

# SPORTS MEDICINE REPORTS™

*The essential guide to developments in sports medicine and orthopaedics*

American Health Consultants Home Page—<http://www.ahcpub.com>

CME for Physicians—<http://www.cmeweb.com>

## EDITOR

**David R. Diduch, MS, MD**  
Assistant Professor,  
Department of Orthopaedic  
Surgery, University of  
Virginia School of Medicine,  
Charlottesville, VA

## ASSOCIATE EDITORS

**Letha Y. Griffin, MD, PhD**  
Adjunct and Clinical  
Faculty, Department of Kinesiol-  
ogy and Health, Georgia State  
University, Atlanta, GA

**Stephen B. Gunther, MD**  
Assistant Professor of Clinical  
Orthopaedic Surgery, UCSF  
Department of Orthopaedic  
Surgery, San Francisco, CA

**Chris Harner, MD**  
Blue Cross of Western  
Pennsylvania Professor  
Director, Division of  
Sports Medicine  
UPMC Health System  
Center for Sports Medicine  
and Rehabilitation  
Pittsburgh, PA

**Clayton F. Holmes, EdD, PT, ATC**  
Assistant Professor,  
University of Central Arkansas,  
Department of  
Physical Therapy,  
Little Rock, AR

**Mark Miller, MD**  
Clinical Associate Professor  
of Orthopaedic Surgery,  
Southwestern Medical School;  
W.B. Carrell Memorial Clinic,  
Dallas, TX

**David H. Perrin, PhD, ATC**  
Joe Gieck Professor of  
Sports Medicine; Chair,  
Department of Human Services,  
Curry School of Education,  
University of Virginia,  
Charlottesville, VA

**Robert C. Schenck, Jr., MD**  
Deputy Chairman,  
Department of Orthopaedics,  
University of Texas Health  
Science Center,  
San Antonio, TX

**James R. Slauterbeck, MD**  
Associate Professor,  
Department of Orthopedic  
Surgery, Texas Tech University  
Health Sciences Center,  
Lubbock, TX

**James P. Tasto, MD**  
Associate Clinical  
Professor, Orthopaedic Surgery,  
University of  
California—San Diego, CA

## Lower-Extremity Compensations Following Anterior Cruciate Ligament Reconstruction

ABSTRACT & COMMENTARY

**Synopsis:** *The hip and/or ankle can compensate for knee extensor moment deficits during weight-bearing activities in the involved extremity of patients after ACL reconstruction.*

**Source:** Ernst GP, et al. Lower extremity compensations following anterior cruciate ligament reconstruction. *Phys Ther* 2000;80:251-260.

Weight-bearing tests such as the vertical jump are often used to assess overall function of patients following knee injury or surgery. This study evaluated lower-extremity kinetics following autograft bone-patellar tendon-bone anterior cruciate ligament (ACL) reconstruction in 20 subjects an average of 9.8 months postreconstruction, and 20 comparison subjects matched by sex, age, weight, and activity level (using the Tegner and Lysholm activity scales). Knee laxity was assessed with a KT1000, and any subjects with an involved-uninvolved side difference greater than 4 mm were excluded to avoid the potential confounding effects of knee instability. The ACL reconstruction subjects followed similar rehabilitation protocols that included both weight-bearing and non-weight-bearing exercises. A Vicon Motion Analysis System was used to determine the knee extensor moment and summated extensor moment (hip + knee + ankle extensor moments) for the lower extremity during a single leg vertical jump (take-off and landing) and lateral step-up exercise on an 18-cm-high step. Performance was measured on both the involved and uninvolved sides in the ACL reconstruction group, and both matched extremities in the comparison group.

For the knee extensor moments, the findings indicated the difference between the involved and uninvolved extremities for each of the three activities was different for the experimental and comparison groups. The knee extension moment of the involved side in the ACL reconstruction group was less than the uninvolved side, and of

## INSIDE

*Beware of the  
bone bruise*  
**page 58**

*Pain manage-  
ment after  
shoulder  
surgery*  
**page 59**

*ACL recon-  
struction in  
the skeletally  
immature  
athlete*  
**page 60**

*Foot  
pronation  
and lower  
extremity  
injury*  
**page 61**

*MRI evalua-  
tion of grade  
III injury to  
posterolateral  
corner of the  
knee*  
**page 62**

Volume 2 • Number 8 • August 2000 • Pages 57-64

NOW AVAILABLE ONLINE!  
Go to [www.ahcpub.com/online.html](http://www.ahcpub.com/online.html) for access.

the matched extremity for the comparison group. There was no difference between the uninvolved extremity of the ACL reconstruction subjects and the matched extremity of the comparison subjects, and no differences between extremities of the comparison group.

For the summated extensor moments, the involved lower extremity of the ACL reconstruction group was less than the uninvolved side and the matched side of the comparison group only for vertical jump landing. No other differences were found for the summated extensor moments between groups or extremities.

#### ■ COMMENT BY DAVID H. PERRIN, PhD, ATC

Rehabilitation following ACL reconstruction should include both weight-bearing (closed-chain) and non-weight-bearing (open-chain) exercises. Some clinicians have moved to almost exclusive use of closed-chain exercise for rehabilitation of ACL reconstruction patients, and many clinicians use weight-bearing performance tests to assess functional outcome. This study found that the hip and ankle extensors are capable of compensating for a knee extensor moment deficit in the involved extremity of ACL reconstruction patients. The implications of these findings are twofold as they relate to rehabilitation and functional assessment.

The subjects in this study participated in rehabilitation programs that incorporated both closed- and open-chain exercise, and still displayed knee extensor moment deficits at an average of 9.8 months postsurgery. One would expect rehabilitation protocols that use exclusively closed-chain exercise would result in knee extensor strength deficits of an even greater magnitude than found for subjects in this study. These findings would seem to support the importance of both closed- and open-chain exercise for rehabilitation of ACL reconstruction patients. Given the compensation found in this study, it is likely the only way to isolate the quadriceps muscle group for strengthening is with open-chain knee extension exercise.

This study also illustrates that normal function on closed-chain exercises such as the vertical jump (take-off) and step-up maneuver don't necessarily indicate a normal knee extensor mechanism. While weight-bearing performance is certainly an important component of overall lower extremity functional assessment, clinicians should not overlook non-weight-bearing isolated strength assessment of the knee extensor mechanism during and following rehabilitation of ACL reconstructed patients.

This study reinforces the need for both open- and closed-chain exercise and assessment following ACL reconstruction. Ernst and colleagues correctly identify the need for additional research to determine how long these deficits remain, the implication of the deficits on performance and reinjury, and the need for studies to determine the best rehabilitation program to restore the entire lower extremity to preinjury levels of strength and performance. ❖

**Sports Medicine Reports**,<sup>SM</sup> ISSN 1524-0991, is published monthly by American Health Consultants, 3525 Piedmont Rd., NE, Bldg. 6, Suite 400, Atlanta, GA 30305.  
**VICE PRESIDENT/GROUP PUBLISHER:**  
Donald R. Johnston.  
**EDITORIAL GROUP HEAD:** Glen Harris.  
**ASSOCIATE MANAGING EDITOR:** Robin Mason.  
**ASSISTANT MANAGING EDITOR:** Neill Larmore.  
**COPY EDITOR:** Michelle Moran.  
**MARKETING PRODUCT MANAGER:**  
Schandale Kornegay.  
**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.

Copyright © 2000 by American Health Consultants. All rights reserved. No part of this newsletter may be reproduced in any form or incorporated into any information-retrieval system without the written permission of the copyright owner.

**Back issues:** \$33. Missing issues will be fulfilled by Customer Service free of charge when contacted within one month of the missing issue's date.

This is an educational publication designed to present scientific information and opinion to health professionals, to stimulate thought, and further investigation. It does not provide advice regarding medical diagnosis or treatment for any individual case. It is not intended for use by the layman.

#### Subscriber Information

Customer Service: 1-800-688-2421.

**Customer Service E-Mail Address:**

customerservice@ahcpub.com

**Editorial E-Mail Address:** michelle.moran@ahcpub.com

**World-Wide Web:** <http://www.ahcpub.com>

#### Subscription Prices

##### United States

\$199 per year (Student/Resident rate: \$100).

##### Multiple Copies

1-9 additional copies: \$179 each. 10-20 copies: \$159 each.

##### Canada

Add GST and \$30 shipping.

##### Eisewhere

Add \$30 shipping.

#### Accreditation

American Health Consultants (AHC) designates this continuing medical education (CME) activity for up to 20 hours of category 1 credit toward the AMA Physician's Recognition Award.

Each physician should claim only those hours of credit that he/she actually spent in the educational activity.

This CME activity was planned and produced in accordance with the ACCME Essentials.

AHC is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education for physicians.

*Sports Medicine Reports* is also approved by the American College of Emergency Physicians for 20 hours of ACEP Category 1 Credit.

**For CME credit, add \$50.**

#### Questions & Comments

Please call **Robin Mason**, Associate Managing Editor, at (404) 262-5517; or e-mail: [robin.mason@ahcpub.com](mailto:robin.mason@ahcpub.com) or **Michelle Moran**, Copy Editor, at (404) 262-5589; or e-mail: [michelle.moran@ahcpub.com](mailto:michelle.moran@ahcpub.com) between 8:30 a.m. and 4:30 p.m. ET, Monday-Friday.

## Beware of the Bone Bruise

ABSTRACT & COMMENTARY

**Synopsis:** *Patients with a geographic bone bruise in association with an ACL rupture have larger effusions and require a longer time to obtain normal knee range of motion and gait pattern after an ACL tear when compared to patients who sustain an ACL rupture without a bone bruise.*

**Source:** Johnson DL, et al. The effect of a geographic lateral bone bruise on knee inflammation after acute anterior cruciate ligament rupture. *Am J Sports Med* 2000;28:152-155.

This is a prospective study of patients with acute anterior cruciate ligament (ACL) ruptures that compares those with and without a geographic bone bruise. The exclusion criteria eliminated all patients with multiple

#### Statement of Financial Disclosure

In order to reveal any potential bias in this publication, and in accordance with Accreditation Council for Continuing Medical Education guidelines, we disclose that Dr. Griffin, Dr. Gunther, Dr. Holmes, Dr. Miller, Dr. Perrin, and Dr. Stauterbeck report no consultant, stockholder, speaker's bureau, research, or other financial relationships with companies having ties to this field of study. Dr. Tasto is on the surgical advisory boards at Arthrocare and OBL and receives royalties from DonJoy.

ligament injuries and/or a reticular or linear bone bruise pattern on magnetic resonance imaging (MRI).

The bone bruise group comprised 20 patients (7 men, 13 women) with an average age of 18 years. Six injuries were contact related and 14 were noncontact. The group without a bone bruise comprised 20 patients, with an average age of 19. The mechanism of injury was contact in 11 and noncontact in nine. Gender was not specified for this group. At weekly physician and physical therapist visits, the size of effusion, range of motion, ambulation, and knee pain on a visual analogue scale were recorded. Physicians and therapists were not blinded as to patient group.

The results showed that patients with a bone bruise required a longer time for the knee effusion to dissipate, to regain a normal gait, and to equalize knee range of motion. In addition, patients with bone bruises had higher visual analogue pain scores.

#### ■ COMMENT BY JAMES R. SLAUTERBECK, MD

Bone bruises are associated with articular cartilage injury. Unfortunately, many articular cartilage injuries have little ability to recover. Therefore, the bone bruises may have a significantly poor prognostic factor in the early and late outcomes after ACL reconstruction. To date, it is not known what the long-term effect of a bone bruise has on the overall function of the knee.

This study showed that a bone bruise may delay the time needed for a patient to recover after the initial injury. It also implies that one should consider waiting a longer than normal period before surgery is undertaken. In addition, this article cites unpublished data by Garrit demonstrating that patients with bone bruises and ACL ruptures have more pain and complications after ACL reconstructions. Maybe the arthritic changes following ACL reconstruction identified by Daniels represent a subset of patients with more extensive bone bruises.

Although this article recommends waiting 2-4 weeks before ACL reconstruction, this may not be the best recommendation for all patients. It is my opinion and practice to clinically assess the injured knee and to delay surgery until a normal gait, a mild or absent effusion, and a full range of motion are established. Patients who are slow to recover after ACL injury may benefit from a MRI to identify if a bone bruise is present. This may assist the surgeon in predicting the time to perform an ACL reconstruction and may help to predict which patients may be at risk for poorer outcomes. These data help define that all patients with isolated ACL ruptures are not the same and those with bone bruises may require longer time periods before reconstruction. ❖

## Pain Management After Shoulder Surgery

ABSTRACT & COMMENTARY

**Synopsis:** *Pain control pumps have recently been investigated in order to minimize postoperative pain and use of narcotic medications. Early results for outpatient shoulder surgery are promising.*

**Source:** Savoie FH, et al. The pain control infusion pump for postoperative pain control in shoulder surgery. *Arthroscopy* 2000;16:339-342.

Savoie and associates performed a prospective, randomized trial to evaluate the use of an indwelling subacromial catheter for continuous postoperative pain relief. Thirty-one patients were randomly assigned to saline infusions, and 31 patients were randomly assigned to 0.25% bupivacaine infusions. An indwelling infusion catheter was placed in the subacromial space intraoperatively and set to deliver a 2-cc-per-hour infusion for 48 hours postoperatively. Patients were then evaluated for postoperative pain using a visual analog scale, and the use of supplemental medications was monitored as well. There was a statistical difference in postoperative pain ( $P < 0.05$ ) and the use of supplemental narcotic and non-narcotic medications in the group treated with bupivacaine. None of the patients developed any complications from the infusion system, and Savoie et al were able to teach the patients to remove their own catheters. Savoie et al suggest the use of a continuous infusion catheter system for postoperative pain control in the outpatient setting.

#### ■ COMMENT BY STEPHEN B. GUNTHER, MD

This prospective, randomized study concludes that indwelling continuous infusion catheters are an effective means of preventing postoperative pain in outpatient shoulder surgery. The patients were able to manage their own catheters, and there were no complications related to the catheters. Clinical results of the arthroscopic procedures were not included.

Outpatient shoulder surgery has gained popularity as the breadth of arthroscopic procedures has multiplied. The constraints of our medical system have also demanded shorter hospital stays and more outpatient surgery.<sup>1</sup> This study illustrates the importance of the patient in cost-based medicine. Outpatient procedures will remain popular if patients feel that they are well cared for and not caused to suffer unnecessarily. This study proves the efficacy of the analgesic infusion catheter. Although there were no com-

plications related to its use in this patient setting, a larger series would help elucidate whether any complications may occur with its widespread use. A cost analysis would be helpful as well. However, it appears to be a safe and efficacious procedure likely to increase in popularity. ❖

## Reference

1. Mallon WJ, Thomas CW. Patient-controlled lidocaine analgesia for acromioplasty surgery. *J Shoulder Elbow Surg* 2000;9:85-88.

# ACL Reconstruction in the Skeletally Immature Athlete

ABSTRACT & COMMENTARY

**Synopsis:** *The patient, family, and surgeon must balance the risks of further knee injury while delaying reconstruction vs. the risk of growth disturbance with transphyseal techniques vs. possibly inferior stability with physeal sparing or extra-articular techniques.*

**Source:** Barber FA, et al. Anterior cruciate ligament reconstruction in the skeletally immature high-performance athlete: What to do and when to do it? *Arthroscopy* 2000;16:391-394.

This “point-counterpoint” article presents the controversy surrounding reconstructing the anterior cruciate ligament (ACL) in the skeletally and physiologically immature athlete (i.e., those in Tanner stages 1 and 2).

Sanders presents the arguments for delaying an ACL reconstruction in young athletes, stressing the need to use physiologic measures such as the Tanner scale to assess maturity rather than relying on chronologic age. He suggests that if the family of the ACL-injured youth insist on proceeding with an ACL reconstruction, even after the surgeon discusses with them the possibility of growth disturbance, one should consider using an intra-articular physeal sparing technique for ACL reconstruction such as that described by Micheli<sup>1</sup> or Brief.<sup>2</sup> However, his preference is to modify activity and wait for growth to become more complete.

Clark presents the argument that one must initially assess the amount of growth remaining in the injured athlete before selecting treatment options following ACL injury. He does not rely on bone age or Tanner staging, as he states “both systems appear to have a wide variance.” He states that it is only necessary to assess if growth sites (physeal lines) are close to closing, in which case the youth

with an ACL injury can be treated like an adult.

Clark feels that if growth centers are “wide open,” he still prefers reconstruction of the ACL, as he argues that the risk of growth arrest following intra-articular ACL reconstruction is far less than the risk of reinjury secondary to an episode of slipping (27/38 patients in one series developed meniscal tears while “waiting” to become skeletally mature and have their ACL reconstructed).<sup>3</sup> However, in this group of young athletes, Clark discourages the use of bone plugs and screws across the physes. He reminds us that clinical reports and animal studies indicate that physeal closure does not typically result from drilling across the physis or from a soft tissue graft. His preference is to use hamstring autograft through transphyseal bone tunnels with staple fixation on the tibia and cross-pin fixation in the femur placed away from the physes using fluoroscopic control.

## ■ COMMENT BY LETHA Y. GRIFFIN, MD, PhD

As the number of young people participating in fast-moving sports requiring frequent cutting, jumping, and pivoting has increased, the number of ACL injuries in this population has also increased. Sanders and Clark agree that:

- Chronological age does not necessarily correlate with the amount of physeal growth remaining in the extremity.
- It is the amount of growth remaining that is important in selecting treatment for the young athlete with an ACL-deficient knee.
- Patients should be adequately counseled regarding the benefits, risks, and limitations of this procedure.

It is interesting that Clark was only able to locate two cases of ACL growth arrest in the literature. In our own community, I have heard of at least two cases of growth arrest following ACL reconstruction. Hence, it would appear that the occurrence of this complication may be underreported in the literature.

McCarroll et al,<sup>4</sup> in their review of this topic, advise waiting to reconstruct the ACL until the athlete has reached Tanner stage 3 or 4, but also stress that compliance with a restricted activity program during this period is enhanced if the young athlete is given a specific date for reconstruction instead of merely being told that ACL reconstruction will occur when “growth is near completion.”

In summary, children in Tanner stages 4 and 5 (and probably 3 also) can be treated like adults when considering ACL reconstructive procedures. Children in Tanner stages 1 and 2 have much growth remaining and therefore although some orthopedists would advise intra-articular reconstruction in this group of young athletes, others advise activity modification, exercises, and brace

protection until sufficient growth has occurred to safely proceed with intra-articular ACL reconstruction. ❖

## References

1. Micheli LJ, et al. Anterior cruciate reconstruction in patients who are prepubescent. *Clin Orthop* 1999; 364:40-47.
2. Brief LP. Anterior cruciate ligament reconstruction without drill holes. *Arthroscopy* 1991;7:350-357.
3. McCarroll JR, et al. Patellar tendon graft reconstruction for midsubstance anterior cruciate ligament rupture in junior high school athletes. An algorithm for management. *Am J Sports Med* 1994;22:478-484.
4. McCarroll JR, et al. Anterior cruciate ligament injuries in the young athlete with open physes. *Am J Sports Med* 1988;16:44-47.

# Foot Pronation and Lower Extremity Injury in Baseball

ABSTRACT & COMMENTARY

**Synopsis:** *Measures of static forefoot position correlated with dynamic rear foot position inversely; however, there was no association between excessive pronation and lower extremity injuries.*

**Source:** Donatelli R, et al. Relationship between static and dynamic foot postures in professional baseball players. *J Orthop Sports Phys Ther* 1999;29:316-330.

Anecdotal evidence has for years linked severe pronation at the subtalar joint with a variety of lower extremity and low back pathologies. Degree of pronation is often measured relative to the subtalar joint neutral position (STJN), a position at which the foot resides during the midstance phase of gait when the maximal amount of pronation and supination is available to the subtalar joint. Theoretically, this position is the best position for the rear foot and the one used to fabricate orthotics. Similar positions are measured at the forefoot. This study used the STJN and other measures to determine if these static measures are related to abnormal foot position during gait, and if a relationship exists between an abnormal foot position (in this case, pronation) and the incidence of lower extremity overuse injuries.

Seventy-four professional baseball players (51 pitchers, 22 position players, and 1 unspecified) were randomly selected. Players were questioned and a history obtained

regarding the incidence of lower extremity injuries. Five measurements were taken: 1) STJN; 2) forefoot position; 3) passive ankle dorsiflexion; 4) standing tibia-to-floor angle; and 5) standing rear foot angle. The standing STJN was measured by palpation of the navicular and talus. When the talus appeared even, the angle of the lower leg relative to the calcaneus from a posterior approach was measured. The static measures were all performed with a goniometer by one individual with 15 years of experience. In order to determine reliability, every fifth measurement was repeated. In addition, dynamic foot measures were performed with a motion analysis system, also from a posterior angle. These included such variables as pronation at heel strike, maximum pronation during the stance phase, and pronation at toe-off. Data analysis included t-tests and a chi-square statistic to determine associations between forefoot position and rear foot angle at maximum pronation dynamically.

Results indicated that a statistically significant relationship exists between static forefoot position and dynamic rear foot position. Subjects with forefoot varus had greater standing valgus rear foot angles than those with forefoot valgus. In addition, more subjects had rear foot valgus than expected. While there were some differences between pitchers and positional players relative to forefoot and rear foot positions, these conditions were not considered statistically significant. Interestingly, only 43% of the subjects who demonstrated excessive pronation reported a history of lower extremity injury. Thus, no correlation between pronation and lower extremity complaints was found.

## ■ COMMENT BY CLAYTON F. HOLMES, EdD, PT, ATC

Static measures such as STJN have long been in question with regard to their clinical usefulness. Even though we commonly use this particular measure when fabricating orthotics for correction of forefoot or rear foot abnormalities (such as pronation), many have questioned whether this is appropriate and functional. This study is important in that it begins to shed some light on this topic. It is a critical finding of this study to relate static forefoot measures to dynamic rear foot position.

Those of us who care for baseball players frequently use orthotics to address foot position, perhaps because of poor footwear available in this sport. This is certainly a population worth studying since they are susceptible to overuse lower extremity injuries. One should not read too much into the finding that only 43% of the individuals with excessive pronation had a history of lower extremity overuse pathology. This portion of the study was retrospective, with obvious limitations regarding sampling. Perhaps a longitudinal, prospective study may find a rela-

tionship with predictive validity. In summary, while there were limitations in design, this study provides evidence to continue this line of research and indicates that perhaps static measures such as STJN may be more clinically relevant than popular opinion suggests. ❖

## MRI Evaluation of Grade III Injury to Posterolateral Corner of the Knee

ABSTRACT & COMMENTARY

**Synopsis:** *MRI imaging of the knee is accurate in anatomic identification of posterolateral corner injuries.*

**Source:** LaPrade RF, et al. The magnetic resonance imaging appearance of individual structures of the posterolateral knee. A prospective study of normal knees and knees with surgically verified grade III injuries. *Am J Sports Med* 2000; 28:191-199.

Magnetic resonance imaging (mri) scans from seven uninjured and 20 patients with posterolateral corner injuries to the knee were reviewed. The injured knees were prospectively collected over two years. Seven injuries were acute (< 3 weeks from injury) and 13 chronic. A single musculoskeletal radiologist read all MRI scans. All injuries recorded by the radiologist were verified at the time of surgery. The knees were examined with a series of tests specifically for the posterolateral knee, including the posterolateral drawer, dial, varus stress, reverse pivot shift, and external rotation recurvatum tests.

The results identified specific posterolateral structures in all knees with a 90% accuracy (iliotibial band, long and short head of biceps, mid-third lateral capsular ligament, fibular collateral ligament, politeus popliteofibular ligament, lateral gastrocnemius, and fabellofibular ligament). Excellent pictures of injured and normal anatomy were included in the article.

### ■ COMMENT BY JAMES R. SLAUTERBECK, MD

Posterolateral corner knee injuries are difficult to diagnose and to treat. MRI evaluation must be performed precisely and read by an experienced physician. This article emphasizes the need to image the entire fibular head in order to fully evaluate the posterolateral corner. Under the protocol described in the article, MRI accurately diagnosed injury 90% of the time.

So how does this anatomic study help us in our prac-

tice? In my opinion, the role of the MRI is to augment what one can identify on physical exam prior to surgery and to assist with preoperative planning. Many posterolateral corner injuries are associated with other ligament injuries and are often associated with knee dislocations. Following acute injury, it is difficult to perform a complete exam without anesthesia secondary to significant pain or associated injury. The best exam is often performed in the operating room just prior to the surgical reconstruction. MRI evaluation identifies the injured structures and defines which structures need repair. The MRI is a tool that assists the surgeon by defining which tissues need repair, which autograft tissues can be used to reconstruct major ligaments, and what allograft tissue may be needed for reconstructive procedures.

I routinely get an MRI on all multiple-ligament-injured knees to better assess the injuries prior to surgery. The MRI can fully evaluate bone bruises, which may have a role in determining ultimate outcome and may help define the weightbearing status post injury or surgery. Additionally, some patients require nonoperative management for posterolateral knee injury and the MRI can assist the surgeon on how to best brace and weightbear the patient.

This is an excellent anatomic article that defines the important anatomy for the posterolateral corner in injured and noninjured knees. It provides great pictures for comparison. I highly recommend reviewing this article and others by the lead author, LaPrade, when dealing with these difficult injuries. ❖

## Biomechanics of Medial Patellofemoral Ligament (MPFL) Reconstruction for Patellar Instability

ABSTRACT & COMMENTARY

**Synopsis:** *Patellar tracking was restored to normal by reconstructing the MPFL with a gracilis graft in a cadaveric model.*

**Source:** Sandmeier RH, et al. The effect of reconstruction of the medial patellofemoral ligament on patellar tracking. *Am J Sports Med* 2000;28:345-349.

This article evaluates the biomechanical effects of reconstruction of the medial patellofemoral ligament (MPFL) with a free gracilis tendon graft. Six cadav-

eric knees were evaluated with (a) intact medial restraints, (b) following sectioning of the medial restraints, and (c) following reconstruction of the MPFL. Patellar tracking was measured with a position-sensing system with and without lateral forces applied to the patella. With no lateral force applied to the patella, patellar tracking was unaffected by the presence or absence of the medial restraints or by reconstruction of the medial patellofemoral ligament. With a lateral force applied to the patella (as occurs in vivo) patellar tracking was changed significantly by the loss of the medial restraints. Normal patellar tracking was substantially restored by reconstruction of the medial patellofemoral ligament.

#### ■ COMMENT BY MARK MILLER, MD

Although many sports medicine physicians have probably never heard of the MPFL, this article provides an opportunity to review recent literature regarding this important structure. The MPFL was described in detail and was found to be the major medial soft tissue restraint to lateral patellar displacement by Conlan et al in 1993.<sup>1</sup> In a follow-up study at Duke University, 15 of 16 patients with acute patellar dislocations were found to have a torn MPFL upon surgical exploration. Surgical repair in these 15 patients resulted in no episodes of recurrent dislocation.<sup>2</sup> Sallay et al also described the MRI findings of MPFL injury. The concept has been extended by one of the current authors (Burks<sup>3</sup>) and others for reconstruction of this ligament in cases of recurrent dislocation. In my own clinical experience, I have been impressed with the remarkable improvement in patellar tracking (viewed arthroscopically from a far proximal medial portal) following acute MPFL repair. I have also been interested in extending the indications to patients with recurrent dislocations, and we have performed MPFL imbrications in select patients with good initial success.

The present study demonstrates that reconstruction of this ligament (in this case, with a free gracilis tendon graft) can substantially restore normal patellar tracking. This has important implications for patients with recurrent patellar dislocations, and may change the way that we address this difficult problem. Long-term clinical follow-up studies may help us to be more successful in restoring normal patellar tracking in patients with recurrent patellar instability. ❖

#### References

1. Conlan T, et al. Evaluation of the medial soft-tissue restraints of the extensor mechanism of the knee. *J Bone Joint Surg Am* 1993;75:682-693.
2. Sallay PI, et al. Acute dislocation of the patella. A cor-

relative pathoanatomic study. *Am J Sports Med* 1996; 24:52-60.

3. Burks RT, Luker MG. Medial patellofemoral ligament reconstruction. *Tech Orthopaedics* 1997; 12:185-191.

## Is Ultrasound Accurate to Diagnose Shoulder Pathology?

ABSTRACT & COMMENTARY

**Synopsis:** *Ultrasound was 100% sensitive and 96% accurate in diagnosing full-thickness rotator cuff tears, but much less effective at diagnosing partial-thickness cuff tears or ruptures of the biceps tendon.*

**Source:** Teefey SA, et al. Ultrasonography of the rotator cuff. A comparison of ultrasonographic and arthroscopic findings in one hundred consecutive cases. *J Bone Joint Surg Am* 2000;82:498-504.

Teefey and associates performed ultrasonography prior to shoulder arthroscopy in 100 consecutive patients and presented their findings. This was a retrospective study that was developed to determine the performance of high-resolution ultrasonography compared with the arthroscopy examination. The study was specifically designed to detect and characterize rotator cuff tears and biceps tendon pathology. They point out that ultrasonography is popular in a number of centers across the United States but, in general, magnetic resonance imaging (MRI) continues to be the gold standard.

One hundred consecutive shoulders in 98 patients underwent preoperative ultrasonography, and this was followed by an arthroscopic procedure. During the arthroscopic procedure, 65 shoulders were identified to have a full-thickness rotator cuff tear, and 15 with a partial-thickness cuff tear. There was an associated diagnosis of frozen shoulder syndrome in 12, and arthritis of the acromioclavicular (AC) joint in two, a superior labral anteroposterior (SLAP) tear in one, and calcific bursitis in another.

Specific attention was focused on the presence of a full vs. partial rotator cuff tear and the status of the biceps tendon—whether it was ruptured or dislocated. The ultrasonography was capable of identifying the full-thickness rotator cuff tears in all patients, which represented a sensitivity of 100%. The overall accuracy was 96% in light of three false positives, and in 86% of the shoulders, the actu-

al size of the tear was able to be determined. A partial-thickness tear was identified by ultrasound and confirmed at the time of arthroscopy in only 10 of 15 shoulders. In addition, five of six biceps dislocations as well as seven of 11 ruptures of the biceps tendon were identified.

Teefey et al conclude that ultrasonography is highly accurate for identifying full-thickness rotator cuff tears and dislocations of the biceps tendon, but less sensitive for detecting partial-thickness rotator cuff tears and full ruptures of the biceps tendon.

#### ■ COMMENT BY JAMES P. TASTO, MD

This is an important paper in light of the increasing sophistication with ultrasonography and the higher resolutions now available. This is also a paper that has far-reaching socioeconomic effects. Should ultrasonography be able to come up to the level of MRIs, it certainly would provide the sports medicine physician with a more cost-efficient diagnostic tool before embarking upon an arthroscopic or conservative program for the patient. There have been a number of studies that are referenced in this article dating back to the mid-1980s, some of which have shown a high level of sensitivity and specificity. However, only a few have correlated their findings with arthroscopic procedures, and most have focused on rotator cuff tears only. The evaluation of the status of the biceps tendon remains a difficult problem both for the clinician as well as by identification with MRI scans.

On three of the patients, a partial-thickness tear was identified on ultrasonography but the rotator cuff was found to be normal at the time of the arthroscopy. In light of the fact that Teefey et al did not have the ability to section this area, it certainly remains possible that these tendons had intrinsic partial tears that were not visible on either the bursal or the glenohumeral side. Teefey et al did not address the issues of labral disruptions, SLAP tears, and Bankart lesions. These, of course, are important elements in the differential of shoulder pain; however, at this stage, they appear to be more appropriately diagnosed with an intra-articular gadolinium-enhanced MRI. This technique is gaining increased acceptance because of the better resolution of the images and enhanced sensitivity.

When one orders a diagnostic test it is important to try to select the appropriate diagnostic tool while maintaining cost-effectiveness and appropriate use of resources. It remains difficult to find an institution with a skilled ultrasonographer on the radiology staff. This is probably the most limiting factor at this stage preventing the widespread

use of this technology. It requires not only a skilled technician to perform the test but also a highly trained radiologist to interpret it.

In the future it would be nice to have portable, high-resolution ultrasonography units available for office use. However, this paper demonstrates that ultrasound is still best used to diagnose full-thickness rotator cuff tears and dislocations of the biceps tendon. Partial-thickness cuff tears, biceps tendon ruptures, and labral pathology are better diagnosed by MR arthrogram or arthroscopy. ❖

#### References

1. Brenneke SL, Morgan CJ. Evaluation of ultrasonography as a diagnostic technique in the assessment of rotator cuff tendon tears. *Am J Sports Med* 1992;20:287-289.
2. Quinn SF, et al. Rotator cuff tendon tears: Evaluation with fat-suppressed MR imaging with arthroscopic correlation in 100 patients. *Radiology* 1995;195:497-500.
3. van Holsbeeck MT, et al. US depiction of partial-thickness tear of the rotator cuff. *Radiology* 1995;197:443-446.

### CME Questions

7. **The study of lower-extremity compensations following ACL reconstruction found each of the following to be present except:**
  - a. knee extension moment of the ACL-reconstructed extremity was lower than the uninjured side.
  - b. knee extension moment of the ACL-reconstructed extremity was lower than the matched extremity in uninjured subjects.
  - c. summated lower-extremity extension moment of the ACL-reconstructed extremity was the same for involved and uninjured sides for experimental and comparison groups for all activities.
  - d. summated lower-extremity extension moment of the ACL-reconstructed extremity was the same for involved and uninjured sides for experimental and comparison groups for the lateral step-up.
8. **MRI evaluation of injuries to the posterolateral corner of the knee has:**
  - a. a high accuracy rate in defining injury.
  - b. a low accuracy rate in defining injury.
  - c. too many false positives to be useful.
  - d. not been compared in injured and uninjured knees; therefore, the accuracy rate cannot be determined.
9. **Indwelling catheter administration of bupivacaine after shoulder arthroscopy showed a statistically significant decrease in:**
  - a. oral narcotic medication use.
  - b. oral non-narcotic medication use.
  - c. postoperative pain.
  - d. All of the above