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Orthopedic Update

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INSIDE THIS ISSUE

Advanced Arthroscopic Techniques Expand Applications

The advantages of arthroscopy's minimally invasive approach are now being offered to more patients suffering from a wider range of hip disorders. This development requires the mastery of advanced arthroscopic techniques to fully leverage the more sensitive and effective instrumentation now available, as well as the enhanced visualization of morphological anomalies (Figure 1).

Elements of Success

Innovative applications are typically seen at high-volume specialty orthopedic centers staffed to accommodate the steep learning curve of advanced arthroscopy. Bruce A. Levy, MD, orthopedic surgeon at Mayo Clinic in Rochester, Minn., says, "Hip arthroscopy can be technically demanding. One key to success is development of a supportive infrastructure of surgical expertise that can rapidly adapt to new arthroscopic applications as the technology becomes available."

His orthopedic surgeon colleague Rafael J. Sierra, MD, adds, "For best outcomes with advanced arthroscopic techniques in the hip, you need to have dedicated orthopedic aftercare and rehabilitation specialists who are integral members of the team." Another orthopedic surgeon on the advanced arthroscopic techniques team, Aaron J. Krych, MD, attributes the expanding applications to improved understanding of the specific pathoanatomy of the hip. When combined with technical advances in surgical instrumentation, this understanding enables more areas in and around the hip to be accessed

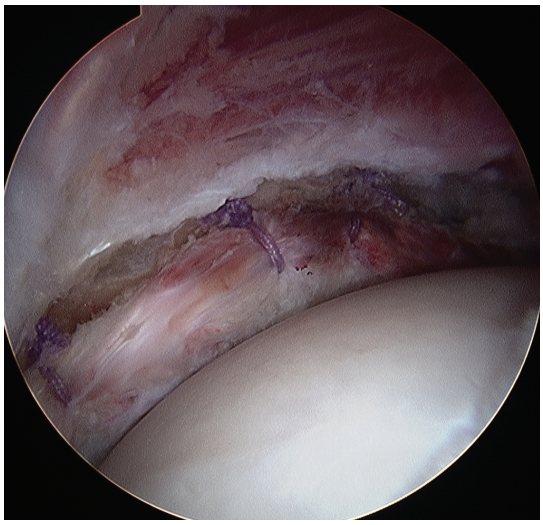

Figure 1. *Arthroscopic image of the suction seal obtained after labral repair and removal of traction from the hip.*

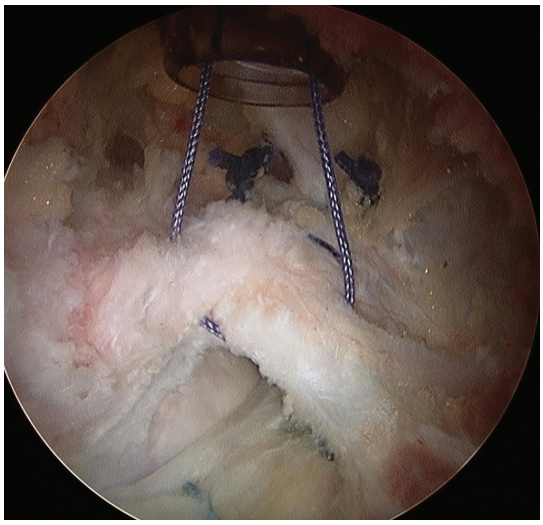

Figure 2. *Capsular repair is being performed with deep blue sutures. Labral repair is viewed below in green-blue sutures.*

Bruce A. Levy, MD

Rafael J. Sierra, MD

Clinical Trials Test Open vs Arthroscopic Management of FAI

To further improve the evidence base of FAI management, Mayo Clinic orthopedic surgeons are developing 2 randomized clinical trials. One evaluates open surgery vs arthroscopic management of FAI, and the other addresses perioperative pain management with nerve blocks vs absence of nerve blocks.

Mayo Clinic orthopedists also are expanding the Young Hip Clinic (http://www.mayoclinic.org/young-hip-clinic/) they began 3 years ago to provide the most current care to young adults with disabling hip pain. Both open and arthroscopic hip surgeons participate in surgical consultations to assure that each patient receives individual and optimal treatment based on unique needs.

Aaron J. Krych, MD

arthroscopically. One such area is the peritrochanteric space, the area outside the hip joint where the powerful abductor muscles are located, including the gluteus medius and minimus and the associated trochanteric bursa.

Gluteus Medius Repair

The gluteus medius is the main abductor muscle in the hip that allows a person to walk with a level pelvis. Some patients with lateral hip pain and weakness may have a gluteus medius tear. "This tendon can be accessed arthroscopically in the peritrochanteric space of the hip and can be thought of as very similar to the 'rotator cuff of the hip,' " Dr Krych says.

Internal Snapping Hip Syndrome

In patients with internal snapping hip syndrome, a painful sensation is caused by slippage of the iliopsoas tendon as it crosses the anterior femoral head or the iliopectineal eminence. It typically occurs as the hip comes from the flexed, abducted, externally rotated position toward extension. Pain emanates from the groin and can be confused with hip joint pathology.

With advanced arthroscopic techniques, the surgeon can pass through the central compartment of the hip during arthroscopy, making a small window in the capsule to locate the tendon and release it. Dr Levy notes, "At this level it's approximately 50% muscle and 50% tendon, so it's more like a fractional lengthening of the muscle as opposed to a complete detachment."

Treatment of the Capsule

Among the most recent advances in arthroscopic hip surgery is the treatment of the capsule. In the past, to access the hip joint the surgeon would cut through the capsule and often remove significant amounts of capsule. This may have contributed to instability of the hip in the form of microinstabilities (Figure 2).

Now, with newer techniques and instrumentation, arthroscopic surgeons usually can restore the anatomy by closing the capsule that has been cut. This minimizes the amount of capsule resected and helps stabilize the hip.

Femoroacetabular Impingement

Since 2003 it has been recognized that there is a pathological relationship between femoroacetabular impingement (FAI) and the development of early osteoarthritis of the hip joint in young adults.

This patient group has an underlying structural deformity in 1 or both of the 2 parts of the hip joint, the femoral head and neck or the acetabulum. These deformities give rise to distinctive types of lesions: Pincer lesions (Figure 3A) amount to an over-coverage of the femoral head. Cam lesions (Figure 3B) are a bony protuberance that forms at the junction of the femoral head and neck.

Patients typically seek medical care due to pain from a labral tear. In the past, all FAI patients

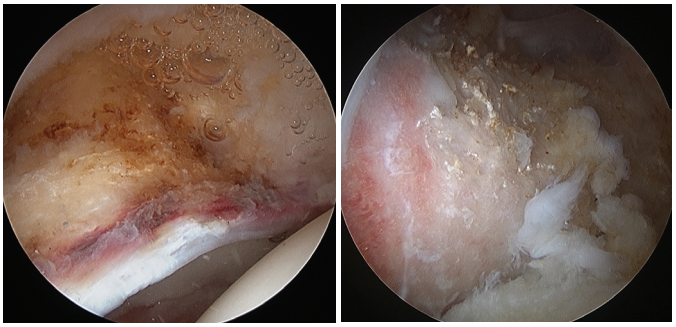

Figure 3A & 3B. *Pre-operative images of (left) pincer rim lesion and (right) cam lesion with cam bump as viewed in the peripheral compartment.*

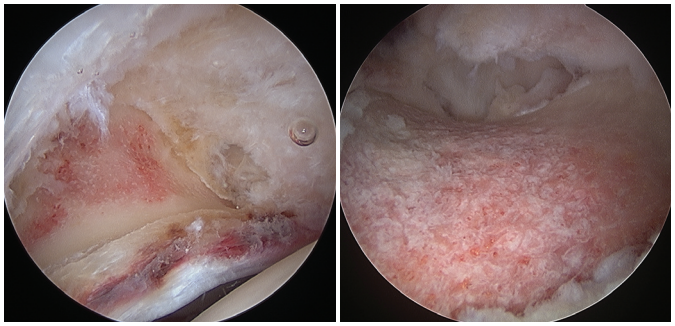

Figure 3C & 3D. *Post-operative images of (left) pincer and (right) cam lesions after arthroscopic resection of both lesions re-established the suction seal.*

were treated with an open surgical hip dislocation to gain access. Labral tears were repaired with sutures and anchors, and the normal geometry of the hip joint and sphericity of the femoral head-neck junction were restored surgically.

These same repairs can now be made in carefully selected patients using advanced arthroscopic technique and improved instrumentation (Figures 3C, 3D). "Our experience and reports in the literature show that, due to its minimally invasive nature, arthroscopic FAI patients tend to have less morbidity, significantly less pain and less challenging rehabilitation," Dr Sierra says.

Shoulder Pain: Raising the Level of Diagnostic Certainty About SLAP Lesions

Many shoulder-pain patients present with symptoms suggestive of a SLAP (superior labrum anterior and posterior) lesion. These include pain with specific shoulder positions, pain during overhead activities such as tennis or throwing sports, or impaired shoulder strength. A range of patients with varying ages and activity profiles can experience these symptoms. As a result of the clinical frequency of SLAP-like symptoms, approaches to SLAP lesion managment currently generate much discussion, including the possibility of surgical overtreatment.

The rise of magnetic resonance imaging (MRI) with gadolinium dye helped bring more attention to SLAP lesions. (Figure 1). These advances made it possible to visualize SLAP lesions pre-operatively.

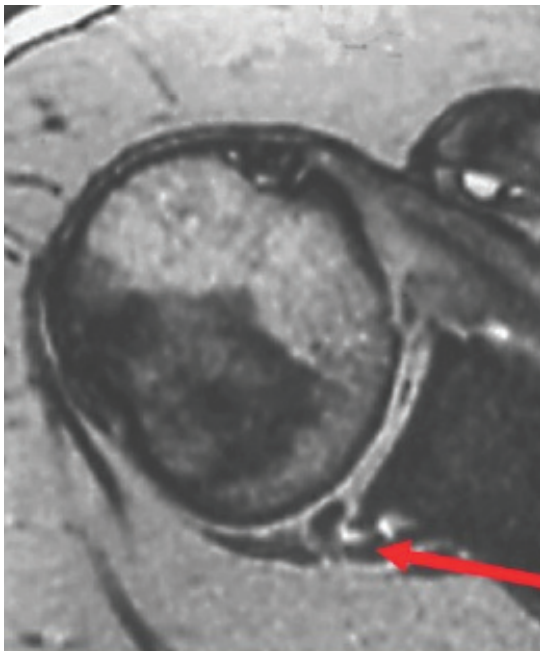

Figure 1. *Magnetic resonance imaging (MRI) with gadolinium contrast dye reveals a SLAP tear. However, clinical evaluation is critical to confirm the diagnosis as a cause of pain.*

Identifying Causal Factors

To minimize the risk of overtreatment, renewed effort should be directed toward meticulous execution of the initial clinical exam and correct diagnosis, according to Mayo Clinic Orthopedic Surgeon Shawn W. O'Driscoll, MD, PhD. "The

Shawn W. O'Driscoll, MD, PhD

Steven J. Hattrup, MD

greatest need right now in the treatment of SLAP lesions is to raise the level of diagnostic certainty that a SLAP lesion is responsible for patients' symptoms, or the substantial contributing factor, and not just a coincidental finding," Dr O'Driscoll says. Adds his Mayo colleague, Steven J. Hattrup, MD, orthopedic surgeon: "The challenge rests on distinguishing a painful SLAP lesion from an anatomic variation. Degenerative lesions and age-related wear, along with fraying or splitting of the labrum, have to be ruled out. They are not the source of the pain—and therefore likely will not benefit from a repair."

Dr O'Driscoll frames the diagnostic challenge this way: "The basic question we address in our research on improving diagnosis is: How do you determine a SLAP lesion is causing pain, and how do you know a patient with pain has a SLAP lesion?"

SLAP Lesion Mimics

As imaging continues to improve and more people undergo MRI studies, physicians are finding that a significant percentage of people within the general population have labral changes that do not cause symptoms or need repair. In particular, there are age-related changes that can cause degenerative splits and tears in the labrum. While they may not be symptomatic, visually they can mimic a SLAP lesion. When these appear in MRI studies, misleading assumptions may be made between the images and the patient symptoms.

"Key clinical skills that a practicing orthopedic surgeon needs are familiarity assessing a patient with shoulder pain and a means for determining the presence or absence of a causal relationship among anatomic pathology, symptoms and functional impairment," explains Dr O'Driscoll. Complicating the task of making the correct SLAP lesion diagnosis is the fact that SLAP lesions can occur as part of other pathologies, such as partial thickness rotator cuff tears, or biceps tears.

Dynamic Labral Shear Test

To raise the level of diagnostic certainty when a SLAP lesion is suspected, Dr O'Driscoll has developed a clinical maneuver, the dynamic labral shear test (DLST). The DLST reproduces the shearing mechanism that can cause a SLAP tear. Easy to perform in the exam room, the DLST yields reliable results that isolate a SLAP lesion's causal role in symptoms and impaired function (Figure 2). Interpreting the results requires skill and experience with the maneuver and its physiologic effects (Table).

In a preliminary report to the American Academy of Orthopaedic Surgeons (AAOS) in 2007, Dr O'Driscoll's team reviewed 105 shoulders comparing DLST, magnetic resonance imaging (MRI), and arthroscopy to diagnose SLAP lesions. The Mayo Clinic team found sensitivity for diagnosing a type II SLAP lesion by DLST was 0.86 (95% confidence interval, 0.75-0.93). This level was as good as MRI with gadolinium, and

Interpreting the Dynamic Labral Shear Test for SLAP Lesions

The dynamic labral shear test helps the clinician diagnose SLAP lesions by establishing during clinical exam a causal connection between the patient's shoulder symptoms and labral injury. Note that the test needs to be performed gently to avoid hurting a patient suspected of having a SLAP lesion.

Test results are positive for SLAP lesion if:	Test results are negative if:
• The patient's pain deep within the shoulder or at the posterior glenohumeral joint is reproduced by DLST through an arc from approximately 90 degrees to 120 degrees.	• Test is not painful in the 90 degree to 120 degree range OR • It does NOT reproduce the patient's pain deep in the shoulder or at the posterior glenohumeral joint.

Note: If a false-negative test is suspected in the clinical setting of a suspected subtle posterior superior labral tear, the examiner should repeat the test while applying a slight force on the elbow to enhance the horizontal abduction and external rotation beyond those accomplished with gravity alone.

Figure 2A. *Dr O'Driscoll has developed a clinical maneuver, the dynamic labral shear test (DLST), to diagnose a SLAP lesion. Perform the DLST with the patient supine with the affected arm off the side of the examining table. The shoulder is close to the edge of the bed so that the examining table mattress supports the scapula but the humerus is free.*

Figure 2B & 2C. ***B.*** *For the right shoulder, with the arm at the side, the examiner flexes the right elbow 90° and grasps the olecranon and distal humerus with his or her left hand. This hand is used to (1) maintain 90° of elbow flexion, (2) passively rotate the shoulder externally to its natural limit with the force of gravity alone pulling down on the forearm, (3) drop the elbow back into its natural limit of horizontal abduction (toward the floor), and (4) passively elevate the shoulder while maintaining both the horizontal abduction and the external rotation at their natural limits under gravitational force alone. During elevation of the shoulder, the magnitude of horizontal abduction will vary and must be permitted to do so without constraint. Similarly, the degree of external rotation will also vary throughout the arc of elevation and must be unconstrained. While the shoulder is being elevated in the manner just described, the examiner's right hand is kept on the acromion to stabilize the scapula and to detect any palpable click transmitted through the bony structures. The click will usually be felt by the left hand on the olecranon, as well as the distal humerus.* ***C.*** *After full overhead elevation,the entire motion is reversed and the arm is brought down to the side while the natural limit of shoulder external rotation and horizontal abduction is maintained.*

better than MRI without gadolinium contrast dye. A negative DLST indicates that either there is no SLAP lesion or, if there is, it is asymptomatic.

Comments Dr O'Driscoll: "Since using that test over a number of years it has proved to be more reliable in determining whether the patient's symptoms are caused by SLAP lesions than MRI or arthroscopic findings. It comes back to something we learn in orthopedics very early: Often the clinical assessment of the patient is the most reliable way to determine what is causing the pain. The imaging certainly helps us understand the pathology responsible for the pain, but the clinical exam establishes causality."

Michael J. Stuart, MD

Cedric J. Ortiguera, MD

Anterior Cruciate Ligament Reconstruction Graft Selection

Figure 1A. *Anterior-posterior post-operative image of allograft revision ACL reconstruction.*

Figure 1B. *Lateral post-operative view.*

Graft selection for anterior cruciate ligament (ACL) reconstruction remains controversial, despite studies over the past 10 years indicating roughly equivalent clinical outcomes over both short- and long-term follow-up. However, new data in 2012 suggest that allograft should be avoided in athletic patients under the age of 25 years due to an unacceptably high failure rate in this group.

"ACL graft selection is surgeon-dependent—but outcome goals are consistent: Optimize functional results, minimize morbidity, and decrease the incidence of revision," explains Mayo Clinic orthopedic surgeon Michael J. Stuart, MD (Figures 1A and B).

Adds his colleague, Cedric J. Ortiguera, MD: "There is no perfect graft choice, with advantages and disadvantages to each. Allografts can provide excellent outcomes in the properly chosen patient."

Mayo Clinic published research demonstrates that handling and sterilization of allografts can have a significant impact on performance, emphasizing that knowing the processing and irradiation parameters of the graft supplier are central to successful outcomes.

At Mayo Clinic Department of Orthopedic Surgery, surgeons use the following approach to inform decision-making and obtain best results from an ACL reconstruction.

About ACL

In North America and Europe, surgical reconstruction of a ruptured ACL is one of the most common knee procedures. Tears are usually related to rapid pivots and turning movements common in football, soccer, and basketball. The only study on the prevalence of ACL injuries in the general population has estimated the incidence as 1 case in 3500 people, resulting in 95000 new ACL ruptures per year, although the actual incidence may be higher.

Approximately 60000-75000 ACL reconstructions are performed annually in the United States. Data are limited by the absence of any standard surveillance mechanism for the general population. Registries exist for injuries sustained by US college and high school athletes, but these account for a small

Figures 2A-C. *Common allograft types used in ACL repair*

A. *Achilles tendon*

B. *Hamstring tendon*

C. *Patellar tendon*

percentage of the total number of injuries.

Because the ACL is a central stabilizer of the knee, the objective of surgery is to restore knee integrity so the patient can avoid additional injury and return to sports. The ultimate goal of participation in strenuous activity is dependent on graft selection, the surgical procedure, and postoperative rehabilitation.

Allografts: Risks and Benefits

Over the past decade, use of allografts has risen as processing of grafts has improved its safety profile. Commonly used allografts include the semitendinosus, Achilles, hamstring and patellar tendons (Figures 2A-C). The main disadvantages of allografts relate to increased cost, longer incorporation time, and secondary sterilization with irradiation that alters the biomechanical properties of the graft.

In addition, performance concerns include allograft elongation and rupture. Most recently, a higher failure rate has been reported in young athletes. In a June 2012 study published in the American Journal of Sports Medicine, 120 young, active adults entering the US Military Academy at West Point as cadets were 7.7 times more likely to experience a graft failure with an allograft ACL reconstruction compared to autograft prior to matriculation.

The main advantages of allograft use are lack of donor-site morbidity and suitability for cases requiring multiple ligament reconstruction procedures.

Autografts: Risks and Benefits

Commonly used autografts include patellar, hamstring (semitendinosis and gracilis) and quadriceps tendons (Figures 3A and B). The disadvantages of autografts include increased postoperative pain and potential complications resulting from graft harvest. Recent data also show that quadrupled hamstring tendons less than 8 millimeters in diameter are associated with an increased risk of failure.

The use of autograft eliminates concerns about allograft contamination, disease transmission, and structural compromise from irradiation.

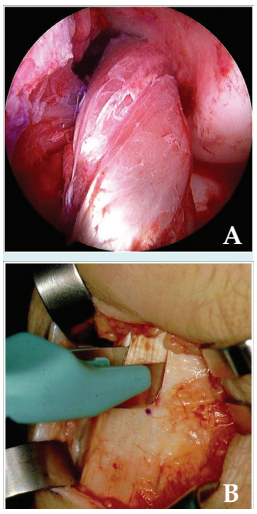

Figure 3. *Common autografts used in ACL repair: A. Hamstring B. Patellar autograft harvest.*

Research Highlight

Improving patient care through scholarship on orthopedic issues has long been a core commitment of Mayo Clinic Department of Orthopedic Surgery. From Jan. 1 to Sept. 30, 2012, orthopedists on Mayo's Minnesota, Florida and Arizona campuses published approximately 222 original articles across all orthopedic subspecialty areas. One highlight appears below.

The Epidemiology of Injury in ATV and Motocross Sports

Medicine and Sport Science - 2012;58:158-172.

A. Noelle Larson, MD, Amy L. McIntosh, MD

Children younger than 16 years old are most prone to injury from motocross and all-terrain vehicle (ATV) use. Moreover, ATV use appears more dangerous than motocross due to a higher mortality rate that disproportionately affects children, according to new research from Mayo Clinic pediatric orthopedic specialists.

The team collected epidemiologic data for their study by reviewing relevant PubMed articles, starting in 1980 (n=22). They also investigated records of the US Consumer Product Safety Commission to determine the prevalence, type, morbidity and mortality associated with off-road motorsport accidents.

Common injuries associated with the use of off-road vehicles predominantly affect the extremities, spinal cord, and head. Head trauma is the most common cause of death associated with motocross and ATV use. While children typically recover more fully from brain trauma due to head injury, similar injuries in adults have resulted in permanent brain damage, paraplegia and tetraplegia.

To improve the safety profile of this increasingly popular pastime—especially for children—the Mayo team suggests developing programs that emphasize safety training, use of protective helmets, and restricting minors' access to ATVs.

Mayo Clinic Orthopedic Update

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CME Opportunities

Transfuse 2013: Transformative Fusion of Innovative Blood Management Technologies

March 13-16
Phoenix, AZ

In this 3-day multidisciplinary conference clinicians from all fields will learn innovative and strategic blood management with the goal of mastering state-of-the-art blood management practice. This is a one-of-a-kind summit designed by leaders in blood management from Mayo Clinic, Hartford Hospital, and Cleveland Clinic. Faculty from all 3 organizations will lead highly targeted, lively, and productive sessions.

To register, contact tracy@matrixmeetings.com or call 507-288-5620.

Shoulder Arthroscopy, Arthroplasty, and Fractures

April 26-27
Rochester, MN

This advanced course is designed for orthopedic surgeons treating disorders of the shoulder. It consists of didactic sessions and laboratory experience using cadaver specimens to probe principles and techniques for management of rotator cuff tears, SLAP lesions, instability, and arthritis. To enhance the learning experience, live video demonstrations and panel discussion are an integral part of the dynamic exchange.

For information, contact cme@mayo.edu or 800-323-2688.

Disorders of the Wrist

May 23-26
Rochester, MN

This is a case-oriented course designed for orthopedic and plastic surgeons with a significant specialty hand practice. It covers the spectrum of disorders of the wrist and distal radioulnar joint, focusing on topics in bony and soft tissue trauma, degenerative disease, and inflammatory arthritis, and others. Mastery of surgical technique is enhanced by the use of videotaped surgery clips and cadaveric surgical dissection. The course will begin with a review of normal wrist anatomy and mechanics, including examination maneuvers, imaging modalities and surgical exposures. The pertinent features of each wrist disorder will then be highlighted, followed by detailed descriptions of treatment techniques and outcomes. Case examples will be presented prior to each didactic session, followed by open discussion. Breakout sessions will provide more in-depth coverage of specific wrist topics and provide updates on advances in arthroscopy and arthroplasty from recognized experts in the field. A strong emphasis will be placed on surgical technique throughout the sessions, and registrants are encouraged to bring their own cases to discuss with the faculty. Special times for these exchanges will be arranged.

For information, contact cme@mayo.edu or 800-323-2688.

To view all Mayo Clinic CME offerings visit www.mayo.edu/cme/

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