginous volar plate stabilizes the palmar aspect of the MCP joint. The MCP joint is most unstable dorsally. The thumb MCP joint is similar to other MCP joints with the addition of 2 sesamoids that are imbedded in the volar plate. A fall on an extended outstretched hand can result in the more common MCP joint dislocation dorsally. Less common, in a poorly understood mechanism, the MCP joint can dislocate volarly. With hyperextension of the MCP, the volar plate tears from the metacarpal neck, allowing the joint to dislocate. With continued extension, the volar plate can be interposed into the joint, and the metacarpal head buttonholing between the lumbricals, natatory ligament, and the superficial transverse metacarpal ligament. A rotatory force to the dislocation can tear the collateral ligaments. Patients present with a painful hyperextended MCP joint. Dimpling of the skin volarly at the MCP joint should alert the physician of a complex dislocation. **Management:** Unlike other digit dislocations, simple distraction is usually unsuccessful in reducing an MCP joint dislocation and carries a high probability of converting it to a complex dislocation. Traction tends to pull the volar plate into the joint, blocking reduction. Additionally, traction tightens the structures buttonholed by the metacarpal head. With adequate anesthesia, the closed reduction maneuver consists of flexing the wrist and proximal interphalangeal joint to relax structures around the MCP. Dorsal-to-volar pressure is applied to the base of the proximal phalanx with the intention to push the volar plate out of the MCP joint, allowing reduction. Irreducible dislocations are addressed surgically. The dorsal approach is safer, as the neurovascular bundle is taken out of play, easier to reduce the trapped volar plate, and easier to fix any associated fractures. The volar approach allows one to release the A1 pulley, better visualization of the volar plate, and manipulation of any soft tissue trapping the metacarpal head. However, great care should be used as the neurovascular bundle is displaced volarly and draped over the dislocated metacarpal head. **Conclusions:** Complex MCP joint dislocations typically require open reduction with much care to the neurovascular bundle to the digit with a volar approach. **Reviewer's Comments:** This is a nice review article of an uncommon dislocation. In the authors’ exhaustive bibliography, only 2 sources are from the last 5 years. While there is little news to report on MCP joint dislocations, it is good to review this injury to avoid potential greater injury. (Reviewer-John H. Wilckens, MD).
Antegrade femoral nailing through a far-lateral trochanteric starting point does not carry a significant risk of growth disturbance in children.

Background: Although intramedullary nailing is arguably the best fixation for femur fractures in terms of patient tolerance and weight bearing, there is concern about rigid antegrade nailing in growing children, including the risk of avascular necrosis (AVN) of the femoral head as well as narrowing and lack of growth in height of the femoral neck.

Objective: To describe the authors’ technique of starting through a lateral trochanteric entry site and to report their results with respect to concerns listed above.

Design: Retrospective review.

Participants/Methods: Over a 7-year period, the authors reviewed all patients at their center who were skeletally immature at treatment and had follow-up to maturity. They obtained radiographs of both hips to document the growth pattern of the femoral neck and epiphysis. There were 149 fractures treated, and 80 were followed to maturity and had the requisite radiographs. Mean age at fracture was 12.9 years, with the lower limit being 8.0 years. Mean weight was 70 lbs. There were 3 open fractures. The procedure was done on a fracture table with a percutaneous approach.

Results: All fractures healed. There were no cases of AVN in either group followed to their last visit. Mean articulotrochanteric distance was 1 mm shorter on the operative side. There was no significant difference in the neck-shaft angle or the femoral neck width. There were 2 infections, but these were in patients with significant risk factors. Nine patients had rods removed.

Conclusions: Antegrade femoral nailing through a lateral trochanteric starting point is safe and effective for children aged >8 years. Although there are several reports of AVN in children after piriformis starting points, there is only 1 case of AVN that has ever been documented after a trochanteric starting point. The authors devised this far-lateral starting point so that there was no likelihood that instrumentation could deviate medially and interfere with the medial femoral circumflex artery as it wraps around the base of the femoral neck.

Reviewer’s Comments: I think this is good evidence of safety. There are now several nail designs commercially available that can accommodate such a lateral starting point and small femurs. Of course, since the incidence of AVN is estimated to have been about 1% to 2% after piriformis nailing, it will require a larger series to prove the concept. It is interesting to observe the radiographs. Although the nail has only a 10° bend, it takes about a 25° to 30° bend of the guidewire to make this trajectory. Rods tend to migrate inside the trochanter once they are down. (Reviewer-Paul D. Sponseller, MS, MD).

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Keywords: Femoral Fractures, Antegrade Intramedullary Nailing, Lateral Trochanteric Entry

Print Tag: Refer to original journal article
Background: Obesity is increasing in children in the United States. Consequences of obesity include adolescent Blount disease (ABD), slipped capital femoral epiphysis (SCFE), and diabetes, as well as visceral problems such as sleep apnea, liver disease, and others. Obesity is defined as having a body mass index (BMI) >95th percentile. The incidence of obesity in U.S. children is >15%. Sometimes, if the orthopedic surgeon is seeing an overweight teen, there is concern about which consequences to screen for.

Objective: To determine if there is overlap among problems of SCFE, tibia vara, and type 2 diabetes in overweight adolescents.

Design: Retrospective review.

Participants/Methods: Patients seen with new diagnosis of either SCFE, adolescent tibia vara, or type 2 diabetes during a defined period after 2000 had records reviewed to compare demographic factors and to determine whether the other 2 conditions coexisted. Diabetes was defined as having a random blood glucose >200 or a fasting glucose >126 mg/dL. Obesity was defined as a BMI >30 kg/m2.

Results: There were roughly similar numbers of each condition: 41 with ABD, 57 with SCFE, and 53 with diabetes. Patients with SCFE showed a trend to be the youngest, having a mean age of 11.9 years versus 12.6 years for ABD and 12.9 years for diabetes. ABD patients were the most obese, with a mean BMI of 41, versus 36 for diabetes and 29 for SCFE. There were no differences in height among groups. There was no overlap among diagnoses; in other words, no patient with a slipped epiphysis had ABD or diabetes, and so on.

Conclusions: The authors discuss that this study was spurred by the observation of the senior author, that he had not seen co-occurrence of these conditions during his long and extensive career, even though SCFE and tibia vara are abnormalities of the growth plate. They postulate that these may represent different obesity phenotypes. They even postulate that down-regulation of insulin-like growth factor receptors in diabetes may confer a protective effect on growth plates to prevent the other 2 conditions.

Reviewer's Comments: I enjoyed this article. I have not been practicing as long as Dr Bowen, but in 23 years, I have not seen a patient with ABD who has SCFE, or vice versa. Another reason is that these conditions are still very rare; the cumulative incidence of SCFE is 1:2000 or less. We, as orthopedic surgeons, tend to see them but cannot appreciate how highly selected they are before they get to us. I did find it interesting that ABD patients were the most obese (BMI >40), while SCFE patients as a whole did not quite make the obesity cutoff (BMI 29). (Reviewer-Paul D. Sponser, MS, MD).
In slipped capital femoral epiphysis, the angular change seen on the lateral is much greater than that seen on the anteroposterior view.

**Background:** The deformity resulting from slipped capital femoral epiphysis (SCFE) sometimes is tolerated but, on occasion, may lead to functional disability. There have been multiple osteotomies developed to correct this deformity. One of the earliest was the intertrochanteric osteotomy, popularized by Southwick. This osteotomy can incorporate correction in 1 plane or multiple planes. It rarely produces avascular necrosis (only 6% vs up to 20% for subcapital osteotomies).

**Objective:** To compare the range of motion with a flexion osteotomy versus valgus-flexion-internal rotation.

**Design:** Experimental study using CT scans and a computer model.

**Participants/Methods:** CT scans of 23 hips with SCFE collected for an earlier study were analyzed. These patients had a mean age of 13 years and a slip angle of moderate to severe degrees (in other words, at least 30° of slipping). Three-dimensional models of femurs and acetabulae were made on a computer. An osteotomy of each type (multiplanar or just flexion) was simulated on each femur. The amount of correction made was that needed to normalize slip angles in relevant planes. They were ranged until the femur impinged upon the acetabulum. Ranges of motion in each plane were measured and compared.

**Results:** In the specimens before osteotomy, the amount of posterior slip seen on the lateral was much greater than the inferior slip seen on the anteroposterior (54° vs 25°, respectively). The multiplanar osteotomy resulted in a greater increase in motion in all planes, but the difference was only significant in abduction. In this plane, the abduction was 57° for the multiplanar osteotomy and 36° for the uniplanar osteotomy. Interestingly, neither hip reached 90° of flexion—only 61° and 63° after osteotomy.

**Conclusions:** The uniplanar osteotomy produces as much flexion as the multiplanar osteotomy. It is technically simpler. The authors point out that the model does not account for soft tissue impingement so that it might overestimate the amount of flexion obtained. However, they also point out that the metaphysis might remodel over time and give a greater range of motion.

**Reviewer’s Comments:** I think it is interesting how much limitation occurs even after osteotomy. This is undoubtedly because the subtrochanteric correction does not remove the impinging focus of the metaphysis. It just compensates for it. However, I would point out that if the patient adopts a bit more external rotation, a great deal more flexion may be allowable. The multiplanar osteotomy may allow this to happen. It also does not account for the improvement in the gluteal muscle tension that occurs from correcting the varus. This model has a great deal of promise for helping us to understand hip impingement and its corrective options. (Reviewer—Paul D. Sponseller, MS, MD).

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Keywords: Slipped Capital Femoral Epiphysis, Range of Motion, CT Simulation, Osteotomy

Print Tag: Refer to original journal article
Pay Attention to Vertebral Artery in Significant Forward Subluxation


Hedequist D, Proctor M:


Screw fixation to C2 is feasible in children with cervical spine abnormalities.

**Background:** Internal fixation of all parts of the spine is changing. There is increased reliance on rigid internal fixation and less on external immobilization. This can improve reductions and decrease pseudarthrosis. However, issues in children relate to altered anatomy with smaller structures and slight differences in angles. In addition, the learning curve for a pediatric orthopedic surgeon needs to be studied.

**Objective:** To report a planning process and results of C2 fixation in children.

**Design:** Retrospective cases series, level IV evidence.

**Participants/Methods:** Over a 3-year period at Boston Children's Hospital, patients who had screw fixation to C2 (including intralaminar, transarticular, and intrapedicular screws) were studied. Sensory and transcranial motor monitoring were performed on all patients. The authors used bipolar electrocautery to control the venous plexus. They started caudally on the articular facet of C2 and then dissected up cranially on the medial and lateral border of the dorsal pars. They used intraoperative fluoroscopy to determine the proper trajectory for the screw, either transarticular or pedicular in C2. Postoperative CT scans were obtained on all patients.

**Results:** Screw fixation was possible in all 17 patients. Mean age at surgery was 10 years (range, 3 to 16 years). Diagnoses included os odontoideum, skeletal dysplasias, fractures, and rotatory subluxation. Preoperative CT revealed 1 pedicle that was unfavorable for screw placement because of a high-riding vertebral artery in 1 patient with os odontoideum and 1 with a sclerotic pars in a Morquio patient. Intraoperatively, there was 1 patient who was unable to undergo a planned transarticular screw placement due to atlantoaxial rotation and who underwent separate screws in C1 and C2. Postoperatively, there was 1 patient whose transarticular screw was too long and was not detectable on intraoperative imaging and was seen only on postoperative CT. There were no neuromonitoring changes. All patients had solid fusion by 20 months' postoperative follow-up.

**Conclusions:** The authors believe that screw fixation of the upper cervical spine is usually feasible in children. Some preoperative planning is essential. They recommend obtaining a preoperative CT with multiplanar reconstructions and paying special attention to the pedicle of C2 and to the course of the vertebral artery.

**Reviewer's Comments:** I thought this was a valuable article. Although children have a good propensity to heal in general, the upper cervical spine is so mobile that it tests this ability and sometimes nonunion can occur if there is not rigid immobilization. Use of screw fixation makes the union rate ideal. It may also prevent unwanted extension of the fusion by confining the immobilization only to instrumented segments, unlike the effects of a long-term halo. I would also caution surgeons to pay attention to the vertebral artery in patients with significant forward subluxation since it can become stretched out and may be tortuous when the subluxation is reduced. (Reviewer-Paul D. Sponseller, MS, MD).

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**Keywords:** Cervical Spine, C2, Screw Fixation

**Print Tag:** Refer to original journal article
The highest rate of premature physeal closure at the ankle occurs in Salter II fractures of the distal tibia.

Background: Fractures of the growth plate of the distal tibia are very common in adolescents. This is also one of the most common areas for growth arrest.

Objective: To quantify and find possible predictors for growth plate injury in fractures of the distal tibial physis in children.

Design: Retrospective review, level III evidence.

Participants/Methods: Over an 8-year period, pediatric physeal fractures were reviewed. Maximum displacement was recorded. Reduction was performed if there was >2 mm displacement of intra-articular or extra-articular components. If adequate closed reduction was not accomplished, open reduction and stabilization was performed. Implants were removed as clinically indicated. Risks of physeal injury by Salter class and by mechanism were calculated.

Results: 124 patients met inclusion criteria. Mean age was 12.5 years. Mean follow-up was 57 weeks. Most were followed to skeletal maturity. The most common injury was Salter II (32%). Premature physeal closure occurred in 15 patients (12%). Risks of physeal injury were greatest for Salter II injuries (25%), followed by Salter IV (13%), Salter III (10%), and Salter I (0%). There were also no premature physeal closures in Tillaux or triplane fractures. Displacement of the fracture at presentation was a significant risk; each millimeter of displacement increased the risk of premature physeal closure by 15%.

Conclusions: The overall incidence of growth arrest after physeal fractures of the ankle is about 1 in 8 (12%). This is lower than the most recent report, but still significant. Salter-Harris II fractures were initially felt to be a relatively innocuous pattern when first described by Salter, but this has been found to vary significantly by region of the skeleton. Salter II injuries represent the most common fracture pattern of the distal tibia and also the highest risk for premature physeal closure. The fact that the premature closure rate for Salter III and IV fractures (13%) is so much lower than that of Salter II and lower than what Salter would have predicted is a reflection of the effects of operative intervention. The low rates for Tillaux and triplane fractures also probably reflect the mature age of these patients.

Reviewer's Comments: This is a useful article for the pediatric and the general orthopedic surgeon who care for trauma in children. It shows the high rate of growth disturbance. What to do about it is a significant quandary. Some of these injuries occurred in 12-year-old girls and 14-year-old boys, who have <5 mm of growth left at this region of the body. More guidance is needed for this dilemma. At this point, it is important to make families aware of the problem and to refer them to an expert who can interpret the effects of growth. (Reviewer-Paul D. Sponseller, MS, MD).

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Keywords: Distal Tibia, Physeal Fractures, Predictive Factors, Premature Closure

Print Tag: Refer to original journal article
Deadman’s Angle Falls Short in Suture Anchor Durability

The Effect of the Angle of Suture Anchor Insertion on Fixation Failure at the Tendon-Suture Interface After Rotator Cuff Repair: Deadman's Angle Revisited.

Strauss E, Frank D, et al:
Arthroscopy 2009; 25 (June): 597-602

After fixation failure of rotator cuff repair, inserting suture anchors at 90° results in a stronger construct than inserting them at Deadman's angle of 45°.

Background: Many surgeons advocate placing suture anchors at 45° with respect to the bone when performing a rotator cuff repair. However, changes in anchor technology may make this angle less important, as factors other than anchor pullout may play a greater role in rotator cuff failure.

Objective: To examine the effect of the angle of suture anchor placement on rotator cuff tear integrity.

Design: Laboratory study.

Materials/Methods: The authors used 7 matched-pair cadaveric shoulders with an average age of 48.3 years. All shoulders underwent x-ray and bone mineral density to assess any pathology and bone mineral differences. The supraspinatus and humeral head were isolated. Each supraspinatus tendon was split to form an anterior and posterior half. Tendons were cut horizontally to simulate a rotator cuff tear. Rotator cuffs were repaired by placing 5-mm Mitek Spiralok in the anterior half in either a 45° (or Deadman's angle) or a 90° angle, and in the posterior half using the angle not originally used. For each matched pair, the combination was switched from the other shoulder. A single suture was used and tied using a standard arthroscopic knot-tying technique. Each specimen was placed into a vise in an Instron machine to be longitudinally loaded. After preconditioning, the tendon was cyclically loaded to 90 N at 1 Hz and a rate of 33 mm/second. Two failure modes were evaluated: a 3-mm gap at the repair site and complete failure of the construct.

Results: Failure occurred in a predictable manner as the suture loop progressively cut through the tendon. The mean number of loading cycles to form 3 mm of gap formation was 380 cycles in the 90° group (range, 272 to 549 cycles) and 297 in the 45° angle group (range, 197 to 408). This finding was statistically significant. The mean number of cycles to complete failure was 443 in the 90° group and 334 in the Deadman's angle group. The authors found in post-test examination that 2 anchors inserted at 45° loosened, while none of those inserted at 90° failed.

Conclusions: The authors found that inserting suture anchors at 90° resulted in a stronger construct than inserting them at Deadman's angle of 45°.

Reviewer’s Comments: This elegant study challenges the accepted wisdom that the optimal angle for insertion of suture anchors in the rotator cuff is 45°. The authors highlight the fact that use of screw-in anchors, which have gained in popularity, has resulted in fewer pullouts from bone. I do wonder if the angle of pull in this study may have influenced the results. A power analysis would have made the study stronger, as there were fairly disparate results. (Reviewer-Nathaniel P. Cohen, MD).

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Keywords: Suture Anchor Angle, Fixation Failure, Rotator Cuff Repair, Deadman's Angle

Print Tag: Refer to original journal article
Preoperative MRI can be helpful in predicting which rotator cuff tears can be completely repaired.

**Background:** Some authors have recommended partial rotator cuff repair if complete repairs are not possible. Knowledge of which tears are completely repairable and which are not will help to guide both surgeon and patient.

**Objective:** To determine whether any preoperative MRI variables can predict complete reparability of large and massive rotator cuff tears.

**Design:** Retrospective review of operative data; level of evidence, II.

**Participants/Methods:** The authors examined 51 patients with large and massive rotator cuff tears from May 2005 to January 2007. They used Post's system for diagnosing large (3 to 5 cm) and massive (>5 cm) tears at surgery when they measured with a marked probe. All tears had a gap of >3 cm in both the anteroposterior and medial-lateral directions. The authors performed complete and incomplete repairs. They subdivided their repairs into 4 categories: type 1 was a complete repair with full mobilization of the tendon; type II was a complete repair of the cuff with some medialization; type III was a partial repair with <10 mm of exposed humeral head; and type IV was partial repair with >10 mm of exposed humeral head. Repair type was classified by the operating surgeon and confirmed by an independent surgeon assessing images. Two musculoskeletal radiologists subsequently assessed MRIs. They looked at the following parameters: the Goutallier fatty degeneration index (FDI) of the supraspinatus, infraspinatus, and subscapularis; supraspinatus atrophy (the Thomazeau grade); the tangent sign for supraspinatus atrophy; coronal oblique and sagittal oblique distance to measure tear length; coronal oblique thickness; and the axial cut FDI.

**Results:** The authors found that FDI of the supraspinatus and infraspinatus on sagittal oblique sections and the tear distance on coronal and sagittal oblique were significantly correlated with the ability to completely repair the cuff. They found that a tear distance of >32 mm on the sagittal view and 31 mm on the coronal view correlated with an inability to completely repair the cuff. An FDI score of >3 for the supraspinatus and >2 for the infraspinatus was associated with incomplete repair. Age and gender were not risk factors for incomplete repair.

**Conclusions:** Preoperative MRI can be helpful in predicting which tears can be completely repaired.

**Reviewer's Comments:** This study helps in counseling patients on their perioperative and postoperative expectations. It does seem intuitive that tear size is predictive of whether a tear can be completely repaired. The correlation with FDI may indicate chronicity, which would also play a role in the ability to repair a tear completely. The authors do not discuss if margin convergence was attempted in their repairs. This is often a good way to make a seemingly irreparable tear more repairable. (Reviewer-Nathaniel P. Cohen, MD).
In this study, eversion of the patella and anterior tibial translation during primary total knee arthroplasty (TKA) had no detrimental effect on function or pain following TKA.

**Objective:** The authors hypothesize that patellar subluxation without tibial translation would improve recovery and enhance pain control during total knee arthroplasty (TKA).

**Participants/Methods:** 37 patients were randomized to 1 of 2 treatment groups: patellar eversion or patellar subluxation. Every patient had 1 knee arthroplasty performed with each approach. Exclusion criteria included a diagnosis of a neuromuscular disorder, previous open knee surgery, a previous extensor mechanism injury, and morbid obesity (a body mass index of >40 kg/m2). Patients and physical therapists were blinded to the type of treatment. Clinical outcomes, including Knee Society scores, range of motion, quadriceps strength, and the patient's individual preference were collected and evaluated at 6 weeks, 12 weeks, and 6 months postoperatively. Average body mass index for the cohort was 31.6 kg/m2 (range, 24 to 40.0 kg/m2). Preoperative knee alignment averaged -4° of valgus (range, 20° of varus to 19° of valgus).

**Results:** At 6 and 12 weeks and 6 months after the surgery, there were no significant differences between the treatment groups in terms of range of motion, quadriceps strength, or Knee Society scores, and there was no difference with regard to the patient's knee preference or pain levels. The mean range of motion in both groups was approximately 113°. There were 2 complications: one patient had a deep infection (requiring revision surgery), and one had bilateral manipulation to treat stiffness.

**Conclusions:** There were no significant differences between the 2 treatment groups (patellar eversion and anterior tibial translation compared with patellar subluxation and no tibial translation) at 6 weeks, 12 weeks, or 6 months after the surgery. Patellar eversion and anterior tibial translation did not affect range of motion, quadriceps strength, or patient's knee preference during the early postoperative recovery period after TKA.

**Reviewer’s Comments:** It is encouraging to see more randomized, blinded studies in orthopaedics, and that is the major strength of this study. I am not surprised that eversion of the patella and anterior translation of the tibia did not impact the outcome of knee arthroplasty, as seen in this study. One potential weakness of this study is the small sample size; to detect a difference in the 2 groups would require a much larger population than the numbers included in the present study. (Reviewer-Kris J. Alden, MD, PhD).

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Keywords: Knee Arthroplasty, Minimal Invasive Surgery, Patella Eversion, Tibial Translation

Print Tag: Refer to original journal article
SLAP Repair Stronger With a Knot Than Not

Biomechanical Comparison of a Knotless Suture Anchor With Standard Suture Anchor in the Repair of Type II SLAP Tears.

Sileo MJ, Lee SJ, et al:

Arthroscopy 2009; 25 (April): 348-454

Repair of type II SLAP tears with knotless suture anchors is weaker than repair with standard suture anchors.

Background: The most common surgical treatment for superior labrum anterior to posterior (SLAP) lesions is arthroscopic repair using suture anchors with arthroscopic knots. Some authors have proposed a knotless repair technique. There have been no studies examining the strength of SLAP repair with knotless suture anchors or the mode of failure of SLAP repairs with these anchors.

Objective: To compare the biomechanical strength of knotless suture anchors and standard suture anchors in the repair of type II SLAP tears.

Methods: 5 matched pairs of cadaveric shoulders (mean age, 40.8 years) were dissected free of soft tissue except for the glenoid labrum and long head of the biceps tendon. Type II SLAP tears were created in all shoulders. Each pair of shoulders was then divided into 2 groups. Shoulders in group 1 were repaired with a standard "knotted" Mitek lupine anchor (DePuy Mitek). In group 2, the contralateral shoulder from the same donor was repaired using the Mitek Bioknotless suture anchor. All specimens were preloaded to 10 N, and loaded for 25 cycles in 10 N increments to a maximum of 200 N. If specimens were still intact after 200 N, they were loaded to ultimate failure. The load at which 2 mm of gapping occurred, load to ultimate failure, mode of failure, and the number of cycles to failure were compared.

Results: The mean load repair failure, defined as permanent gapping of 2 mm, was lower (P <0.05) for knotless anchors (70 N) versus knotted anchors (104 N). Mean ultimate failure was also lower for the knotless anchors compared to the knotted anchors (74 N vs 132 N; P<0.05). In addition, the knotless anchors showed fewer cycles to 2-mm gapping (mean, 133 cycles vs 219 cycles; P<0.05), and cycles to failure (mean, 143 cycles vs 297 cycles; P<0.05) than the knotted anchors. Eight of 10 specimens failed at the soft tissue interface (4 knotless, 4 knotted) and 2 failed by anchor pullout (1 knotted, 1 knotless).

Conclusions: The results of this study suggest that repair of a type II SLAP tear with a Mitek knotted suture anchor and mattress suture configuration through the biceps anchor is stronger than repair with a Mitek knotless suture anchor. The most likely method of repair failure was at the suture/soft tissue interface regardless of the type of anchor used.

Reviewer's Comments: This study is limited by the fact that it is a biomechanical cadaveric study with no dynamic data. In addition, the knotless anchor design used did not allow for the sutures to be passed in a true mattress configuration. It would be interesting to see if using a different knotless anchor that allowed a true mattress configuration would affect the results. (Reviewer-Adam J. Farber, MD).

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Keywords: Arthroscopy, Knotless Suture Anchors, SLAP Tears

Print Tag: Refer to original journal article
In this study, ORIF of grade IV OCD loose bodies resulted in stable fixation in 92% of cases in the short-term (12 weeks), and minimal pain and normal function in activities of daily living in the long-term (9 years).

**Background:** Osteochondritis dissecans (OCD) lesions can progress to loose body formation, resulting in a grade IV defect. The decision to fix versus excise the loose body is controversial.

**Objective:** To report the long-term results of a series of patients who underwent open reduction and internal fixation (ORIF) for loose bodies associated with OCD of the knee.

**Design:** Case series.

**Participants/Methods:** 12 patients (6 male and 6 female; mean age 19.2 years [range, 12 to 34]) who underwent ORIF of a knee OCD loose body between 1991 and 2006 were retrospectively identified. All patients had grade IV osteochondral defects treated with ORIF using metallic screws performed via an arthrotomy. Defect size ranged from 2.0 to 8.0 cm² (mean, 3.5 cm²). Lesions were located on the medial femoral condyle (42%), lateral femoral condyle (25%), lateral trochlea (17%), and medial facet of the patella (17%). After 12 weeks, hardware was removed, and healing was assessed. Long-term outcomes were assessed with a Knee injury and Osteoarthritis Outcome Score (KOOS) and a Marx activity score.

**Results:** No patients experienced any perioperative complications at either the index surgery or subsequent removal of hardware. Arthroscopy for screw removal revealed stable healing in 92% (11 of 12) of patients. No patients required subsequent surgery for a loose body. At an average of 9.2 years’ follow-up (range, 3.8 to 15.8 years), 83% (10 of 12) of patients completed the KOOS. The KOOS subscale scores for pain (mean, 87.8; range, 67 to 100), other symptoms (mean, 81.8; range, 61 to 96), function in activities of daily living (mean, 93.1; range, 72 to 100), and sports and recreation function (mean, 74.0; range, 40 to 100) were not significantly lower than those of published age-matched controls. However, the KOOS subscale score for knee-related quality of life (mean, 61.9; range, 31 to 88) was significantly lower (P = 0.003). The mean Marx activity score was 4.6 (range, 0 to 12).

**Conclusions:** Operative fixation of grade IV OCD loose bodies results in stable fixation. At an average of 9 years after surgery, patients did not have symptoms of osteoarthritis pain and had normal function in activities of daily life. However, patients reported significantly lower knee-related quality of life. Operative fixation of OCD loose bodies is a better alternative to lesion excision.

**Reviewer’s Comments:** This study is limited by: its small sample size, its retrospective nature, heterogeneous study population, lack of follow-up imaging studies, and lack of a control group. Nonetheless, the results of this study are encouraging; future prospective controlled trials to validate these results would be useful. (Reviewer-Adam J. Farber, MD).

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Keywords: Osteochondritis Dissecans, Operative Fixation, Healing, Functional Outcome

Print Tag: Refer to original journal article
In this study, moderate/severe dislocation arthropathy was seen in 26% of patients 25 years after an anterior dislocation event.

**Background**: Shoulder dislocation may cause arthropathy, but the natural history of this evolution is not well described.

**Objective**: To document the natural history of arthropathy after anterior shoulder dislocation with long-term follow-up results.

**Design/Methods**: Prospective Swedish multicenter study (1978 to 1979) including 257 shoulders in 255 patients (205 men and 50 women aged 12 to 40 years) with a first-time anterior shoulder dislocation. Follow-up evaluation consisted of a personal interview, a physical examination, and radiographs (2 AP views, a subcoracoid view, and an axial view) of both shoulders. The degree of arthropathy on the radiographs was graded by both authors together.

**Results**: In February 2005, the 227 patients (229 shoulders) who were alive had had follow-up. Radiographic examinations were done in 223 of 229 shoulders (97%); of these, 7 patients (7 shoulders) were classified as alcoholics. Imaging showed 99 shoulders (44%) were normal. Arthropathy was mild in 65 shoulders (29%), moderate in 21 (9%), and severe in 38 (17%). Younger patients (age ≤25 years) had less arthropathy than older patients ($P = 0.01$). The 7 alcoholics all had severe arthropathy of the involved shoulder. Alcoholics had an increased rate of moderate/severe arthropathy (7 of 7 compared with 52 of 216; $P < 0.001$). Shoulders with one isolated dislocation event had less arthropathy than the group that had become stable over time ($P = 0.007$) and those that were persistently recurrent ($P = 0.047$). Of the shoulders without a recurrence, 18% had moderate/severe arthropathy. The corresponding figures were 39% for shoulders that recurred once or more (without surgery) and 26% for surgically stabilized shoulders. The group that sustained the primary dislocation because of traumatic sports had the highest percentage of moderate/severe arthropathy (37%) and the nontraumatic sports activity sustained the lowest (15%; $P = 0.009$). Sixty-two surgically stabilized shoulders had less arthropathy than those that became stable over time ($P = 0.047$). Gender, side of dislocation, treatment of the initial dislocation, impression fracture of the humeral head, or glenoid rim fracture by the first dislocation had no effect on the degree of arthropathy (moderate/severe) at 25 years. No patient had surgery because of arthropathy during the 25 years the study has been ongoing.

**Conclusions**: Age at primary dislocation, recurrence, high-energy sports, and alcohol abuse were factors associated with the development of arthropathy following an anterior shoulder dislocation.

**Reviewer's Comments**: This is an excellent natural history study of anterior shoulder instability. Future studies are needed that compare the data presented here to data for patients who undergo current arthroscopic stabilization techniques to determine if current surgical stabilization methods can decrease the risk of arthropathy. (Reviewer-Adam J. Farber, MD).

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**Keywords**: Anterior Shoulder Dislocation, Recurrence, Alcohol Abuse, Arthropathy

**Print Tag**: Refer to original journal article
The rate of short-term complications, including infection and need for amputation, following ORIF of ankle fractures is significantly higher in patients with complicated diabetes and peripheral vascular disease.

**Background:** Previous studies that reported on surgical complications associated with ankle fractures have relied on case series from single institutions or have focused on specific patient populations. **Objective:** To determine the short- and intermediate-term complication rates after open reduction and internal fixation (ORIF) of ankle fractures and to clarify the role of patient- and provider-related factors in predicting these rates. The use of a large, diverse population-based dataset overcomes some of the biases inherent in existing case series. **Methods:** California's discharge database was used to identify patients who had undergone ORIF of a lateral malleolar, bimalleolar, or trimalleolar ankle fracture as inpatients from 1995 to 2005. The short-term outcomes of pulmonary embolism, below-the-knee amputation, readmission because of infection or wound complication, and reoperation for ORIF were reported for the first 90 days following discharge. The intermediate-term rate of reoperation for ankle fusion or arthroplasty was also analyzed. Logistic regression and proportional hazard regression models were used to determine the strength of the relationships between the rates of complications and fracture type, patient demographics and comorbidities, and hospital characteristics. **Results:** 57,183 patients (63% females and 37% males; mean age, 51 years) were identified for this study. Overall, 16% of patients had lateral malleolar fractures, 45% had bimalleolar fractures, 39% had trimalleolar fractures, and 7% had open fractures. The overall rate of short-term complications was low, including the rates of pulmonary embolism (0.34%), mortality (1.07%), wound infection (1.44%), amputation (0.16%), and revision ORIF (0.82%). The intermediate-term rates of reoperation were also low, with ankle fusion or arthroplasty being performed in 0.96% of patients who were observed for 5 years. Open fractures, age, and medical comorbidities were significant predictors of short-term complications. The presence of complicated diabetes was a particularly strong predictor ($P < 0.001$), as was peripheral vascular disease ($P < 0.001$). The intermediate-term rate of reoperation for ankle fusion or replacement was higher in patients with trimalleolar fractures ($P < 0.001$) and open fractures ($P < 0.001$). Treatment at a low-volume hospital was not significantly associated with increased risk of short-term complications or intermediate-term reoperation. **Conclusions:** Open injury, diabetes, and peripheral vascular disease were strong risk factors predicting a complicated short-term postoperative course. Fracture type was a strong predictor of reoperation for ankle fusion or replacement. Hospital volume did not play a significant role in the rates of short-term or intermediate-term complications. **Reviewer's Comments:** This study highlights the importance of diabetes and peripheral vascular disease in predicting the risks of the short-term complications of mortality, infection, reoperation, and amputation. This study is limited in that complications treated or procedures performed on an outpatient basis are not identified. (Reviewer-Adam J. Farber, MD).

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Keywords: Ankle Fracture, Open Reduction, Internal Fixation, Complications Database

Print Tag: Refer to original journal article
Augmented repair of a fresh total Achilles tendon rupture with a down-turned gastrocnemius fascia flap does not have any advantage over simple end-to-end repair.

**Background:** Augmented and non-augmented techniques have been used for the operative repair of a fresh total Achilles tendon rupture. The literature is unclear on which method is superior.

**Methods:** 60 patients with an acute Achilles tendon rupture were randomized to receive end-to-end suture repair with use of the Krackow locking loop technique either without augmentation (simple repair group) or with a down-turned gastrocnemius fascia flap (augmented repair group). A brace allowed free active plantar flexion of the ankle postoperatively, whereas dorsiflexion was restricted to neutral for the first 3 weeks. Twenty kilograms of weight bearing for 3 weeks, half weight bearing between the third and sixth weeks, and full weight bearing after 6 weeks were allowed. At final follow-up (1 year), the patients were evaluated in terms of clinical measurements, an outcome score, isokinetic calf muscle performance tests, and tendon elongation measurements.

**Results:** Average duration of surgery was 77 minutes in the augmented repair group and 52 minutes in the simple repair group ($P<0.001$). The average length of the incision was 18 cm in the augmented repair group and 11 cm in the simple repair group ($P<0.001$). There were 6 reruptures (3 in each group) and 2 deep infections (both in the augmented repair group). In the simple repair group, the overall ankle score was excellent for 19 patients (63%) and good for 8 patients (27%), and 3 patients (10%) had an early failure (because of rerupture). In the augmented repair group, the ankle score was excellent for 14 patients (56%) and good for 6 patients (24%), and 5 patients (20%) had a failure because of rerupture (3) or deep infection (2). The difference between the groups with regard to the overall result was not significant ($P=0.68$). In the simple repair group, the isokinetic calf muscle strength score was excellent for 11 patients (37%), good for 14 patients (47%), and fair for 2 patients (7%); in the augmented repair group, the score was excellent for 9 patients (36%), good for 7 patients (28%), fair for 3 patients (12%), and poor for 1 patient (4%). No significant differences were seen between the 2 groups with regard to pain, stiffness, subjective calf muscle weakness, footwear restrictions, range of ankle motion, overall outcome, isokinetic calf muscle strength, mean peak work-displacement relationships, or tendon elongation.

**Conclusions:** Augmented repair of a fresh total Achilles tendon rupture does not have any advantage over simple end-to-end repair.

**Reviewer’s Comments:** This well-done prospective, randomized study suggests that use of a down-turned gastrocnemius fascia flap to augment primary Achilles tendon repair does not have any advantage over simple end-to-end repair. It would be interesting to perform a similar study to investigate other augmentation techniques. (Reviewer-Adam J. Farber, MD).

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Keywords: Achilles Tendon, Acute Repair, Augmentation

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Prior MSTs Result in Poorer Outcomes After ACI for Lesions >4 cm

Increased Failure Rate of Autologous Chondrocyte Implantation After Previous Treatment With Marrow Stimulation Techniques.

Minas T, Gomoll AH, et al:


Use caution in treating large chondral lesions with marrow stimulation techniques.

**Background:** Marrow stimulating techniques (MST) are successful in 60% to 80% of patients being treated for full-thickness cartilage lesions. Data suggest that MST might not be as successful in larger lesions and locations other than femoral condyles.

**Objective:** To investigate whether previous marrow stimulation techniques compromised subsequent cartilage repair with autologous chondrocyte implantation (ACI).

**Design:** Cohort study; Level of evidence II.

**Participants/Methods:** Prospective data were collected on 321 patients (325 knees) who met inclusion criteria. Patients were divided into 2 groups: those undergoing ACI and those undergoing ACI that had a previous MST. ACI was delayed 9 to 12 months after the MST to allow healing. Defect sizes were recorded as well as any concomitant procedures including tibial realignment osteotomies, tibial tubercle osteotomies, and ligamentous reconstruction. For analysis, the cohort was classified by defect into simple (single lesion, <4 cm\(^2\)), complex (multifocal, >4 cm\(^2\) or on trochlea, tibia, or patella), and salvage (kissing lesions, all lesions in knees with early arthritis). A subgroup of patients that had failed ACI after MST that had additional untreated lesions was found. These patients had both lesions treated and served as an internal control subgroup.

**Results:** Average follow-up was 55 months. The 2 groups had similar demographics as well as concomitant procedures. The failure rate in the control group was 8% (17 of 214) and was 26% (29 of 111) in those patients with previous MST. There was 1:1 failure ratio after previous MST in the simple group, but a 3:1 ratio in the complex and salvage groups. No significant differences were seen among the 3 MSTs (microfracture, drilling, and abrasion arthroplasty). Those patients with failed lesions and additional untreated lesions in which both were treated showed increased failure rate in the revised lesions. Sixteen of 17 MST lesions failed compared to 2 of 18 untreated lesions in this subset of patients.

**Conclusions:** MSTs are good first-line treatments for small (<4 cm\(^2\)), full-thickness cartilage defects. This study shows that larger lesions previously treated with MST have higher failure rates when ACI is performed. The authors suggest that the subchondral bone is compromised or changed in some way by the MST and could be the reason for high failure rates. Failure in previously MST-treated lesions occurs in 3 ways: delamination, intralesional osteophyte, and subchondral cysts.

**Reviewer's Comments:** This is an excellent study that demonstrates ACI may be a first-line treatment for larger lesions. The subchondral changes that occur after MST and the modes of failure were interesting findings. I would be interested in knowing which of the 3 MSTs evaluated have the poorest outcomes. The data showed a trend for lower failure rates in the microfractured lesions. (Reviewer-Mark Clough, MD).

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Keywords: Autologous Chondrocyte Implantation, Marrow Stimulation Techniques

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If previous meniscus resection is <25% of the total meniscus, then MRI can be reliably interpreted as if it were a virgin meniscus. If resection is >25%, then direct or indirect MRA should be considered.

**Background:** Arthroscopic knee surgery for meniscal pathology is a commonly performed procedure. MRI is a good way to evaluate primary meniscus injuries. It is often difficult to interpret an MRI after prior meniscus surgery and to decide whether signal changes are due to a new meniscus tear or to postoperative changes. A retear may be seen on MRI by a linear signal abnormally extending to an articular surface or morphology not typical of a postoperative meniscus such as meniscal fragmentation or displaced meniscal tissue. Asymptomatic patients after meniscectomy do not routinely get follow-up MRIs; therefore, comparing findings in symptomatic patient's repeat MRIs is difficult.

**Objective:** To review the literature regarding MRI of the postoperative meniscus with the purpose of aiding clinicians who treat patients with clinical symptoms after prior meniscal surgery.

**Design:** Literature review.

**Results:** Conventional MRI had an accuracy of 89% in detecting retears in postoperative meniscus patients who had had <25% of total meniscal resection. In patients with >25% resection, the accuracy of conventional MRI decreased to 65%. In such patients with >25% resection, direct MRA improved detection accuracy to 87%. MRA allows contrast material to imbue the tear because of intra-articular distention and pressure. Direct MRA requires the patient to undergo an intra-articular injection and uses physician resources that may be disadvantageous. Indirect MRA (IV contrast) has a similar accuracy to direct MRA and may be more appealing to the patient and relies less on physician resources. Pathology is able to be imaged because of increased blood flow via inflammation. A prospective randomized trial looking at detection of recurrent meniscal tears comparing MRI to both direct and indirect MRA showed MRI to be 58% sensitive, 80% specific, and overall accuracy to be 62.5%. Indirect MRA improved sensitivity to 90.9%, specificity to 100.0%, and overall accuracy to 93.8%. Direct MRA had a sensitivity of 92%, specificity of 100%, and accuracy of 93%. MRI interpretation after meniscal repair may be even more problematic than after partial meniscectomy. One would expect some signal change at the repair site, but whether or not this correlates with pain is difficult to determine. Signal changes after meniscus repair are persistent in 50% of menisci at a mean follow-up of 12.9 years. The literature review did not conclusively find one MRI modality better than another, but suggests that contrast MRI may be more accurate in detecting recurrent tears in post-meniscal repair patients. The authors comment on CT arthrography as a technique that shows potential as an adjunct test.

**Conclusions:** Evaluating the postoperative meniscus is difficult, and overall accuracy of detecting recurrent tears can be improved using direct or indirect MRA.

**Reviewer's Comments:** This is an excellent literature review and I recommend it to anyone evaluating and treating patients with meniscal pathology. The authors include a nice algorithm for the evaluation of postoperative menisci. (Reviewer-Mark Clough, MD).
Primary anterior cruciate ligament repair combined with bone marrow stimulation may be an alternative surgical option for a select group of patients.

**Background:** Anterior cruciate ligament (ACL) tears are traditionally reconstructed, not repaired, due in part to poor healing ability and reliable outcomes with reconstruction.

**Design:** Case series; Level of evidence IV.

**Participants/Methods:** 99 athletes clinically diagnosed with an acute ACL tear underwent arthroscopy; 26 had confirmed incomplete proximal ACL tears. Tears were classified as: type 1, anteromedial bundle <100%; type 2, posterolateral bundle <100%; type 3, both bundles; and type 4, complete tear. Types 1 through 3 were included where tears involved no more than 50% of both bundles. These were treated using primary suture repair combined with bone marrow stimulation/microfracture. Patients underwent a strict rehab protocol similar to the Steadman protocol. Outcome measures included: Marx, Noyes, Tegner, Single Assessment Numeric Evaluation (SANE), Lysholm, and International Knee Documentation Committee (IKDC) scores. Anterior tibial translation was measured using a Rolimeter (Aircast) instrument under anesthesia at final follow-up.

**Results:** Mean follow-up was 25.3 months (range, 17 to 38 months). Mean patient age was 26.6 years, and 20 of 26 were males. On preoperative MRI, 13 of 26 had a possible partial ACL tear and 13 had apparent complete ACL tears. Fourteen patients had type 1 tears, 2 had type 2, and 10 had type 3 tears diagnosed at arthroscopy. Pivot shift was positive in 11 of 26, a glide in 9, and negative in 6. Postoperative side-to-side difference for anterior knee translation was decreased from 3.5 mm to 1.3 mm ($P<0.001$). Pivot shift was negative in 23 of 26 at final follow-up, 2 were positive, and 1 was a glide. Tegner scores improved from 3.5 to 6.7 ($P<0.001$). Five patients (19%) did not return to preinjury sports level. Of these, 3 chose to reduce activity and were not related to impairment. SANE scores improved from 47.7 to 87.7 ($P<0.001$). Final Marx and Noyes scores were similar to preinjury scores ($P=0.011$ and $P=0.303$, respectively). Mean Lysholm score was 93.7. Final IKDC objective scores were normal in 23 of 26 patients (88%), nearly normal in 2 (8%), and severely abnormal in 1; these 3 patients who were not entirely normal all had associated injuries. Six patients had second-look arthroscopy, and ACLs appeared healed and were stable to probing.

**Conclusions:** Primary ACL repair with bone marrow stimulation can restore stability and function. This has a potential advantage of preserving ACL proprioceptive nerve fibers and diminishing graft site morbidity.

**Reviewer's Comments:** This is an interesting possible alternative for a select group of patients with incomplete proximal ACL tears. I would be hesitant, though, to subject an athlete to a potential second surgery/rehab given the reliable outcomes of reconstruction. Limitations are noted in the article, including nonrandomized prospective design, lack of control group, and short follow-up. With more literature showing promise regarding biologic supplementation (growth factors, etc) of primary repair, I look forward to learning more about this topic. (Reviewer-Mark Clough, MD).

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Keywords: Anterior Cruciate Ligament, Primary Repair, Bone Marrow Stimulation

Print Tag: Refer to original journal article
Operative Tx for First-Time Anterior Dislocations Not Always Recommended

Long-Term Follow-Up of Acute Arthroscopic Bankart Repair for Initial Anterior Shoulder Dislocations in Young Athletes.
Owens BD, DeBerardino TM, et al:

Acute stabilization of traumatic anterior instability results in good long-term outcomes.

**Background:** A recurring topic in the sports medicine literature is on the management of first-time traumatic anterior shoulder dislocations. Nonoperative treatment results in high recurrence rates in young, active patients, and therefore some advocate early surgical intervention.

**Objective:** To report on the long-term outcomes of acute arthroscopic Bankart repairs for initial traumatic anterior shoulder dislocations.

**Participants/Methods:** A 48-patient cohort (49 shoulders) of first-time anterior glenohumeral dislocations was evaluated. Patients underwent arthroscopic Bankart repairs using the Suretac (Smith & Nephew) device. Outcome measures included: Single Assessment Numeric Evaluation (SANE), the subjective portion of the Rowe shoulder score (30-point max), American Shoulder and Elbow Surgeons score (ASES), Western Ontario Shoulder Instability Score (WOSI), the Simple Shoulder Test (SST), SF-36 Physical component scores, Tegner score, Army Physical Fitness Test (APFT; push-ups, sit-ups, 2-mile run), and shoulder history. The mean follow-up was 11.7 years (range, 9.1 to 13.9 years).

**Results:** 39 patients (40 shoulders) were available at follow-up (82%). Average age was 20.3 years (range, 17 to 23) and included 37 men and 2 women. Mean SANE score was 91.7. Mean WOSI score was 82% of normal. Mean subjective Rowe score was 25.3; mean ASES score was 90.9; and mean SF-36 score was 94.4. Patients felt their shoulder was a mean of 93.3% of their preinjury function. Mean Tegner score was 6.5. The postoperative number of push-ups changed little from their preinjury number (72.8 and 77.7 average, respectively). There were 6 recurrent dislocations and 9 recurrent subluxations. Revision surgery was performed on 6 patients (4 recurrent dislocations and 2 recurrent subluxations). Mean time for recurrence was 37 months (dislocations) and 22 months (subluxations). All episodes of recurrent instability occurred during athletic activity. The revision rate was 14%.

**Conclusions:** This study demonstrates good long-term acute surgical outcomes in this cohort of patients. The revision rate of 14% is excellent given the level of activity in this cohort, especially when compared to reports of up to 92% recurrence in nonoperatively treated first-time dislocations.

**Reviewer’s Comments:** Operative treatment for first-time anterior dislocations in young active patients is not always recommended. Natural history studies demonstrate a high rate of recurrence in this group of patients. Performing acute Bankart repairs is potentially easier from a technical standpoint with regard to tissue quality. However, caution must used in interpreting this data, and the decision regarding treatment should be based on an individual case basis. There was a lack of objective data in this study as mentioned by the authors. The authors point out that all the Bankart repairs utilized the Suretac device during the mid-1990s in which this cohort was formed. The authors have replaced the Suretac system with suture-anchor repair and anticipate improved results as these patients become available for long-term evaluation. (Reviewer-Mark Clough, MD).

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Keywords: Anterior Shoulder Instability, Acute Repair, Bankart

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Meniscus Repair in Elite Athletes Results in Highly Possible Return to Sport

Meniscal Repair in the Elite Athlete.

Logan M, Watts M, et al:

This aggressive patient population demonstrates successful meniscal repair with a low rate of atraumatic failure.

**Background:** Arthroscopic meniscectomy is a commonly performed procedure. In certain cases, the meniscus may be repaired when the tear is peripheral enough to receive adequate blood supply to heal.

**Objective:** To evaluate treatment using an arthroscopically assisted inside-out meniscus repair technique (AAMR) in the elite athlete population.

**Participants/Methods:** 42 elite athletes underwent a total of 45 AAMRs. Transverse and degenerative tears were not repaired, but some middle third and complex types were. All menisci were rasped and the rim was prepared with a microfracture awl to promote a healing response. An inside-out technique was used with 2/0 PDS sutures. Mean age was 23.2 years, and mean follow-up was 8.5 years (range, 5.4 to 12.6 years). Overall, 83% of patients had concomitant anterior cruciate ligament (ACL) reconstructions. Patients completed Lysholm and International Knee Documentation Committee (IKDC) forms and a general questionnaire to indicate current function. Failure was defined as those patients who developed joint line pain and/or locking or swelling requiring repeat arthroscopy and partial meniscectomy.

**Results:** 45 meniscus repairs were performed and 83% of these had concomitant ACL reconstruction. There were 67% medial and 33% lateral repairs. Three patients had both sides repaired. Average number of sutures was 3.7. The majority of tears were posterior horn and longitudinal type. Lysholm and IKDC scores indicated success with means of 87.4 and 82.2, respectively. In total, 81% of patients returned to their sport. Mean return to sport for the isolated meniscal tear group was 5.6 months, and in the ACL reconstruction group, 11.8 months. There were 11 failures (24%), with 10 being medial and 1 lateral. One additional patient reported failure but was treated by another surgeon making the failure rate (26.7%). Average time from surgery to failure was 41.7 months. Seven failures had a further sporting injury; therefore, if these traumatic failures are removed, the atraumatic failure was 11%.

**Conclusions:** This medium- to long-term outcome study shows an 11% atraumatic failure rate. Medial repairs failed more than lateral repairs, and patient age, time to surgery, and number of sutures did not affect failure. This could be due to the medial meniscus being less mobile and the fact that lateral meniscus tears can often be asymptomatic. This study shows elite athletes have successful medium to long-term outcomes after AAMRs, and the majority return to their sports.

**Reviewer's Comments:** This is a nice outcome study on meniscus repair in elite athletes. The study lacks second-look arthroscopy demonstrating definitive healing, but accepts asymptomatic repairs to be an indirect indicator of healing. The authors repaired meniscus tears that might not have been in the peripheral third or red-red zone. It would have been interesting to have the failures stratified according to tear type to see if this made a difference. (Reviewer-Mark Clough, MD).

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Keywords: Meniscus Repair, Inside-Out, Outcomes

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