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Long-Term Durability of Autolo- gous Chondrocyte Transplantation

ABSTRACT & COMMENTARY

Synopsis: Fifty-one of 61 patients reported good-to-excellent clinical results at 5-11 years follow-up. Using an electromechanical indentation probe, implanted areas were 90% of normal cartilage stiffness. Eight of 11 biopsy specimens demonstrated hyaline-like features by histological and immunohistochemical analyses.

Source: Peterson L, et al. *Am J Sports Med.* 2002;30:2-12.

THE INITIAL TREATMENT OF FOCAL CHONDRAL DEFECTS INVOLVED marrow stimulating techniques that resulted in fibrous repair tissue that lacks the mechanical durability of normal articular cartilage. The fate of these lesions carries a poor long-term prognosis, and many patients required additional surgical intervention or activity modification. In 1994, Brittberg and colleagues reported an initial series of 16 patients with 14 demonstrating good-to-excellent results, and 11 of 15 biopsy specimens revealing hyaline-like cartilage.¹ The purpose of the present study was to evaluate the long-term clinical data, to characterize histological and immunohistochemical features of implanted grafts, and to measure the biomechanical properties of implanted grafts.

Between 1987 and 1994, 61 patients were transplanted and divided into separate groups by type and location of defect: group 1, isolated femoral condyle lesions; group 2, osteochondritis dissecans lesions; group 3, patellar lesions; group 4, femoral condyle lesions with ACL reconstructions. Patients' clinical status was assessed annually by 5 scoring systems including Lysholm and Gillquist, the modified Cincinnati knee score, the overall Cincinnati knee-rating score, the Tegner-Wallgren activity score, and the overall Brittberg clinical grading scores.

Eleven of 18 patients from groups 1, 2, and 4 that were randomly selected agreed to undergo a second-look arthroscopy for gross appearance, biomechanical testing, and histology of an implanted biopsy specimen. Patients from group 3 were not included due to the inability of the electromechanical indenter probe to access the patellar surface. At an average follow-up of 54 months (range, 33-84 months), biopsies were obtained and scored grossly with a 12-point scoring system, and

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microscopically by 2 blinded pathologists. The degree of staining for each specimen was assessed for collagen type I, collage type II, cartilage oligomeric matrix protein, and aggrecan. Each graft was then classified as hyaline-like, fibrous, or mixed tissue. The electromechanical indenter probe (Artscan Inc, Kuopio, Finland) was used to measure the biomechanical properties of the implanted graft and normal surrounding cartilage.

Fifty-one of 61 patients reported good or excellent results at between 5 and 11 years. Overall, 10 of 61 (16%) patients failed treatment, with the lower failure rates occurring in the isolated femoral condylar lesion (11%) and osteochondritis dissecans (14%) groups, compared to the concomitant ACL reconstruction (18%) and patellar lesion groups (24%). All patients who failed had fair to poor results at 2 years, and 7 of 10 failures occurred by 2 years postimplantation.

Of the 12 biopsy specimens, 8 had hyaline-like features with positive type II collagen immunohistochemical staining, and 4 demonstrated fibrous features with type I collagen staining. The grafted areas were generally well integrated with the surrounding normal cartilage and well anchored to the subchondral bone. Most biopsy speci-

mens demonstrated a superficial fibrous surface most likely as a result of the periosteal patch. Samples demonstrating hyaline-like cartilage demonstrated twice the stiffness of those with fibrous features.

The scientific and clinical results suggest that autologous chondrocyte transplantation can be a long-term solution for localized articular lesions. In most cases, failed grafts will manifest clinically within 2 years of implantation. Patients with good or excellent clinical results by 2 years will most likely maintain their clinical performance over a longer period of time.

■ COMMENT BY BRIAN J. COLE, MD, MBA

Peterson and colleagues have done an exceptional job describing the long-term durability of autologous chondrocyte transplantation by clinical, histological, immunohistochemical, and biomechanical analyses. Collagen subtyping supported the presence of type I collagen in fibrous specimens and type II collagen in specimens with hyaline-like features. Stiffness measurements supported more normal biomechanical features of the hyaline-like specimens. Despite the presence of fibrous tissue, good-to-excellent results were still achievable. Clearly, the variability in sampling error that occurs with biopsy and stiffness testing must be considered when using these tools as primary outcome variables. Despite these limitations, the clinical results continue to remain promising beyond 2 years providing informative data for the majority of patients treated in the United States with autologous chondrocyte implantation who are still in the early follow-up period. ❖

Author Acknowledgment: The reviewer would like to acknowledge Shane J. Nho, MS, for his assistance in preparation of this report.

Reference

1. Brittberg M, et al. *N Engl J Med*. 1994;331:889-895.

A New Twist for ACL Reconstruction Surgery

ABSTRACT & COMMENTARY

Synopsis: Pretensioning followed by rotating the ACL graft improved stability and graft tension. However, rotating the graft before tensioning did not have the same effect. The direction of rotation did not matter.

Source: Hame SL, et al. *Arthroscopy*. 2002;18:55-60.

MANY AUTHORS SUPPORT ROTATING THE BONE-patella tendon-bone (BTB) graft during anterior

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cruciate ligament reconstruction (ACLR). The purpose of this study was to determine the effects of rotating the BTB during ACLR on anteroposterior (AP) knee laxity and to determine the forces developed within the graft. Thirteen fresh cadaver knee specimens underwent ACLR and received BTB grafts that were pretensioned at 30° of flexion to restore normal AP knee laxity. AP knee laxity was then measured at 0°, 30°, and 90° of flexion with the graft placed in neutral, 90°, and 180° of internal and external rotation. Additionally, 5 knees received grafts that were first rotated, second tensioned, and finally tested.

In specimens tensioned and then rotated, AP laxity significantly decreased at most testing positions by about 1 mm. In general, AP laxity decreased and graft tension increased with increasing amounts of external or internal rotation of the graft.

In specimens where the graft was first rotated and then tensioned, rotation had no significant effect on laxity. Mean graft forces were significantly increased at a few positions but the increases were very small. For example, by rotating the graft 180° internally or externally, mean graft force increased at full extension by 25 N.

Hame and colleagues concluded that rotating the graft had small but significant effects on knee laxity and graft tension. However, the direction of rotation did not seem to be important.

■ COMMENT BY JAMES R. SLAUTERBECK, MD

Does twisting the BTB graft significantly alter the biomechanical properties for the graft? Keith Markolf's biomechanics lab can begin to answer the question. He has published his technique of obtaining mechanical property and strain analysis for the ACL and PCL in many journals. The protocol cores out the ligament, leaving it intact on a long bony pedestal and maintains its origin or insertion in anatomic position. A load cell or strain gauge can be attached to one side of the ligament bone interface for measurement purposes.

In these experiments, the BTB graft was pretensioned at its original length then rotated, or it was rotated then pretensioned. The later condition was more clinically relevant since the twist is applied before the graft is pretensioned at surgery. The results show small differences in the properties when the ligament is tensioned then twisted, and no differences if twisted then pretensioned.

All in all, little effect is seen by twisting the graft, other than possibly exposing the graft to higher than desired pretensions and decreasing the knee laxity by 1 mm or so. The increase in the tension in the BTB tissue is low, relative to the approximately 500 N pullout strength for the bone-screw interface used in most ACL reconstructions.

The effects of remodeling on a graft with higher tension are not known. Therefore, I would not recommend spending much time twisting the graft on insertion. ❖

Is Notchplasty a Problem?

ABSTRACT & COMMENTARY

Synopsis: *Notchplasty, previously considered an integral part of ACL reconstruction, may have detrimental effects on ACL graft biomechanics.*

Source: Markolf KL, et al. *Am J Sports Med.* 2002;30:83-89.

NOTCHPLASTY WAS ONCE AN INTEGRAL PART OF ACL reconstruction. Recent studies have suggested that only a “minimal” notchplasty is required, and many lecturers on ACL reconstruction have suggested recently that they no longer routinely perform a notchplasty as a part of ACL reconstruction. In the present study, 26 fresh-frozen cadavers were studied. Two groups, consisting of 15 and 11 specimens respectively, had a 2-mm and a 4-mm notchplasty prior to biomechanical testing. Through an elaborate testing design and instrumentation, graft tension was measured before and after notchplasty. The mean intra-articular pretension required to restore normal anterior-posterior laxity at 30° of flexion was 27 N before notchplasty, 48 N after a 2-mm notchplasty, and 65 N after a 4-mm notchplasty. Mean graft forces increased dramatically after notchplasty at both 30° and 90° of flexion. Markolf and colleagues caution that these changes may affect the clinical success of ACL reconstructions.

■ COMMENT BY MARK D. MILLER, MD

Following notchplasty, knee laxity was greater in full extension and less in flexion. Wouldn't this be both bad (in extension) and good (in flexion) news? The answer is no—knee laxity is not good in ACL reconstruction, but too much tension is not good either. As patients work in rehab to get their motion postoperatively, it puts too much tension on the graft and may lead to excessive graft stretching. It would appear from these results that notchplasty may affect tunnel placement and graft isometry in a negative fashion.

Markolf et al also showed the benefit of adequate pretensioning of the graft. This should be done clinically with the use of a graft table and cycling the knee prior to graft fixation. Although the ideal amount of graft tension is still very much a matter of debate, graft pretensioning is recommended. The real issue with all of these studies,

of course, is whether in vitro experimental data can be directly applied in the operating room. With all of the recent studies on commonly held precepts of ACL surgery, how have any of our grafts survived at all, let alone have an excellent record of clinical success? The take home message, however, reflects current clinical trends—as far as notchplasty goes, less is better. ❖

Risk Factors for Early Failure After Thermal Capsulorrhaphy

ABSTRACT & COMMENTARY

Synopsis: *This paper concludes that previous recurrent dislocations and previous shoulder surgery are 2 risk factors for failure of thermal capsular shrinkage in the treatment of glenohumeral instability.*

Source: Anderson K, et al. *Am J Sports Med.* 2002;30:103-107.

GLENOHUMERAL INSTABILITY IS A COMMONLY encountered orthopaedic problem in young, active patients. Open stabilization procedures to correct this problem have resulted in high success rates but with some studies showing mild loss of external rotation compared with arthroscopic procedures. A criticism of arthroscopic techniques has been the failure to address capsular laxity adequately, possibly leading to higher failure rates. Thermal capsular shrinkage was developed to arthroscopically address glenohumeral capsular laxity. The use of thermal devices is increasing despite the fact that current clinical and basic science data on thermal shrinkage are limited. The objective of this study was to identify risk factors for poor outcome after thermal capsulorrhaphy.

One hundred six patients with glenohumeral instability were treated with capsular shrinkage alone or with capsular shrinkage plus another procedure. Fifteen patients with treatment failures were identified and different variables analyzed. The mean time to failure after the procedure was 6.3 months. Previous operations and multiple recurrent dislocations were associated with poor outcome at a highly significant level. Multidirectional instability, participation in contact sports, and age did not attain statistical significance as risk factors given the numbers available.

Anderson and colleagues conclude that thermal shrinkage may be more likely to fail in patients who

have had prior operations or have a history of multiple dislocations. The data also suggest that thermal capsulorrhaphy should be used cautiously in patients with multidirectional instability or in those who are involved in contact sports.

■ COMMENT BY WILLIAM W. COLMAN, MD

This paper provides additional valuable data in the rapidly growing area of thermal shrinkage. Given the paucity of clinical and basic science data in this area, identifying contraindications is very helpful. However, the follow-up is short and more data will be important to elucidate if further failures occur with time. The failures in this study occurred at a mean of 6 months, which is rapid. Should we expect more failures over time? If previous surgery correlated with failure, then it would be helpful to know if this implies only previous open instability surgery or other types of shoulder surgery? Also, as Anderson et al indicate, there were not sufficient numbers to exclude multidirectional instability, participation in contact sports, or age as risk factors for failure. Further studies with better design, greater numbers, and longer follow-up will help to answer some of these questions. ❖

Predicting Recurrence of Shoulder Dislocation

ABSTRACT & COMMENTARY

Synopsis: *This retrospective review of a large series of patients confirms that young age at the time of first shoulder dislocation (in this series 21-30 years) is the only predictor of recurrence of shoulder instability.*

Source: Kralinger FS, et al. *Am J Sports Med.* 2002;30:116-120.

KRALINGER AND ASSOCIATES FROM THE UNIVERSITY Hospital of Innsbruck, Austria, attempted to define predictive factors for recurrence of instability following a primary anterior shoulder dislocation. They reviewed the records of 241 patients, of which they were able to clinically and radiographically evaluate 166 at an average of 43 months (range, 13-76 months) after the first dislocation. The goal was to determine what factors may be present that suggest early surgery may be indicated.

Kralinger et al found that young age at the time of the initial dislocation is associated with recurrence. The

overall recurrence rate for their patient population with an average age of 46 years (range, 13-76) was 29%. Their highest risk group of patients included those between the ages of 21 and 30 years, with a recurrence rate of 63%. They also noted an increased risk of recurrent dislocation for those with large Hill Sachs lesions (> 2.5 cm²). They noted reduced external rotation and less recurrent instability in those with greater tuberosity fractures. Those without fracture who did have recurrence of instability had near equal external rotation, while stable shoulders tended to have less rotation as compared with the unaffected shoulder.

Kralinger et al found that sports activities are not an independent variable for recurrence of shoulder instability. Physical therapy or immobilization did not affect the recurrence rate in their subjects. Kralinger et al recommend surgery after a first time anterior dislocation of the shoulder in young athletes (21-30 years of age). They also note that they do not recommend surgery for any other group, including similarly aged individuals who do not participate in sports.

■ COMMENT BY MARC R. SAFRAN, MD

Though proposed in the 1980s, there has been much recent enthusiasm for surgical stabilization after a primary dislocation of the shoulder in the last several years. This may be due in part to the purported lower morbidity and potentially better results with arthroscopic stabilization, in addition to the reproducible results of open stabilization. Many authors have shown that recurrence of shoulder instability is age-related, including the landmark prospective work by Hovelius. Though many investigators have tried to show a correlation with sports activities, no prospective study has been able to confirm an increased risk of recurrence when controlled for age of the athletes, and this study reaffirms these known facts. Kralinger et al also found that size of Hill Sachs lesion does correlate to risk of recurrence. This is controversial as much of the earlier research suggested that these lesions are not associated with recurrence, though recent work by Burkhart and others challenge this notion. It is the feeling of this reviewer that the reason Kralinger et al were able to show that a Hill Sachs lesion is associated with recurrence may be that stratification of the size of the impression fracture allows for more critical analysis.

The effect of physical therapy and immobilization on recurrence is controversial in the literature, and this study adds more evidence for the lack of effect. The range of motion finding as a risk factor is a new proposed risk factor that is consistent with this reviewer's experience. However, it is likely that the degree of

motion difference reported is within clinical measurement error. Thus, more study is necessary.

The prospective study by Hovelius revealed that the risk of recurrent dislocation is 52% at 10 years, while only 23% underwent surgery for shoulder instability. Interestingly, in a comprehensive review of the literature, it appears that approximately 50% of those having recurrent instability request surgery. Other factors to consider when determining if early intervention is indicated include a consideration of quality of life, although there is not much data in the literature on this topic.

In summary, Kralinger et al made a fine attempt on retrospective review to determine predictive factors for early surgery on subjects with a first time shoulder dislocation. It is likely that there is a subgroup of patients that would benefit from surgical intervention after the primary dislocation, however who these patients are is unknown as of yet. More study is necessary in this area before early surgery can be recommended. ❖

Use of the Impingement Test to Predict Outcome Following Shoulder Surgery

ABSTRACT & COMMENTARY

Synopsis: *The classic impingement test, relief of pain with injection of anesthetic into the subacromial space with the impingement position, was not useful to predict clinical outcome following arthroscopic subacromial decompression.*

Source: Kirkley A, et al. *Arthroscopy*. 2002;18:8-15.

THE CLASSIC IMPINGEMENT TEST IS DEFINED AS SIGNIFICANT relief of shoulder pain following a subacromial injection of local anesthetic as the arm is then placed into the Neer impingement position. This has been used for years to help confirm the diagnosis of impingement as the source of pain. Many physicians, including myself, have taken a positive test result to suggest a positive outcome should the patient undergo subacromial decompression surgically. Kirkley and colleagues have challenged this assumption with the present study.

Thirty patients who had failed at least 6 months of conservative treatment were enrolled in this study. Patients having rotator cuff tears by ultrasound or arthroscopy, as well as glenohumeral or acromioclavicular arthritis, were excluded. They were left with patients

with classic impingement and rotator cuff tendonosis or partial, insignificant tears. On the day of surgery immediately prior to the procedure, 1 of the 2 surgeons performed the impingement test by injecting 5 mL of 1% Lidocaine into the subacromial space using fluoroscopy to confirm needle location. Ten minutes following the injection, the arm was placed into the impingement position and pain relief was assessed using a visual analogue scale. Both the Neer and the Hawkins impingement positions were used, as well as an assessment of pain at rest and pain with resisted abduction of the shoulder. The outcome following the ensuing arthroscopic subacromial decompression was assessed with a Western Ontario Rotator Cuff Index and the scoring system of the American Shoulder and Elbow Surgeons at 3, 6, and 12 months postoperatively.

Kirkley et al found that pain relief with the impingement test was not a useful predictor of outcome following surgery. Similarly, they found that pain relief with the aggregate impingement test, that is, pain at rest + Neer impingement sign + Hawkins impingement sign + resisted abduction, also is not a good predictor of outcome following surgery.

■ COMMENT BY DAVID R. DIDUCH, MD

Kirkley et al challenge a common assumption in orthopaedics. That is, that pain relief with a subacromial injection will predict pain relief once surgical decompression is performed. They carefully constructed a prospective, randomized study that confirmed that both pain relief with the classic Neer impingement test following injection, as well as relief following the Hawkins impingement test and resisted abduction, really had no bearing on whether the patients would improve following surgery. Potential confounding variables that may dilute their findings included that a third of the patients were Workers Compensation and perhaps less motivated to show any improvement and that 43% of their patients had partial thickness rotator cuff tears less than 50% of the cuff thickness. The vast majority of these were on the undersurface of the tendon that is not likely to see the local anesthetic that was injected into the subacromial space. Although this is a confounding variable, that is often the case clinically as well.

Kirkley et al present 6 assumptions that would need to be met in order for the impingement test to be a positive predictor of outcome. They state that if any of these 6 assumptions are not met, then the correlation does not hold true. The first is that the impingement sign of pain with forward flexion overhead may not be sensitive to detect impingement. Next, the injection

must be placed into the subacromial space within the bursa at the site of the impingement. The rotator cuff and corresponding bursa would have to be the only structures affected by the anesthetic to make the test valid. The entire thickness of the rotator cuff tendon would have to be anesthetized to provide pain relief for partial thickness tears on the articular surface. Surgery must address the source of pain in terms of the decompression. This is also important in terms of treatment of partial thickness rotator cuff tears. Whether to excise and repair vs. debride alone can be very difficult to determine at the time of surgery. And lastly, as always, the surgery must be done correctly.

This is a very thoughtful paper that really helps us understand the limitations of the impingement test. While it does not discredit the usefulness of the impingement test in the clinical setting, it does help us better understand what to do with the results. ❖

Magnetic Resonance Imaging of Reconstructed Anterior Cruciate Ligament

ABSTRACT & COMMENTARY

Synopsis: *This study sequentially imaged anterior cruciate ligament grafts and found increases in size and signal intensity of the grafts, presumably corresponding to graft revascularization and remodeling. It was noted that the oblique axial image was extremely helpful in assessing graft integrity.*

Source: Min BH, et al. *Clin Orthop.* 2001;393:237-243.

MIN AND COLLEAGUES USED MR IMAGING PERFORMED at 1, 2, 3, 6, and 12 months postoperatively to evaluate sequential changes in the cross-sectional area and signal intensity of bone-patella tendon-bone autografts in 23 patients. Of those evaluated, 8 patients had meniscal tears that were corrected at the time of surgery. All grafts were fixed with interface screws. All patients were males with an average age of 32 years (range, 16-54 years), and all were asymptomatic with good clinical and functional knee stability during the time of the investigation.

Imaging was accomplished with a 1.5 T signal MR unit with the use of fast spin-echo pulse sequences. An oblique axial image at a right angle to the reconstructed graft was obtained in proton density and T-2-weighted

images in addition to the 15° oblique sagittal scan.

Patients were found to have a gradual increase in graft cross sectional area and this increase was statistically significant at 1 year. Although the grafts demonstrated progressive signal intensity, this increase in intensity was not statistically significant until 1 year. Min et al felt the increase in graft cross-sectional area was indicative of ligament hypertrophy and, hence, remodeling, while the increase in signal intensity initially represented edema and later revascularization.

Although Min et al's intent in initiating this study was to correlate MRI changes in reconstructed grafts with previously reported histologic changes, they also discovered during their imaging process 3 patients whose grafts were not well visualized on sagittal imaging. In fact, on that image alone, these patients may have been misdiagnosed as having a partial graft rupture. However, when oblique axial images were examined, the graft had a normal appearance that was verified at second look arthroscopy. Therefore, Min et al added a second message to their study, that is, to always consider the oblique axial image when evaluating graft integrity.

■ COMMENT BY LETHA Y. GRIFFIN, MD, PhD

Min et al attempted the difficult task of obtaining MR images at regularly scheduled time sequences in patients during the first postoperative year. Unfortunately, all patients, although examined at the first postoperative month, were not available for every sequential imaging. In fact, only 7 patients had MRIs at 2 months, 10 at 3 months, and 14 at both 6 months and 1 year postoperatively. Min et al do not comment on whether the same 14 patients were examined at 6 months and 1 year. This information would be extremely helpful in assessing the significance of their numbers for increases in cross-sectional area and graft intensity over time.

Despite this, Min et al do provide us with a helpful, historical review of current thoughts on the histology of graft remodeling as well as present the controversies over the significance of early MR changes in size and signal intensity of autografts.

Perhaps one of the greatest values of this article is its emphasis on the oblique, axial view for visualization of the ACL. Frequently, not only in the assessment of graft integrity, but also in the evaluation of the intactness of the native ligament following traumatic injury, sagittal images do not clearly reveal the intactness of the ligament. Review of the oblique axial image at right angles to the ACL typically clarifies ambiguities that exist after initial sagittal assessment. ❖

Stress Fracture of the Ulna

ABSTRACT & COMMENTARY

Synopsis: *This case report emphasizes the point that stress fractures can occur in the upper extremity as highlighted by a case of an ulnar stress fracture in an equestrian polo player.*

Source: Clark RJ, et al. *Am J Sports Med.* 2002;30:130-132.

CLARK AND ASSOCIATES AT TEXAS TECH UNIVERSITY report an unusual case of ulnar stress fracture in a competitive male polo player from their university. They review his case history, and note that his stress fracture was related to a sudden increase in training, as is a common point identified in the history of players sustaining stress fractures. They highlight the fact that while most stress fractures occur “below the pelvis” that stress fractures of the upper extremity should be included in the differential diagnosis of upper extremity pain in the athlete. They also note the significant rate of injuries sustained in equestrian polo, as best can be obtained from the sparse literature on equestrian polo injuries.

Clark et al hypothesize that the etiology of this stress fracture was overuse of the flexor digitorum profundus (FDP). This hypothesis is based on the fact that the bone scan revealed abnormally bright activity at the origin of the FDP. They also note that the player had only been playing competitively for 2 years and had a tendency to hit the ball in such a way as to force the ball toward the ground, requiring greater strength to prevent the mallet from falling out of his hand and to drive the ball forward. This poor technique, they hypothesize, contributed to this injury. They also hypothesize that the patient's use of prednisone for 20 months, including during the time he sustained the stress fracture, may have contributed to his sustaining the stress fracture. They performed a dexta scan 7 months after he stopped taking the steroids/sustained the injury. The scan revealed normal bone density.

The stress fracture healed with cessation of steroids and a period of immobilization followed by strengthening. He returned to polo at 7 weeks postdiagnosis.

Clark et al recommend consideration of stress fracture in the differential diagnosis in athletes who have forearm pain and use their upper extremity in sports. They also recommend the athlete's technique be analyzed to rule out improper form as a contributing factor to result in increased stress to the musculoskeletal system resulting in injury.

■ COMMENT BY MARC R. SAFRAN, MD

Stress fractures of the ulna have been reported in many sports including tennis, softball, bowling, body building, and table tennis. In tennis, the nondominant arm is often affected, particularly in players with 2-handed backhand strokes, and in the dominant forearm of softball pitchers, table tennis players, and bowlers. One prevailing theory is that this overuse injury, often associated with sudden increase in activity, is due to repeated pronation of the forearm. It may not be the torsion, per se, but the muscular forces to cause the pronation, or more likely, the eccentric action to slow pronation. While polo players hit the ball in supination, the mechanics of hitting the ball include a sudden pronation of the mallet after ball contact. The effects of this sudden pronation are pronounced by the long lever arm of the end-weighted mallet.

The symptoms of ulnar stress fractures are often very subtle and may result in a significant delay in diagnosis. Thus, a high index of suspicion is needed in athletes, particularly unilateral arm dominant athletes, to be able to make this diagnosis. The player's symptoms and clinical examination may be masked by the anti-inflammatory effects of corticosteroids. Corticosteroids are known to result in osteopenia and increase the risk of fractures. Bone scan is certainly a useful tool in making this diagnosis, although MRI has also been useful in this reviewer's experience with ulnar stress fractures. Conservative management is the rule with ulnar stress fractures, as these heal with reduction in activity.

As with most overuse injuries, especially in athletes involved in repetitive mechanics sports, review of technique can be critically important in the treatment and prevention of future injury. ❖

CME Questions

21. What group of autologous chondrocyte implantation patients are associated with the highest rate of failure?

- a. Femoral condyle defects
- b. Patellar defects
- c. Osteochondritis dissecans defects
- d. Trochlear defects
- e. Concurrent anterior cruciate ligament instability

22. Rotation of the BTB graft after pretensioning for ACL reconstruction will:

- a. increase AP laxity in the knee.
- b. decrease AP knee laxity in the knee by greater than 3 mm compared to the other side.

- c. decrease AP knee laxity in the knee by approximately 1 mm compared to the other side.
- d. have no effect on AP laxity in the knee.

23. What is the effect of notchplasty on ACL grafts in vitro?

- a. It results in laxity in both extension and flexion
- b. It results in laxity in extension but increased tension in flexion
- c. It results in increased tension in both extension and flexion
- d. It results in increased tension in extension but laxity in flexion
- e. It has no effect on graft tension

24. Which factor is *not* associated with early failure of thermal capsular shrinkage when used for the treatment of glenohumeral instability?

- a. Previous surgery
- b. Multiple recurrent dislocations
- c. Anterior Dislocater
- d. All of the above

25. Early surgery for the treatment after a first-time shoulder dislocation:

- a. is indicated for all subjects.
- b. is indicated for all athletes.
- c. is indicated for all young athletes players.
- d. is still controversial, and who would benefit is still undefined.

26. What outcome of surgical subacromial decompression can be accurately predicted by a positive impingement test preoperatively?

- a. 100% of the time
- b. 75% of the time
- c. 60% of the time
- d. The impingement test was a poor predictor of outcome following surgery.

27. In addition to the oblique sagittal view in assessing the integrity of the ACL, which MRI view is most helpful?

- a. The coronal T2 weighted image
- b. A fat suppression T1 view
- c. An oblique axial image at right angles to the ACL
- d. A contrast enhanced T1 coronal image

28. Stress fractures of the forearm:

- a. are related to supination.
- b. are not related to technique.
- c. occur in the nondominant arm of polo players.
- d. are due to sudden and sustained increase in activity.

Readers are Invited. . .

Readers are invited to submit questions or comments on material seen in or relevant to *Sports Medicine Reports*. Send your questions to: Neill Larmore, *Sports Medicine Reports*, c/o American Health Consultants, P.O. Box 740059, Atlanta, GA 30374. We look forward to hearing from you. ❖

In Future Issues:

Tendon Healing in Bone Tunnels with Absorbable Screws