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Necessary Inflammation in the Early Healing Response

ABSTRACT & COMMENTARY

Synopsis: *Early use of celecoxib reduced the biomechanical strength of a healing ligament injury in a rat model.*

Source: Elder CL, et al. A cyclooxygenase-2 inhibitor impairs ligament healing in the rat. *Am J Sports Med.* 2001;29(6):801-805.

CELECOXIB IS ONE OF A FEW MEDICATIONS IN THE CLASS OF cyclooxygenase-2 (COX-2) inhibitors, which block inflammation but have less side effects then other traditional nonsteroidal anti-inflammatory medications (NSAIDs). The indications for its use in musculoskeletal injury include pain and inflammation control. The purpose of this study was to determine if the short-term biomechanical properties of a healing rat medial collateral ligament (MCL) were altered by use of a COX-2 inhibitor.

The study included 50 Sprague-Dawley rats that underwent surgical transection of the right MCL. Half were given celecoxib for the first 6 days postoperatively and the other half were not treated. All animals were sacrificed at 14 days and the transected MCLs were biomechanically tested to failure in a tension mode. The rats treated with celecoxib were found to have a significantly lower load at failure than the untreated animals. Elder and associates conclude that the study does not support the use of celecoxib in the treatment of acute ligament injury.

COMMENT BY JAMES R. SLAUTERBECK, MD

NSAID medications are the mainstay of treatment for musculoskeletal injuries. As a class of medications they are useful in treating pain and inflammation. These medications are usually prescribed in younger athletes for short courses without concern for significant consequences. But wait—should we reconsider?

The early inflammatory response is a key step in the healing process as the body begins to remove necrotic tissue and initializes the reparative response. The basic science of ligament healing indi-

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cates that the first stage of healing begins at the time of injury as the blood clot forms at the site. The second phase begins as the monocytes migrate to the injured area at the end of 24 hours. The third or proliferate phase begins as the cellular matrix begins to proliferate at 1-3 weeks and extends into the remodeling phase which lasts for up to 1 year. It would seem that the major effect of NSAIDs on ligament healing would be in the early phases of tissue repair and would have the greatest effect during the first 1-2 week period. This study brings to light that the early inflammatory response may be necessary for sufficient healing of the injured tissue to establish early biomechanical integrity following ligament injury.

Although this study does not determine if long-term biomechanical properties of the ligaments are altered, it does raise early concern in sports medicine patients because our main priority is to return an athlete to sport as early and safely as possible. An early return on a painless but biomechanically weakened ligament may lead to further and more significant injury.

So will I change my treatment of an athlete with an acute ligament injury? Maybe! I might consider alternative, short-term pain medications like Tylenol and Ultram. For more significant injuries I might consider prescribing Tylenol 3 for a very short course. So when would I start to use NSAIDs? In my opinion, the ideal time to start an NSAID would be around 1-2 weeks, or after the initial and necessary inflammatory process was well underway. More studies are needed in this area to determine if what is presented here is mostly theoretical rather than clinically relevant. However, one should think twice about the necessary inflammatory process that occurs after injury and one may want to consider delaying the use of NSAID medications if early return to sport is important to the athlete. ❖

Sports Medicine Reports, ™ ISSN 1524-0991, is published monthly by American Health Consultants, 3525 Piedmont Rd., NE, Bldg. 6, Suite 400, Atlanta, GA 30305.

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GST Registration Number: R128870672.

Periodical postage pending at Atlanta, GA.

POSTMASTER: Send address changes to ***Sports Medicine Reports***, P.O. Box 740059, Atlanta, GA 30374.

Back issues: $37. Missing issues will be fulfilled by Customer Service free of charge when contacted within one month of the missing issue's date.

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Customer Service: 1-800-688-2421.

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World-Wide Web: http://www.ahcpub.com

Subscription Prices

United States

$269 per year (Student/Resident rate: $108).

Multiple Copies

1-9 additional copies: $197 each. 10-20 copies: $175 each.

Canada

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In-Vivo ACL Behavior and Long-Term Follow-up

ABSTRACT & COMMENTARY

Synopsis: *This study correlates initial ACL graft elongation behavior (stretch) at the time of surgery and long-term ACL biomechanical behavior (A-P laxity). Patients in whom the initial graft matched elongation values of an intact ACL showed no recurrent A-P laxity 5 years later. The other group, which demonstrated increased graft elongation at the time of surgery, stretched out during the 5-year follow-up period.*

Source: Beynnon BD, et al. The elongation behavior of the anterior cruciate ligament graft in vivo: A long-term follow-up study. *Am J Sports Med.* 2001;29:161-166.

THIS 5-YEAR FOLLOW-UP STUDY MEASURES THE BIOmechanical behavior of a remodeled ACL graft and correlates these data with the initial elongation behavior of the same graft at the time of surgery. Thirteen patients with an ACL tear and functional instability were treated with an arthroscopic-assisted ACL reconstruction with a bone-patella-bone autograft. Patients with meniscal tears requiring repair, multiligamentous injuries, and medical comorbidities were excluded. The ACL grafts were tested for elongation intraoperatively during passive flexion-extension using a Hall-effect transducer.[1] The patients were then divided into 2 separate groups. Patients with grafts that were bounded by a 95% confidence interval of normal ACL elongation values were assigned to group 1. Patients with grafts that stretched excessively during initial passive motion outside a 95% confidence interval were assigned to group 2. Also, initial laxity measurements were performed intraoperatively with the KT

1000 arthrometer which showed no significant difference between the 2 groups. All patients were then followed prospectively.

At 5-year follow-up, laxity measurements (KT 1000 arthrometer) and surgical outcome measures (IKDC, Lysholm, Tegner) were recorded. There was a statistically significant ($P = 0.004$) increase in A-P laxity in group 2 (4.7 mm side-side difference) compared to group 1 (1.2 mm side-side difference). The grafts in group 2 stretched out over time. Thus, graft elongation at the time of surgery that exceeded the normal limits of an intact ACL (group 2) predicted excessive A-P laxity at 5-year follow-up. Beynnon and colleagues conclude that "not only is restoration of anterior posterior laxity values to within normal limits important, but the biomechanical behavior of the graft produced by flexion-extension of the knee should be appreciated." It is interesting to note, however, that the outcome measures did not show a statistical difference between the 2 groups at 5 years and there was no difference in rates of patient satisfaction.

COMMENT BY STEPHEN B. GUNTHER, MD

This is an important addition to the literature on ACL graft behavior. Beynnon et al combine scientific diligence and attention to detail with a wealth of clinical experience. They have shown, for the first time in the orthopedic literature, that initial midsubstance ACL graft elongation behavior correlates with subsequent A-P laxity of the knee.[2] The group of patients in whom the initial graft matched elongation values of an intact ACL showed no recurrent A-P laxity 5 years later, and the other group stretched out over time. It is interesting that the A-P laxity measurements in this second group were initially within the "normal" range at the time of surgery. Thus, the ACL grafts that showed increased initial elongation values had normal initial arthrometer measurements and, therefore, could not be deciphered from group 1 patients by current standards of testing (arthrometer testing and physical exam). However, this same group produced abnormally high A-P laxity measurements 5 years later.

It is also interesting to examine why some grafts demonstrated increased elongation values. All ACL reconstructions were performed with autogenous bone-patella-bone autografts using a standard technique. Variable tunnel placement and variable graft tension could explain these differences in initial elongation behavior. Beynnon et al did evaluate tunnel placement radiographically and found no difference between the 2 groups. The graft tension may play an important role when the tunnels are not perfectly anatomic. I suspect that there may be subtle differences in tunnel placement between the 2 groups such as femoral tunnels which are slightly more anterior or slightly more central. It would be interesting to measure tunnel placement in these cases using a 3-dimensional computer model with markers or a 3-D CT scan.

It is also interesting to note that the A-P laxity differences between the 2 groups at 5-year follow-up did not affect patient satisfaction. There were no statistical differences between the outcome scores for these 2 groups, and there was no significant difference in patient satisfaction.

No patients had functional instability or limitations of sporting activities. This begs the question as to what will happen with the patients in group 2 during the next 5 years. Will they stretch out further and become functionally unstable or will they remain functional and stable? We will only know if Beynnon et al publish again at 10-year follow-up. ❖

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ACL Tibial Tunnel Landmarks—Have We Been Given a 'Black Pearl?'

ABSTRACT & COMMENTARY

Synopsis: *Landmarks that reference from the existing PCL position were most reliable for tunnel placement in ACL reconstruction.*

Source: Hutchinson MR, Bae TS. Reproducibility of anatomic tibial landmarks for anterior cruciate ligament reconstructions. *Am J Sports Med.* 2001;29:777-780.

RECOMMENDATIONS FOR ACL TIBIAL TUNNEL placement, published in the mid 1990s by both Jackson[1] and Morgan,[2] have been widely adapted, but never challenged—until now. Recommended landmarks included placement of the tibial guide pin: 1) in the posteromedial aspect of the native ACL footprint; 2) adjacent to the apex of the medial eminence; 3)

along a line extended from the posterior border of the anterior horn of the lateral meniscus; and 4) 7 mm in front of the PCL. Hutchinson and Bae dissected and studied 42 pairs of cadaveric knees to critically evaluate these recommendations. They carefully exposed the ACL and PCL and then studied the relationship of the ACL to Jackson and Morgan's recommended landmarks. Although it is difficult to determine from their materials and methods, it appears that the posterior border of the native ACL was used as the main reference to these landmarks. They determined that the PCL and the so-called "over the back position" (a depression in the tibial plateau at the anterior aspect of the PCL insertion described by McGuire[3]) were the most consistent landmarks, with a standard deviation of only 1.2 mm in cadavers of various sizes and shapes. They recommended use of the old ACL stump and 10-11 (not 7) mm in front of the PCL (or over the back position) as the primary landmarks for ACL reconstruction.

COMMENT BY MARK D. MILLER, MD

Add this study to the growing list of articles challenging "classic" recommendations for ACL reconstruction. It's a wonder that any of our reconstructions are successful, let alone 90% or more! Although this present study presents some potentially important information, several issues must be considered before completely throwing out the recommendations of Jackson and Morgan. Perhaps the most important consideration is not where the existing ACL footprint lies, but where the ideal ACL tibial tunnel should lie. We have become increasingly aware that this location may be different for a 7-mm hamstring graft and an 11-mm patellar tendon graft. The cross-sectional area of hamstring and patellar tendon grafts is different as well, and this may influence recommended tunnel placement. A variety of other factors are also important such as considerations in revision ACL surgery, multiple ligament injuries, and extra-articular tunnel location.

It is important to point out that even though the standard deviation of measurements (1.2 mm) from PCL-based landmarks to the ACL footprint yielded the lowest values, the range of these measurements was more than 6 mm! A difference of 1.2 mm is probably of no clinical significance, but 6 mm would likely make a big difference. In conclusion, I think it is safe to rely more on the PCL based measurements, but don't completely discard the others! ❖

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Tissue Remodeling and Anterior Cruciate Ligament Injury in Female Athletes

ABSTRACT & COMMENTARY

Synopsis: *Normal tissue remodeling may be related to susceptibility of ACL injury in female athletes.*

Source: Slauterbeck JR, Hardy DM. Sex hormones and knee ligament injuries in female athletes. *Am J Med Sci.* 2001; 322(4):196-199.

Slauterbeck and Hardy discuss their research agenda and review the literature related to the potential involvement of normal tissue remodeling and susceptibility to anterior cruciate ligament (ACL) injury in females. In particular, they review the biochemistry of tissue remodeling, and the clinical, biomechanical, and molecular research findings related to the ACL. Finally, they review the clinical and basic scientific significance of this work, and discuss current and future studies to determine if tissue remodeling genes vary by gender.

Slauterbeck and Hardy explain that tissue remodeling occurs simultaneously in normal and injured tissue, and the balance between this degradative and biosynthetic process is controlled by activities of matrix metalloproteinases (MMPs) and tissue inhibitors of metalloproteinases (TIMPs). The female sex hormones—estrogen and progesterone—regulate the transcription of several MMP and TIMP genes, and receptors for these hormones are found in the human ACL.

Slauterbeck and Hardy further cite their work and the work of others that support frequency of ACL injury as a function of day of the menstrual cycle. In general, the cited research points to increased rates of injury around menses, and that injury more likely occurs in the late luteal and early follicular phases of the cycle. Slauterbeck and Hardy had previously reported a decrease in load at failure for the ACL in ovariectomized rabbits supplemented with estrogen. In their work to identify tissue remodeling genes that might be targets regulated by

sex hormones, the authors site research that suggests the MMPs are absent from the ACL.

COMMENT BY DAVID H. PERRIN, PhD, ATC

The fact that female athletes have a higher susceptibility of injury to the ACL is well established,[1] particularly in basketball and soccer. A host of potential predisposing factors for the higher incidence of injury in females has been proposed. These factors include anatomical, biomechanical, neuromuscular, social, and more recently hormonal differences between males and females. Slauterbeck and Hardy are pursuing an intriguing line of research that potentially implicates the interplay between tissue remodeling, estrogen and progesterone receptors in the ACL, and the regulation of several MMP and TIMP genes by these hormones. This research has potential implications on frequency of ACL injury and clinical outcome following ACL reconstruction. The research that points to frequency of ACL injury as a function of the day of the menstrual cycle is inconclusive. Nevertheless, Slauterbeck and Hardy present a compelling case that the remodeling response in females differs from that in males, and as such deserves further research as related to susceptibility of ACL injury.

An intriguing question for sports medicine practitioners is what can be done to prevent ACL injury if indeed a link exists between sex hormones and frequency of injury to the ACL in females? Certainly, the most dramatic strategy would be restriction of physical activity at the times identified as high risk during the menstrual cycle. This is obviously an unacceptable prevention strategy, yet there are others that might have a potential role in reducing injury to the ACL. For example, the role of muscular fatigue on incidence of ACL injury deserves further elucidation, as does the relationship between fatigue, sex hormones, and neuromuscular response to lower extremity perturbation. Prescriptive strength and conditioning strategies and targeted modifications in training schedule might be appropriate. Slauterbeck and Hardy also identify the potential role of prophylactic bracing and birth control pills formulated to modify the remodeling process in favor of ACL repair.

The exact reason for the discrepancy in frequency of ACL injury between female and male athletes remains unclear. In all probability, multiple risk factors are involved, and the solution will involve a multifaceted program of preventive strategies. It is clear that further research needs to explore the potential risk factors, with the ultimate goal being to reduce the disparate rate between physically active males and females. ❖

Reference

1. Arendt EA, et al. Anterior cruciate ligament injury patterns among collegiate men and women. *J Athletic Training.* 1999;34:86-92.

Anterior Internal Impingement

ABSTRACT & COMMENTARY

Synopsis: *Partial thickness undersurface rotator cuff tears were identified with anterior internal impingement between the rotator cuff and the anterior superior glenoid in the absence of any evidence of subacromial impingement. Treatment was simple debridement without acromioplasty.*

Source: Struhl S. Anterior internal impingement: An arthroscopic observation. *Arthroscopy.* 2002;18(1):2-7.

Classical outlet impingement as described by Neer refers to pinching of the bursa and rotator cuff under the coracoacromial arch and is associated with rotator cuff tears that occur by attrition. Subacromial decompression has been a standard of care for this outlet impingement with good results. At times, partial thickness tears are observed that seem to originate on the undersurface. Dr. Struhl has made an association with this entity and a new type of impingement that he terms anterior internal impingement. He makes the case that this is different than outlet impingement and should be treated differently as well.

Ten patients who presented clinically in much the same way as patients with classic impingement were identified as having undersurface or articular-sided partial thickness rotator cuff tears. In all of these cases that he took to arthroscopy there was no evidence of subacromial bursitis or outlet impingement. The undersurface rotator cuff tear was a flap or frayed tissue that he noted to come in contact with the anterior superior labrum and glenoid when the arm was in a flexed, internally rotated position. This is the same position the shoulder is placed for the Hawkins test for impingement. In many cases, the patients also had associated glenoid labral fraying in the anterior superior position where impingement occurred. Interestingly, the MRI correctly diagnosed the partial thickness cuff tear in only 20% of the cases. Dr. Struhl used low volume gas arthroscopy through a single posterior portal at the beginning of each case to help identify these partial

thickness tears before distortion with large volumes of arthroscopic fluid.

He treated each of these cases by simple debridement of the rotator cuff partial tear. No acromioplasty was performed. The follow-up was brief at only 6 months, and 6 of 9 were pain free with full motion. One patient had basically no improvement who also had coexisting osteoarthritis. The point of the study was not the clinical outcome as much as the clinical correlation with this new diagnostic entity.

COMMENT BY DAVID R. DIDUCH, MS, MD

Just when we think we understand something here comes another curve ball. Classic outlet impingement as described by Neer is well understood and is a relatively common clinical finding that responds well to subacromial decompression when nonoperative measures fail. Previously, the concept of internal impingement was identified with a partial thickness posterior rotator cuff tear in high level athletes engaged in overhead sports. In an abducted, externally rotated position with the arm cocked back, the undersurface of the rotator cuff was noted to impinge between the posterior head and glenoid margin creating partial thickness cuff tears. This diagnosis is associated with subtle shoulder instability, allowing the shoulder to slide anteriorly while pinching posteriorly.

This concept presented by Dr. Struhl represents a new flavor of internal impingement. None of these patients was noted to have instability or laxity. Rather, he was able to demonstrate using low pressure gas arthroscopy that the anterior portion of the supraspinatus impinged against the anterior superior glenoid labrum when the arm was forward flexed and internally rotated, equivalent to the Hawkins impingement position. He noted that none of these patients had associated subacromial impingement findings at the time of arthroscopy. The photographs in the paper are quite nice and I recommend that the reader review these to better understand the concept.

Dr. Struhl felt that simple debridement of the partial thickness cuff tear and associated labral damage was sufficient treatment. The concept here is removal of the mechanical irritant, avoiding an acromioplasty with its associated morbidity. The major problem I have with this paper is that we don't have any long-term follow-up or sufficient numbers to determine if his treatment is indeed effective. I agree that his clinical correlation with the arthroscopic images is compelling. I would also agree that this appears to be a variety of partial thickness rotator cuff tear with a different etiology than classic impingement. However, long-term studies must be presented before we can adopt simple debridement as sufficient treatment in the absence of acromioplasty and know that pinching of the cuff without associated laxity is responsible for its diagnosis. The problem is this portion of the cuff has a watershed vascular supply and is associated with outlet impingement as well, possibly predisposing this area of the cuff to undersurface tear from internal impingement. I suspect that we will see a lot more about this in the future. ❖

Mini-Open Rotator Cuff Repair

ABSTRACT & COMMENTARY

Synopsis: *Mini-open rotator cuff repairs have 93% good-to-excellent UCLA Shoulder scores regardless of tear size.*

Source: Shinners TJ, et al. Arthroscopically assisted mini-open rotator cuff repair. *Arthroscopy.* 2002;18(1):21-26.

The efficacy of the arthroscopically assisted, mini-open rotator cuff repair technique is well established. This can largely be attributed to improved joint visualization, decreased deltoid muscle takedown, reduction of pain, decreased length of hospitalization, and more rapid return to baseline shoulder function. In a retrospective clinical review, a single surgeon performed 63 arthroscopically assisted, mini-open rotator cuff repairs. Twenty-two patients were lost to follow-up leaving 41 patients reviewed for the study. Preoperative and postoperative shoulder function and pain were evaluated with the UCLA Shoulder rating system.

Shinners and colleagues describe a technique involving an arthroscopic subacromial decompression with or without arthroscopic distal clavicle excision. The rotator cuff was visualized through a 4-6 cm lateral incision beginning at the acromion and extending distally. A bony trough was created off the articular surface of the greater tuberosity with a motorized burr. The Concept rotator cuff instrumentation (Linvatec, Largo, Fla.) was used to place staggered holes, sutures were tied over bone bridges, and the free edges of the tendon were pulled into the trough.

According to the UCLA scoring system, 20 patients had excellent scores (49%), 18 good scores (44%), and 3 fair scores (7%). Workers' Compensation patients had scores that were 4 points lower than the rest of the

patients ($P < 0.0001$). The average UCLA scores for small (< 1 cm, n = 8), moderate (1-3 cm, n = 28), and large (> 3 cm, n = 5) tears were 33.4, 31.8, and 32.8, respectively ($P < 0.4286$). No massive tears were encountered (> 5 cm).

Although there were no massive tears, their series compared favorably to previously published series, leading Shinners et al to conclude that the arthroscopically assisted mini-open repairs are as effective as open techniques. The ability to visualize the glenohumeral joint allows the surgeon to treat concomitant intra-articular pathology that would not otherwise be addressed with open repairs. Minimal deltoid takedown contributes to less pain and discomfort, optimal rehabilitation, and more rapid return to work or recreational activities.

COMMENT BY BRIAN J. COLE, MD, MBA

Shinners et al have done an excellent job in the analysis of their arthroscopically assisted mini-open repair series. They report a greater number of excellent scores (63%) for small tears. This observation is significant because this trend is consistent with previously published series of mini-open repairs.[1,2] This series did not have any patients with massive tears, and Shinners et al defer comment on massive tear repairs. They do, however, refer to other mini-open series which suggest that massive tears be repaired with open techniques.[2,3] Burkhart and associates[4] recently published arthroscopic rotator cuff repair series comparing tear size and repair techniques. They reported that arthroscopic rotator cuff repair yields 95% good-to-excellent outcomes regardless of tear size, and massive tears repaired by the margin convergence technique is superior to open repair of large and massive tears. The superiority of the all-arthroscopic approach compared to mini-open techniques, however, remains to be demonstrated in any objective fashion. ❖

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

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Medial Olecranon Osteotomy and UCL Strain

ABSTRACT & COMMENTARY

Synopsis: *This laboratory study showed no statistical increase in strain in the anterior portion of the ulnar collateral ligament of the elbow with removal of up to 8 mm of bone from the medial olecranon.*

Source: Andrews JR, et al. Relationship of ulnar collateral ligament strain to amount of medial olecranon osteotomy. *Am J Sports Med.* 2001;29(6):716-721.

Andrews and associates at the American Sports Medicine Institute in Birmingham, Ala, have previously reported that some athletes undergoing surgery for valgus extension overload syndrome (VEOS) not uncommonly require subsequent reconstruction of the ulnar collateral ligament (UCL). Because of this clinical impression, Andrews et al performed this study to determine if excision of part of the medial olecranon results in increased strain to the ulnar collateral ligament, to determine if this was the cause of UCL failure and need for reconstruction.

Andrews et al placed a DVRT (Microstrain, Inc, Burlington, Vt) to determine strain in the anterior bundle of the ulnar collateral ligament in 5 cadavers. The strain was assessed with varying loads and varying elbow flexion angles between 50 and 100° of flexion. Strain in the UCL was recorded in response to valgus stress with the medial olecranon intact, and after removing bone in 2 mm increments up to 8 mm at each flexion angle. After 8 mm of medial olecranon was removed, the proximal 5 mm was also removed from the olecranon as well to serve as a worst-case scenario for the treatment of VEOS. Lastly, the strain to failure of the anterior bundle of the UCL with the elbow at 90° of flexion was determined.

Andrews et al found there were no statistically significant differences in UCL strain with increasing bone removal. The greatest differences in UCL change were with the elbow at 50° of flexion.

COMMENT BY MARC R. SAFRAN, MD

The true pathophysiology and cause of elbow symptoms in baseball pitchers remains controversial. Laxity

of the UCL may not be the "essential lesion" as evidenced by the reports of ball players continuing to pitch despite significant laxity and many pitchers undergoing UCL reconstruction despite clinical examinations that do not reveal significant valgus laxity. Nonetheless, it is clinically evident that many overhead athletes that undergo surgery for posterior elbow symptoms due to VEOS, who have no history of medial elbow problems, do eventually develop complaints related to UCL insufficiency. Two possible explanations may be an increased strain in the UCL due to removal of the medial olecranon bone that may be serving as a secondary restraint, or due to an unmasking of an already insufficient UCL.

Andrews et al did not find a statistically significant increase in strain within the anterior bundle of the UCL with sequential removal of bone from the medial olecranon. Although they did not identify a statistically significant increase, this does not mean that no correlation exists. There clearly appears to be a trend of increasing strain within the UCL with increasing loads and increasing removal of bone from the medial olecranon. There were large standard deviations from the average for the strains recorded and the sample size was small. An increase in sample size alone may prove these trends to be significant. Further, some of the average strains decreased in the mid range of bone removal. This paradoxical finding suggests a need for knowing the reproducibility of the methodology. This study provides a good framework for future studies in this area to evaluate the primary and secondary restraints to the UCL.

It is important to stress that despite the results of this study, removing minimal bone from the olecranon is probably the most reasonable approach in the management of overhead athletes with VEOS. ❖

CME Questions

14. The use of celecoxib in the treatment of ligament injury successfully:
a. manages pain in all patients.
b. manages inflammation in all patients without consequence.
c. inhibits the inflammatory response and decreases the mechanical properties of a ligament at 2 weeks post injury.
d. inhibits the inflammatory response and increases the biomechanical properties of a ligament at 2 weeks post injury.

15. Elongation behavior of an ACL graft at the time of surgery can predict:
a. patient satisfaction.
b. initial A-P laxity.
c. A-P laxity at 5-year follow-up.
d. rotatory instability.

16. The most reproducible landmark for ACL tibial tunnel location is:
a. the medial eminence.
b. the PCL, or over-the-back position of the PCL.
c. the posterior border of the anterior horn of the lateral meniscus.
d. the anterior-posterior measurement of the tibia as determined by lateral radiographs.

17. Which of the following correctly describes what is known about gender and injury to the anterior cruciate ligament?
a. Females have a higher frequency of injury than males only at the collegiate level
b. Females have a higher frequency of injury than males in basketball and soccer
c. The frequency of injury in females is clearly highest around menses
d. Birth control pills reduce the frequency of injury in female athletes

18. Anterior internal impingement represented impingement between:
a. anterior supraspinatus and the anterior superior glenoid.
b. posterior supraspinatus and posterior superior glenoid.
c. anterior acromion and anterior supraspinatus.
d. lateral acromion and supraspinatus insertion.

19. Which variable most affected the UCLA shoulder score?
a. Tear size
b. Age
c. Workers' compensation
d. None of the above

20. Removal of bone from the medial olecranon for the treatment of valgus extension overload syndrome:
a. should be abandoned.
b. results in elbow instability.
c. causes no significant increase strain in the ulnar collateral ligament.
d. should only be performed in conjunction with reconstruction of the ulnar collateral ligament.

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. For subscription information, you can reach the editors and customer service personnel for *Sports Medicine Reports* via the internet by sending e-mail to neill.larmore@ahcpub.com. We look forward to hearing from you. ❖

In Future Issues:

Durability of Chondrocyte Autotransplantation