Hip Arthroscopy in the Athletic Patient: Current Techniques and Spectrum of Disease

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Hip Arthroscopy in the Athletic Patient: Current Techniques and Spectrum of Disease

By Michael K. Shindle, MD, James E. Voos, MD, Benton E. Heyworth, MD, Douglas N. Mintz, MD, Luis E. Moya, MD, Robert L. Buly, MD, and Bryan T. Kelly, MD

Introduction

Over the last decade, the management of hip injuries has evolved substantially due to the advancement of techniques in arthroscopy and diagnostic tools such as magnetic resonance imaging. Arthroscopy of the hip remains a challenge due to the osseous and soft-tissue constraints of the hip. Currently, various hip lesions, including labral tears, loose bodies, femoroacetabular impingement, coxa saltans (snapping hip syndrome), ligamentum teres injuries, and capsular laxity, can be successfully treated arthroscopically. As continued improvements are made in surgical techniques and in specifically designed instrumentation for the hip, the indications for arthroscopy will continue to increase and arthroscopy of the hip will become a standard procedure performed by an increasing number of orthopaedic surgeons.

Educational Objectives

After reviewing this article, the reader should: (1) have a basic understanding of the intra-articular and extra-articular hip disorders that commonly occur in athletes; (2) be able to generate a differential diagnosis for hip pain; (3) have a basic understanding of the relevant anatomy, patient history, and physical examination findings for an athlete who presents with hip pain; and (4) be able to identify normal and abnormal findings on radiographic and magnetic resonance imaging studies.

History and Physical Examination

The differential diagnosis of hip pain in an athletic patient is quite broad (Table I). A complete history and physical examination are necessary in order to determine the source and cause of the pain. It is still common to ascribe hip pain in an athlete to a muscle strain or a soft-tissue contusion. However, hip pain may arise from a number of soft-tissue structures in and around the hip joint, and it is important to be able to differentiate extra-articular from intra-articular abnormalities. The physician should elicit information from the patient with regard to the specific location of the discomfort, the qualitative nature of the discomfort (such as catching, clicking, instability, stiffness, weakness, or decreased performance), the timing of the onset of symptoms, the precipitating cause of symptoms, and any history suggesting referred or systemic causes of hip pain[1]. Byrd described the "C sign," in which a patient cups his or her hand above the greater trochanter in order to describe deep interior hip pain[2,3]. Back pain must be considered in the differential diagnosis and may exist in combination with a hip disorder.

The key to the physical examination is to narrow down the differential diagnosis to intra-articular pain, extra-articular pain, or central pubic pain, which can be associated with athletic pubalgia (chronic groin pain on exertion). Gait and posture should be assessed. The evaluation of posture and limb position should focus on limb-length inequality, pelvic obliquity, scoliosis, foot-progression angles, and muscle contractures. The examination should begin with palpation of specific regions of the hip to localize tenderness, to identify any areas of gross atrophy, and to delineate the integrity of the muscular structures about the hip[4]. When there is an intra-articular disorder, palpable pain can rarely be elicited. Active and passive range of motion should be evaluated with the patient in the supine position[5] and with the hip flexed, and a complete neurovascular examination should be performed.

Several additional tests can be performed to identify specific hip disorders. Log rolling of the lower limb back and forth is a specific test for intra-articular hip pain[2,3]. The Thomas test is used to evaluate the presence of a hip flexion contracture by eliminating the effects of excessive lumbar lordosis on the perceived extension of the hip[6]. Painful flexion, adduction, and internal rotation of the hip can indicate femoroacetabular impingement or labral tears, especially if groin pain or clicking is present. The FABER (flexion, abduction, and external rotation) test is used to distinguish a sacroiliac problem or

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TABLE I Differential Diagnosis of Hip Pain in an Athletic Patient

- Traumatic Causes
  - Subluxation or dislocation
  - Fracture or stress fracture
  - Hematoma
  - Contusion
- Labral Pathology
  - Femoroacetabular impingement
  - Hypermobility
  - Trauma
  - Dysplasia
- Infectious/Tumorous/Metabolic Conditions
  - Septic arthritis
  - Osteomyelitis
  - Benign neoplasms of bone or soft tissue
  - Malignant neoplasms of bone or soft tissue
  - Metastatic disease of bone
- Inflammatory Conditions
  - Rheumatoid arthritis
  - Reiter syndrome
  - Psoriatic arthritis
- Chondral Pathology
  - Lateral impaction
  - Osteonecrosis
  - Loose bodies
  - Chondral shear injury
  - Osteoarthritis
- Capsule Pathology
  - Laxity
  - Adhesive capsulitis
  - Synovitis or inflammation
- Nonmusculoskeletal Causes
  - Psoas muscle abscess
  - Spine problems
  - Hernia
  - Endometriosis
  - Ovarian cyst
  - Peripheral vascular disease
- Unknown Etiology
  - Transient osteoporosis of the hip
  - Bone marrow edema syndrome
- Synovial Proliferative Disorders
  - Pigmented villonodular synovitis
  - Synovial chondromatosis
  - Chondrocalcinosis
- Metabolic Causes
  - Paget disease
  - Primary hyperparathyroidism
- Extra-Articular Pathology
  - Coxa saltans (internal or external)
  - Psoas impingement
  - Abductor tears (rotator cuff tears of the hip)
  - Athletic pubalgia
  - Trochanteric bursitis
  - Ischial bursitis
  - Osteitis pubis
  - Piriformis syndrome
  - Sacroiliac pathology
  - Tendinitis (hip flexors, abductors, adductors)

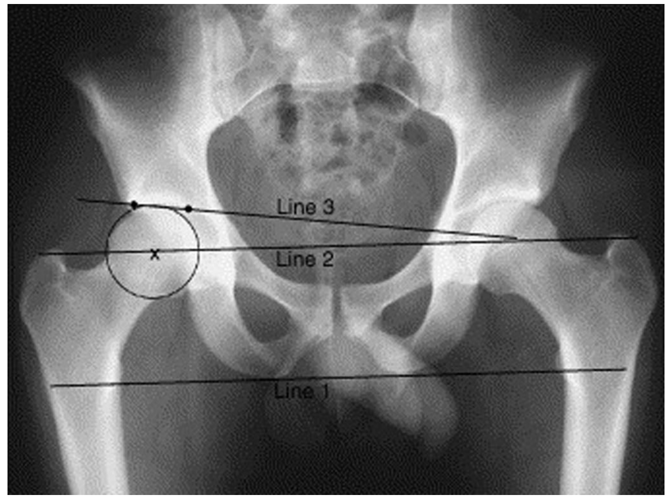

Fig. 1

Anteroposterior radiograph demonstrating the method for measuring the Tönnis angle of the hip. A normal Tönnis angle is <10°. Increased Tönnis angles are associated with lateral subluxation of the hip and increased contact pressures of the femoral head on the anterosuperior weight-bearing zones of the acetabulum. (Reprinted, with permission, from: Shindle MK, Ranawat AS, Kelly BT. Diagnosis and management of traumatic and atraumatic hip instability in the athletic patient. Clin Sports Med. 2006;25:310.)

psoas pain and tightness from hip disorders and is performed by placing the ankle on the affected side across the nonaffected thigh (the figure-of-four position) to create flexion, abduction, and external rotation of the affected hip. The McCarthy hip extension sign will help distinguish if the pain is intra-articular and is performed by placing both hips in flexion; the patient's pain will be reproduced by extending the affected hip first in external rotation and then in internal rotation[7,8]. Several tests have been described to detect piriformis syndrome[9-12]. At our institution, we most commonly place patients in a seated position and have them perform active external rotation of the hip, against resistance, from a position of full passive internal rotation[13]. Patients with dysplasia often have a positive anterior apprehension test (pain with extension and external rotation)[14].

Radiographic Workup

On the basis of the history and physical examination, various categories can be eliminated and the differential diagnosis further narrowed. The conventional radiograph then can provide a great deal of information. In our practice, we routinely make an anteroposterior radiograph of the pelvis, a Dunn lateral radiograph (90° flexion, 20° abduction)[15,16], and a false-profile radiograph[17]. Several radiographic indices have been described to differentiate normal from abnormal osseous anatomy. The anteroposterior radiograph of the pelvis should be carefully examined in order to exclude malalignment, impingement, subtle fractures, or evidence of dysplasia. Osseous landmarks should be identified, including the ilioischial line,

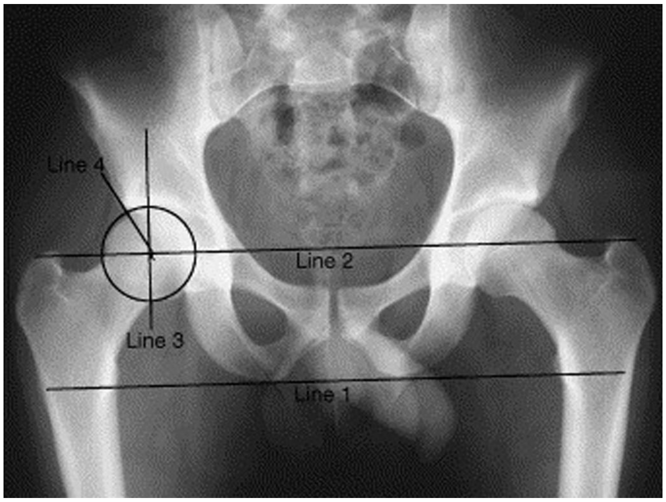

Fig. 2
Anteroposterior radiograph demonstrating the method for measuring the center-edge angle of Wiberg. The center-edge angle is normally >25°, with 20° to 25° being considered borderline. (Reprinted, with permission, from: Shindle MK, Ranawat AS, Kelly BT. Diagnosis and management of traumatic and atraumatic hip instability in the athletic patient. Clin Sports Med. 2006;25:311.)

the iliopectineal line, the anterior acetabular wall, the posterior acetabular wall, the tear drop, and the acetabular roof (sourcil). Careful attention should always be paid to the femoral neck, including its cortical integrity and trabecular pattern, in order to exclude the possibility of a nondisplaced fracture. A Dunn lateral radiograph is useful for identifying a cam lesion associated with femoroacetabular impingement, and a false-profile radiograph is useful in evaluating coverage of the anterior portion of the femoral head. Radiographs should be carefully scrutinized for deviations from normal osseous anatomy, and the joint space should be assessed on all three radiographic views. Radiographic indices should include the femoral neck-shaft angle, the Tönnis angle (Fig. 1)[18,19], the center-edge angle of Wiberg[19,20] (Fig. 2), femoral head-neck offset, and the acetabular version[18,20,21] (Fig. 3). Siebenrock et al. studied the effect of pelvic tilt on acetabular version and demonstrated that radiographic signs of acetabular retroversion, such as the so-called crossover sign and the posterior wall sign, are inaccurate if pelvic inclination is not taken into account[22]. They recommend making anteroposterior radiographs of the pelvis in neutral rotation and in a standardized position of pelvic inclination, which is indicated by the distance between the symphysis and the sacrococcygeal joint (approximately 32 mm in men and 47 mm in women)[22].

Additional Workup

Despite a thorough history and physical examination, it is oftentimes difficult to distinguish extra-articular from intra-articular pain. In nearly all patients with hip pain, a fluoroscopically or ultrasound-guided intra-articular injection of anesthetic medication is invaluable as a tool to determine if the hip pain is due to an intra-articular abnormality of the hip joint. A positive response to an intra-articular injection has been shown to be a 90% reliable indicator of an intra-articular abnormality[23].

For patients who have been diagnosed with symptomatic femoroacetabular impingement, a computed tomography scan with three-dimensional reconstructed images may be acquired preoperatively to better assess the osseous abnormalities and determine how much resection is necessary. In addition, if excessive anteversion or retroversion is suspected, a magnetic resonance imaging or computed tomography study may be acquired to assess femoral version.

Magnetic Resonance Imaging

Traditionally, magnetic resonance imaging of the hip was performed with use of a large-body coil within the magnet bore in order to detect an occult fracture or osteonecrosis, but this method provided very poor in-plane resolution and little or no detail of the labrum or the articular cartilage. More recently, higher spatial resolution has been achieved with use of surface coils. Because hip pain can come from many sources, every magnetic resonance imaging study of the hip that we perform at our institution includes a screening examination of the whole pelvis, acquired with use of coronal inversion recovery and axial proton density sequences. Detailed hip imaging is obtained with use of a surface coil over the hip joint, with high-resolution cartilage-sensitive images acquired in three planes (sagittal, coronal, and oblique axial) with use of a fast-spin-echo pulse sequence and an intermediate echo time. Many authors advocate the use of magnetic


Fig. 3
Anteroposterior radiograph of the pelvis, demonstrating the crossover sign that is indicative of a retroverted acetabulum. In a retroverted acetabulum, the anterior acetabular rim (solid line) crosses over the posterior acetabular rim (dashed line). (Reprinted, with permission, from: Shindle MK, Ranawat AS, Kelly BT. Diagnosis and management of traumatic and atraumatic hip instability in the athletic patient. Clin Sports Med. 2006;25:311.)

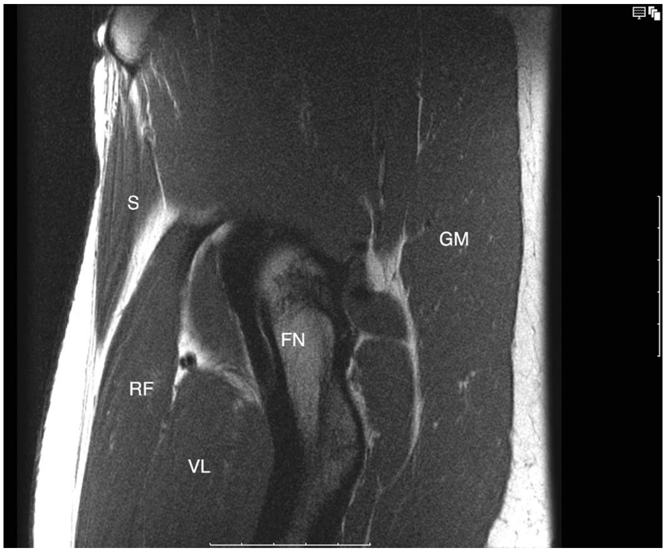

Fig. 4-A

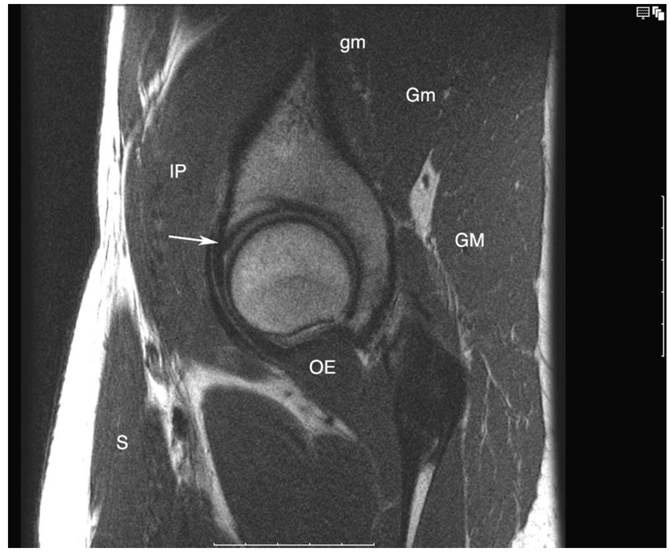

Fig. 4-B

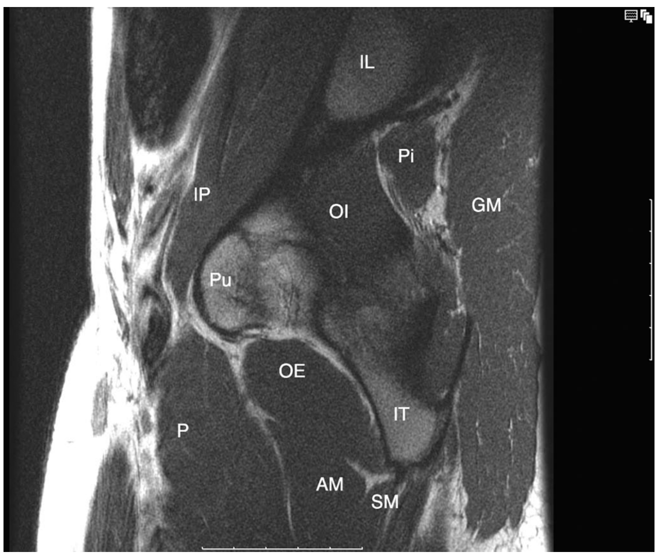

Fig. 4-C

Figs. 4-A, 4-B, and 4-C Sagittal fast-spin-echo magnetic resonance imaging scans, showing the normal anatomy of the hip from lateral (Fig. 4-A) to medial (Fig. 4-C). AM = adductor magnus, FN = femoral neck, GM = gluteus maximus muscle, Gm = gluteus medius muscle, gm = gluteus minimus muscle, IL= iliacus bone, IP = iliopsoas muscle, IT = ischial tuberosity, OI = obturator internus muscle, OE = obturator externus muscle, P = pectineus muscle, Pi = piriformis muscle, Pu = pubis, RF = rectus femoris muscle, S = sartorius muscle, SM = semimembranous muscle, VL = vastus lateralis muscle, arrow = acetabular portion of the labrum.

resonance arthrography of the hip for evaluation of labral pathology and articular cartilage[24-26]. However, this increases the cost and imaging time and also converts magnetic resonance imaging into an invasive procedure[27]. Mintz et al.[28] used an optimized protocol to evaluate ninety-two patients prior to hip arthroscopy and concluded that noncontrast imaging can identify labral and chondral disorders noninvasively. Given the complex three-dimensional geometry of the hip joint, magnetic resonance imaging should utilize all three standardized planes of imaging (coronal, sagittal, and axial). In all three planes, the articular cartilage will appear as an intermediate signal overlying the low-signal cortical bone when fast-spin-echo sequences are obtained.

The sagittal images are best used to evaluate the weight-bearing portion of the femoral head and acetabulum. These images are optimal for the evaluation of the anterior aspect of the labrum (Figs. 4-A, 4-B, and 4-C). The coronal images are best used to evaluate the weight-bearing, suprafoveal margin of the head and dome and to evaluate the superior portion of the labrum. These images also demonstrate the trochanteric bursa and the tendinous insertions of the gluteus medius and minimus and the muscle bellies of the obturator internus, obturator externus, quadratus femoris, and adductors (Figs. 5-A through 5-D). The oblique axial plane is oriented along the long axis of the femoral neck and allows evaluation of the anterolateral portion of the femoral neck. The degree of cam impingement can be quantified by calculating the alpha angle, which measures the loss of offset at the head-neck junction[29] (Figs. 6-A and 6-B). Nötzli et al. evaluated the magnetic resonance imaging scans of thirty-nine patients who had a positive impingement test and groin pain compared with the scans of thirty-five asymptomatic control patients and demonstrated that the average alpha angle was 74° for patients with impingement compared with 42° for control patients[29]. Axial images are most useful to identify the regional neurovascular bundles; specifically, the sciatic nerve and the obturator and femoral neurovascular bundles, where the nerves are seen in cross section and discrete fascicles can be discerned. Axial images are also useful to identify the posterior portion of the labrum, which can be associated with a previous hip subluxation or dislocation (Figs. 7-A through 7-D).

Labral Disorders

As recent literature has emerged to support the association between acetabular labral tears and early onset arthritis of the hip[30,31], interest in arthroscopic management of labral disorders of the hip has expanded. Labral tears and related conditions can arise from a variety of different causes, which are reviewed here.

Traumatic Labral Tears

Classically associated with major trauma to the hip, such as

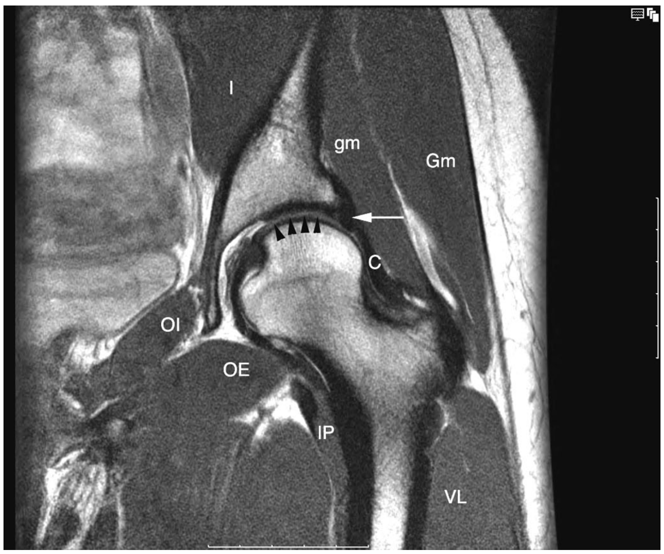

Fig. 5-A

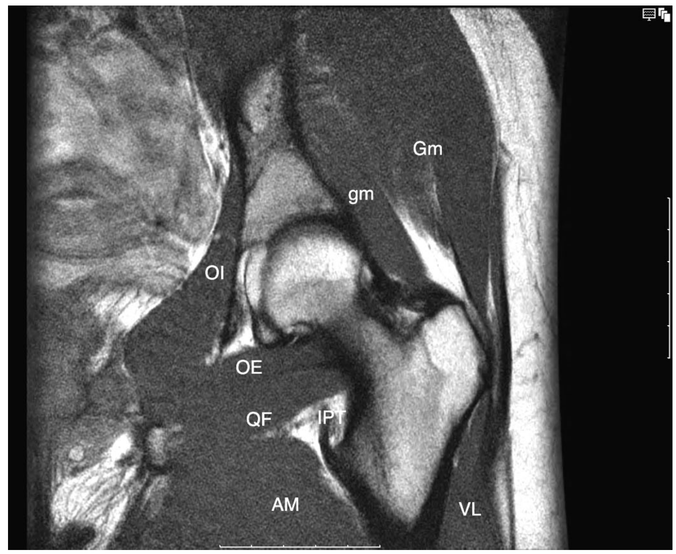

Fig. 5-B

Fig. 5-C

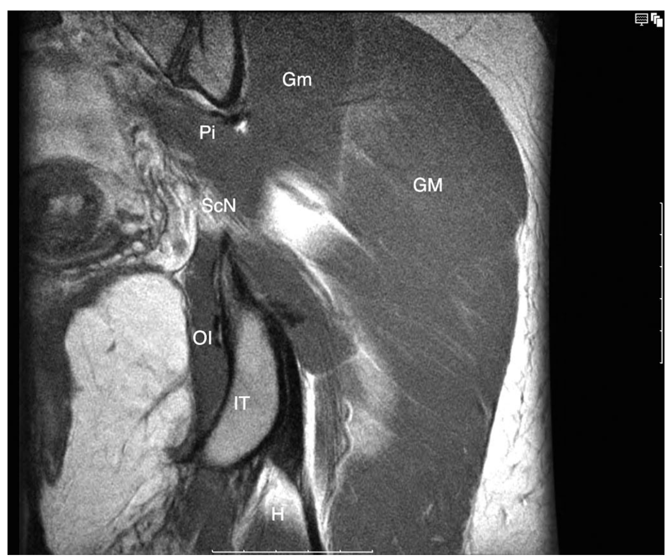

Fig. 5-D

Figs. 5-A through 5-D Coronal fast-spin-echo magnetic resonance imaging scans, showing the normal anatomy of the hip from anterior (Fig. 5-A) to posterior (Fig. 5-D). AM = adductor magnus, C = capsule, GM = gluteus maximus muscle, Gm = gluteus medius muscle, gm = gluteus minimus muscle, GT = greater trochanter, H = hamstring muscles, I = iliacus muscle, IP = iliopsoas muscle, IPT = iliopsoas tendon, IT = ischial tuberosity, OI = obturator internus muscle, OE = obturator externus muscle, Pi = piriformis muscle, QF = quadratus femoris muscle, ScN = sciatic nerve, VL = vastus lateralis muscle, white arrow = acetabular portion of the labrum, black arrowheads = articular cartilage.

posterior dislocation, traumatic labral tears are now also more commonly being diagnosed with magnetic resonance imaging in athletes, who may experience pain or a feeling of catching after a minor twisting or slipping injury (Fig. 8). Alternatively, tears may stem from more chronic repetitive activities and from the lower-extremity stances assumed during sports activity, especially when such activity includes hyperflexion. Although episodes of discrete and major trauma that lead to tears have most often been associated with disorders of the posterior portion of the labrum[32,33], it is the anterior portion of the labrum that has been demonstrated to be more frequently torn in most North American

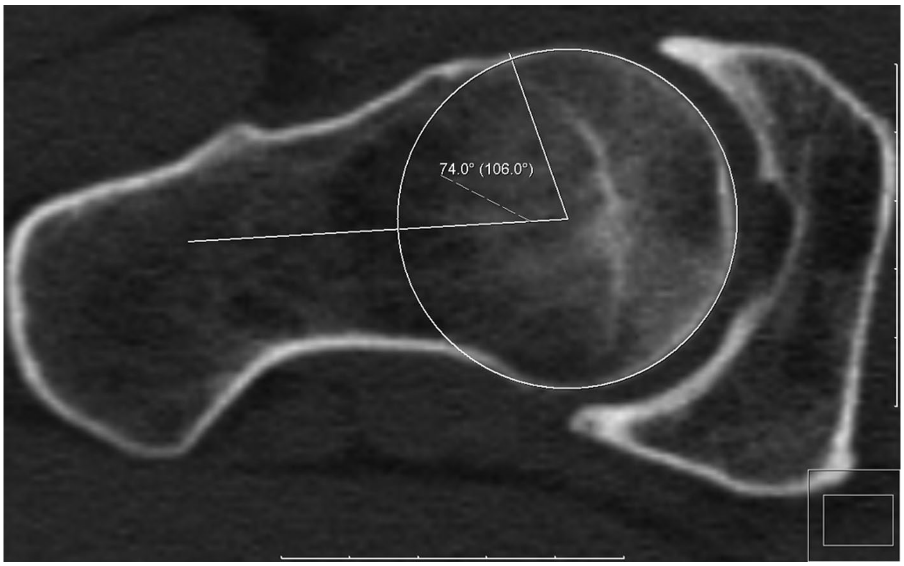

Fig. 6-A

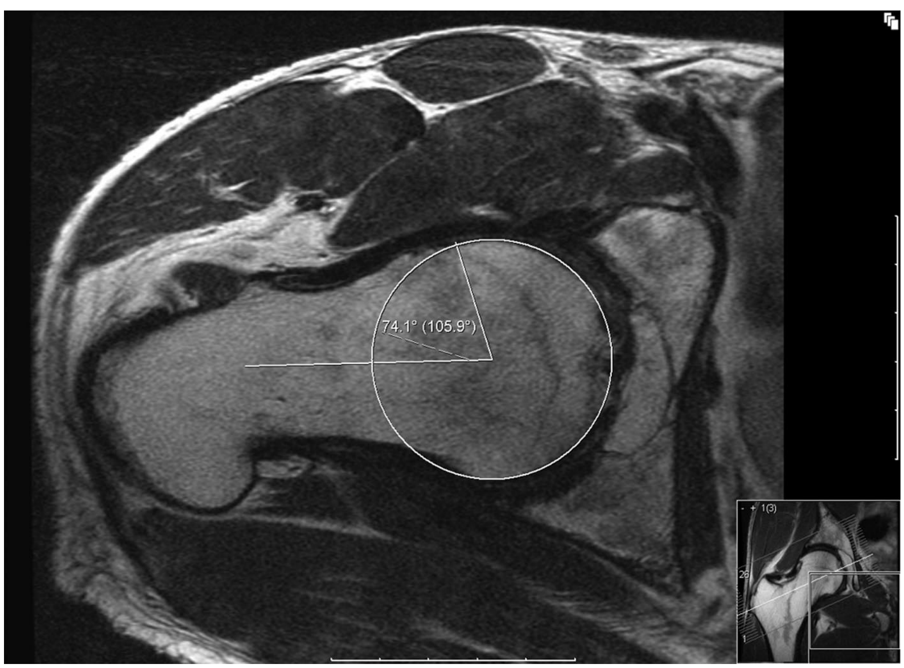

Fig. 6-B

Figs. 6-A and 6-B In a patient with a positive impingement test, decreased internal rotation of the hip, and groin pain, an abnormal alpha angle of 74°, as described by Nötzli et al.[29], is measured on a computed tomography scan (Fig. 6-A) and an axial oblique fast-spin-echo magnetic resonance imaging scan (Fig. 6-B). In the lower right, a coronal view of the hip is shown, demonstrating the axial oblique cut through the femoral neck.

series, which have tended to include large subsets of athletes as patients[28,31].

Femoroacetabular Impingement

Femoroacetabular impingement is a well-described pathologic condition that can lead to osteoarthritis of the hip[34]. The first category of femoroacetabular impingement is the cam-type lesion, which is caused by shear forces of the nonspherical portion of the femoral head against the acetabulum. This results in a characteristic pattern of anterosuperior cartilage loss over the femoral head and corresponding dome, as well as labral tears (Figs. 9-A through 9-D). Predisposing factors that have been associated with femoroacetabular impingement include slipped capital femoral epiphysis, abnormal extension of the femoral head epiphysis, malunion of a femoral neck or head fracture, and femoral retroversion[34-38].

The second category of femoroacetabular impingement is the pincer-type lesion, which is a result of repetitive contact

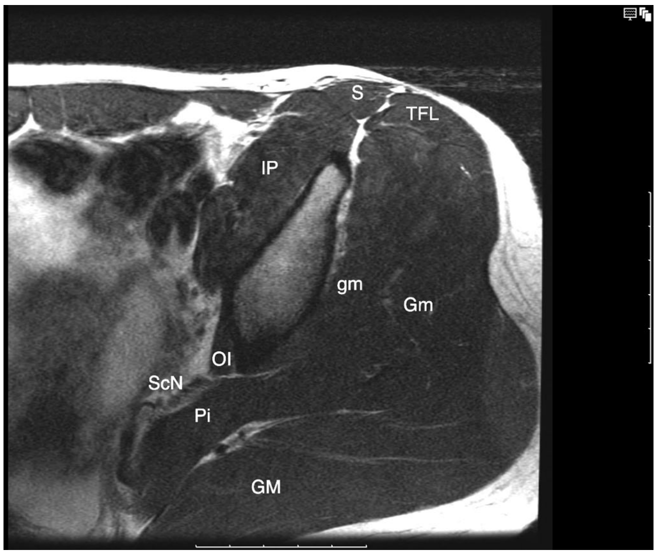

Fig. 7-A

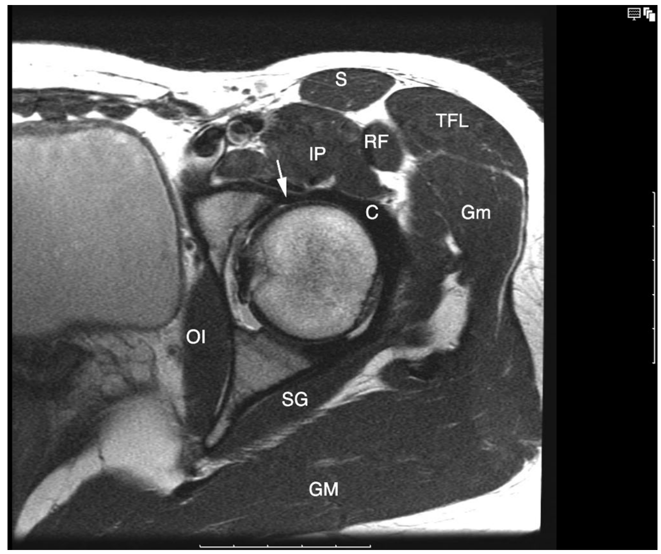

Fig. 7-B

Fig. 7-C

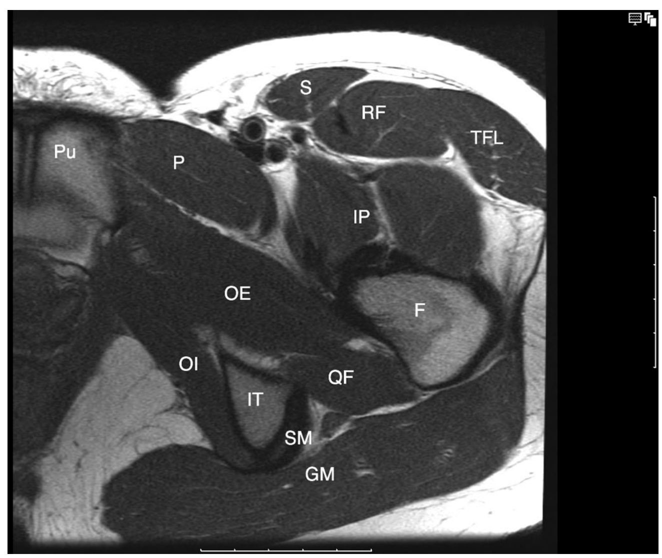

Fig. 7-D

Figs. 7-A through 7-D Axial fast-spin-echo magnetic resonance imaging scans, showing the normal anatomy of the hip from proximal (Fig. 7-A) to distal (Fig. 7-D). C = capsule, F = femur, GM = gluteus maximus muscle, Gm = gluteus medius muscle, gm = gluteus minimus muscle, IFL = iliofemoral ligament, IP = iliopsoas muscle, IG = inferior gemellus muscle, IT = ischial tuberosity, OI = obturator internus muscle, OE = obturator externus muscle, P = pectineus muscle, Pi = piriformis muscle, Pu = pubis, QF = quadratus femoris muscle, RF = rectus femoris muscle, S = sartorius muscle, ScN = sciatic nerve, SM = semimembranosus muscle origin, SG = superior gemellus muscle, TFL = tensor fasciae latae muscle, arrow = acetabular portion of the labrum.

stresses of a normal femoral neck against an abnormal anterior acetabular rim as a result of so-called overcoverage, which results in degeneration, ossification, and tears of the anterosuperior portion of the labrum as well as the characteristic posteroinferior "contre-coup" pattern of cartilage loss from the femoral head and corresponding acetabulum[39]. In this setting, the acetabular labrum fails first, which leads to degeneration and eventual ossification, which worsens the overcoverage. Several conditions may predispose to pincer-type impingement, including acetabular protrusio, acetabular retroversion, malunion of an acetabular fracture, or overcoverage secondary to previous surgery, such as can occur with a periacetabular osteotomy[36]. Overall, the pincer-type lesion has limited chondral damage compared with the deep chondral injury that is associated with cam-type impingement.

Although isolated femoral-side or acetabular-side impingement can occur, the majority of cases of femoroacetabular impingement involve a combination of lesions. Beck et al. analyzed 302 hips and found that only 9% had isolated cam impingement and 5% had isolated pincer impingement[40]. The majority of cases (86%) had a combination of femoral and acetabular lesions.

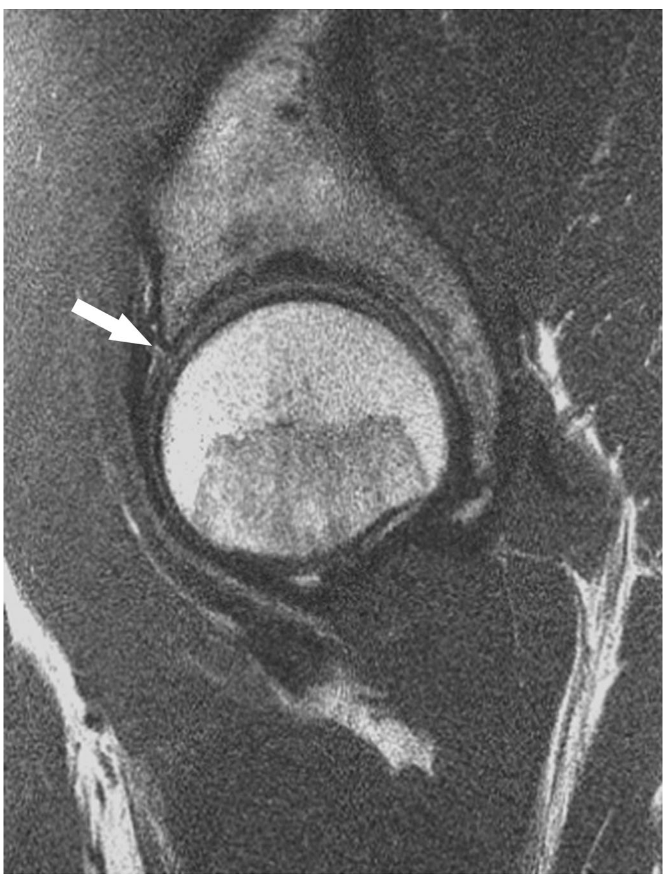

Fig. 8
Sagittal fast-spin-echo (cartilage-sensitive) magnetic resonance image demonstrating an anterior labral tear (arrow) after a posterior subluxation.

Capsular Laxity and Hypermobility of the Hip

Labral tears may also arise in patients who have inherent hypermobility of the hip, which predisposes them to labral microtrauma, degeneration, and possibly separation, over the course of time[41,42]. Capsular laxity may be secondary to an underlying soft-tissue disorder, such as Marfan syndrome or Ehlers-Danlos syndrome, or may represent a physiologic variant in patients with generalized hypermobility. Magnetic resonance imaging can show a redundant capsule; however, optimal surgical treatment strategies for these conditions have not yet been fully elucidated.

Hip Dysplasia

The shallow acetabulum associated with hip dysplasia causes subluxation and abnormal contact stresses of the femoral head on the labrum, which can show varying degrees of degeneration, frank tearing, or detachment. While few arthroscopic options exist to address the osseous pathology inherent in dysplastic hips, arthroscopic débridement of labral tears may provide symptomatic relief[43]. However, the literature is relatively devoid of studies demonstrating such results in this patient population, for whom open acetabular osteotomy remains a reasonable, well-described surgical alternative for selected patients[44,45].

Psoas Impingement

Labral tears typically occur anterosuperiorly in association with femoroacetabular impingement or dysplasia. Less commonly, labral injury may occur in an atypical anterior location in the absence of osseous abnormalities. This pattern of injury is related to compression of the anterior capsulolabral complex by the psoas tendon where it crosses the acetabular rim. This injury may be treated with either labral débridement or repair combined with a partial psoas release at the site of compression.

Degenerative Labral Tears

As osteoarthritis of the hip progresses in severity, the degenerative process may affect the health of the labrum as well as the cartilage. Arthroscopic débridement of osteophytes and a frayed or loose labrum can relieve mechanical symptoms in some patients[46], but research has suggested that even early degenerative joint disease is associated with significantly worse outcomes ($p < 0.0001$) following hip arthroscopy than the outcome seen in patients with nonosteoarthritic hips, and the procedure on such patients should be considered with caution[47].

Hip Instability

Hip instability can be traumatic or atraumatic in origin. Traumatic instability ranges from subluxation to dislocation with or without concomitant injuries and may occur in athletic competition secondary to a forward fall on the knee while the hip is flexed or a blow from behind while the athlete is down on all four limbs[48]. Hip dislocations have been reported in American football, rugby, basketball, soccer, biking, skiing, gymnastics, and jogging[49-51]. Once the diagnosis of a hip

Fig. 9-A

Fig. 9-B

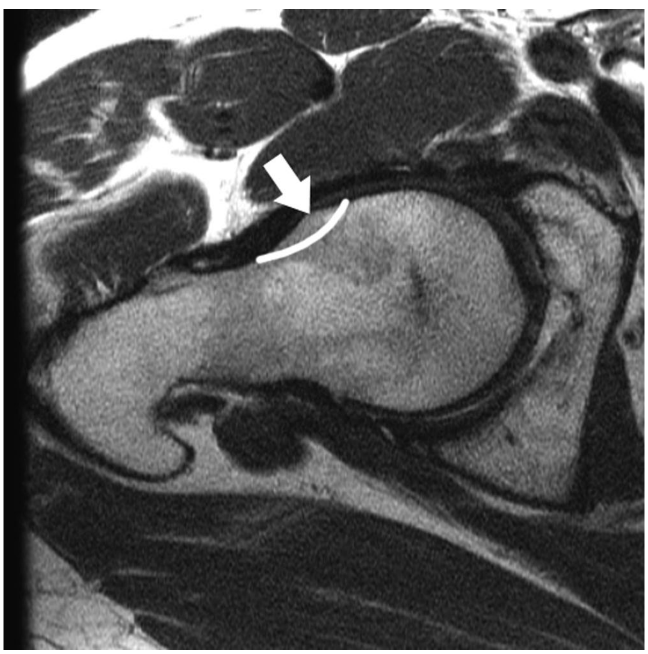

Fig. 9-C

Fig. 9-D

Figs. 9-A through 9-D Fast-spin-echo magnetic resonance images of a forty-one-year-old patient with cam-type femoroacetabular impingement. The coronal image (Fig. 9-A) demonstrates osseous offset at the neck-shaft junction (arrow) and ossification of a torn superior portion of the labrum (arrowhead). Slice prescription (Fig. 9-B) of the oblique axial view (Fig. 9-C) of the right hip accentuates the osseous offset (arrow). The sagittal image (Fig. 9-D) demonstrates full-thickness cartilage loss over the anterior acetabular dome (black arrow), partial-thickness cartilage loss of the femoral head, and an increased signal that could represent either an intralabral ossification or an intralabral cyst (white arrowhead). These images can help in planning the site of bone resection (see curved lines in Figs. 9-A and 9-C). (Figs. 9-A and 9-C reproduced with modification and Figs. 9-B and 9-D reprinted from: Shindle MK, Foo LF, Kelly BT, Khanna AJ, Domb BG, Farber A, Wanich T, Potter HG. Magnetic resonance imaging of cartilage in the athlete: current techniques and spectrum of disease. J Bone Joint Surg Am. 2006;88 [Suppl 4]:36.)

Fig. 10-A

Fig. 10-B

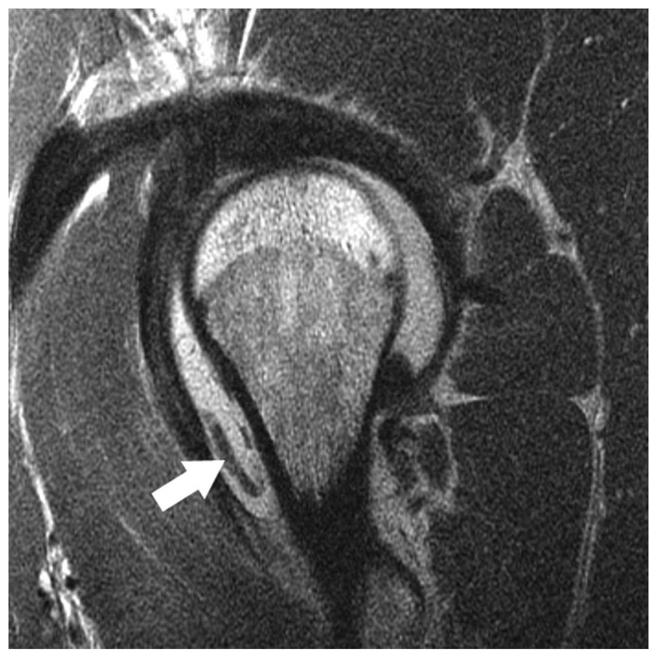

Fig. 10-C

Figs. 10-A, 10-B, and 10-C Axial body coil (Fig. 10-A) as well as sagittal surface coil (Figs. 10-B and 10-C) fast-spin-echo magnetic resonance images of the hip in an eighteen-year-old patient with sequelae of a posterior hip subluxation. An intact posterior hip capsule is seen, attached to a posterior wall fracture (Fig. 10-A, arrowhead). A large full-thickness chondral shear injury (Fig. 10-B, arrow) of the femoral head is well depicted. A cartilaginous loose body (Fig. 10-C, arrow) is seen within a large hemarthrosis within the anteroinferior dependent recess of the hip joint. (Reprinted from: Shindle MK, Foo LF, Kelly BT, Khanna AJ, Domb BG, Farber A, Wanich T, Potter HG. Magnetic resonance imaging of cartilage in the athlete: current techniques and spectrum of disease. J Bone Joint Surg Am. 2006;88 [Suppl 4]:38.)

dislocation is made, a fracture of the femoral neck must be ruled out followed by urgent reduction to minimize long-term complications such as osteonecrosis[52-54]. Due to the relatively low-energy mechanism of injury, most hip dislocations sustained during athletic activities are pure dislocations with either no associated fractures or only small fractures of the acetabular rim. Hip arthroscopy has recently provided a new way to address loose bodies, chondral injuries, and femoral head and labral disorders[55,56].

Traumatic posterior subluxation of the hip is a potentially devastating injury that may be misdiagnosed as a simple hip sprain or strain. The mechanism of injury is similar to a hip dislocation but, due to less energy, the hip subluxates rather than dislocates. The radiographic workup should include oblique radiographs to evaluate for a fracture of the posterior lip. Magnetic resonance imaging has played an important role in the evaluation of traumatic instability. Moorman et al.[57], who performed magnetic resonance imaging on

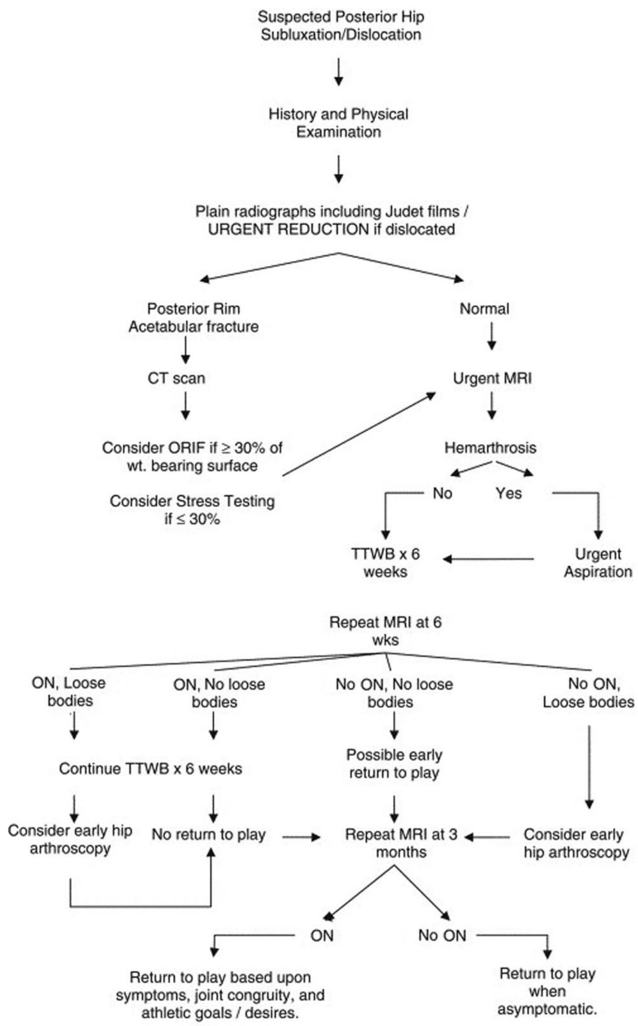

Fig. 11

Treatment algorithm for the management of traumatic dislocation or subluxation of the hip in athletic patients. (Reprinted, with permission, from: Shindle MK, Ranawat AS, Kelly BT. Diagnosis and management of traumatic and atraumatic hip instability in the athletic patient. Clin Sports Med. 2006;25:319.) CT = computed tomography, MRI = magnetic resonance imaging, ON = osteonecrosis, ORIF = open reduction and internal fixation, TTWB = toe-touch weight-bearing.

seven American football players in whom traumatic posterior subluxation of the hip was suspected, defined a characteristic triad of findings that included hemarthrosis, a posterior acetabular lip fracture, and an iliofemoral ligament disruption (Figs. 10-A, 10-B, and 10-C). Aspiration of the hip under fluoroscopy to decrease intracapsular pressure may be warranted. Arthroscopic intervention is useful for the removal of loose bodies and for the treatment of labral pathology and chondral injuries. Magnetic resonance imaging is also useful in detecting osteonecrosis and thus serves as a useful aid in the decision-making process with regard to when or even whether an athlete can return to play. Figure 11 provides a general treatment algorithm for the management of subluxation or dislocation of the hip in athletes[55].

Disorders of the Peritrochanteric Space

Disorders of the lateral or peritrochanteric space, previously grouped into the "greater trochanteric pain syndrome," can now be addressed endoscopically[58-65]. Recalcitrant trochanteric bursitis, external coxa saltans, and gluteus medius or minimus tears are three entities that can be treated effectively with this technique.

Trochanteric Bursitis

Trochanteric bursitis is characterized by chronic aching pain of an intermittent nature over the lateral aspect of the hip. Diagnosis is confirmed by history, physical examination, and the response to injections. Although magnetic resonance imaging is not necessary to make the diagnosis, fluid-sensitive images may reveal increased signal intensity of the trochanteric bursa.

External Snapping Hip (Coxa Saltans)

This condition results when a thickened portion of the posterior margin of the iliotibial band or the anterior gluteus maximus tendon slides over the greater trochanter. With the hip extended, this band lies posterior to the greater trochanter and slides anteriorly over it during hip flexion. Diagnosis is confirmed by history, physical examination, and dynamic ultrasound display of real-time images of the iliotibial band snapping over the greater trochanter.

Tears of the Gluteus Medius or Minimus

Tears of the gluteus medius or minimus tendons share similarities to tears of the rotator cuff tendons in the shoulder. As with rotator cuff tears in the shoulder, it has been hypothesized that gluteal tears are associated with increasing age[66,67]. Physical examination reveals a slight Trendelenburg gait, pain, and weakness with resisted abduction of the hip when compared with the contralateral extremity. The combination of abductor weakness, persistence of symptoms after conservative treatment, and a positive magnetic resonance imaging result that shows increased signal in the tendon confirms the diagnosis of gluteus medius tears.

Arthroscopy of the Peritrochanteric Space

The surgical techniques for hip arthroscopy in the supine and lateral position have been well described[2,68-71]. In this review, we will focus on the arthroscopic anatomy and techniques of the peritrochanteric space. The peritrochanteric space, or lateral compartment of the hip, can be easily entered after routine evaluation and treatment of central and peripheral compartment disorders have been performed.

The same portals used to treat central and peripheral compartment disorders can be used to gain access to the peritrochanteric space. The first portal used is the anterior portal (Fig. 12). It provides the best access into the peritrochanteric space and allows for orientation to the anatomic landmarks.

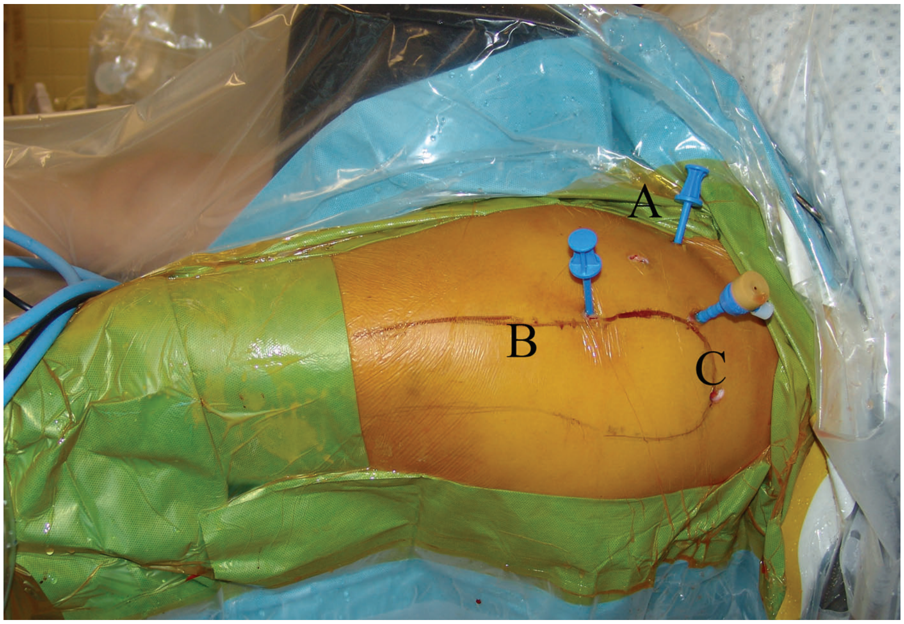

Fig. 12

Intraoperative photograph of a left hip with the portals in place. The anterior portal (A) is placed in the interval between the tensor fasciae latae and the sartorius. The distal posterior portal (B) is placed between the tip of the greater trochanter and the vastus tubercle along the posterior one-third of the greater trochanter. A third portal (C) can be placed proximal to the tip of the greater trochanter in line with the distal posterior portal.

The portal is placed 1 cm lateral to the anterior superior iliac spine within the interval between the tensor fasciae latae and the sartorius. The canula is then swept back and forth between the iliotibial band overlying the trochanteric bursa and the greater trochanter and is freely mobile in this space.

A distal posterior portal is placed between the tip of the greater trochanter and the vastus tubercle along the posterior one-third of the greater trochanter. A third portal can be placed proximal to the tip of the greater trochanter in line with the distal posterior portal. Proper portal placement is critical to visualizing the peritrochanteric space, and the surgeon must first be familiar with the anatomic landmarks of the lateral compartment of the hip.

On entry into the space, the surgeon first must become oriented to the gluteus maximus insertion at the linea aspera and visualize the vastus lateralis (Fig. 13). Inspection proceeds proximally and anteriorly from the vastus lateralis to the gluteus minimus. The fibers of the gluteus medius are found just posterior to the minimus and can be probed to visualize any possible tears at the abductor tendon insertion. Finally, the arthroscope is directed laterally toward the iliotibial band (Fig. 14). In hips with recalcitrant trochanteric bursitis, a shaver can be used to débride the trochanteric bursa alone, which can provide soft-tissue decompression and relieve symptoms.

If snapping of the iliotibial band (external coxa saltans) has been refractory to nonoperative treatment, a release can be performed along the posterolateral portion of the greater trochanter, beginning at the vastus tubercle insertion and extending to the tip of the greater trochanter in a z-type manner (Fig. 15). Variations of this technique may be performed on

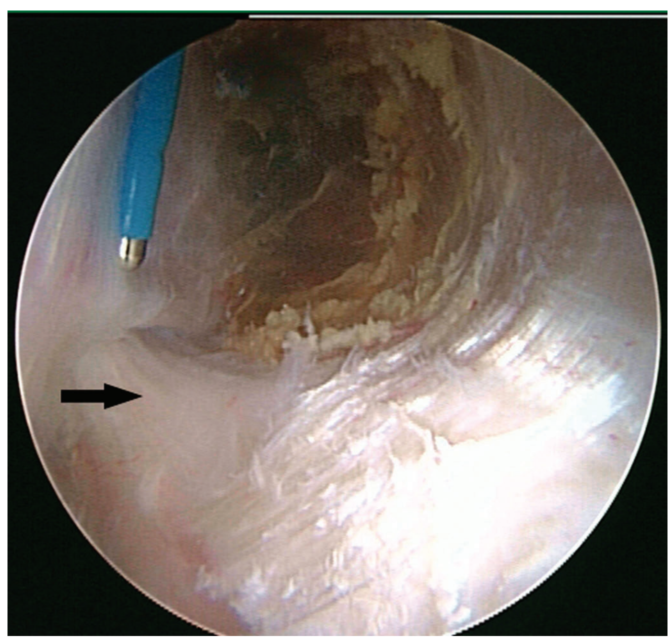

Fig. 13

Arthroscopic image of the insertion of the gluteus maximus tendon (arrow) onto the linea aspera.

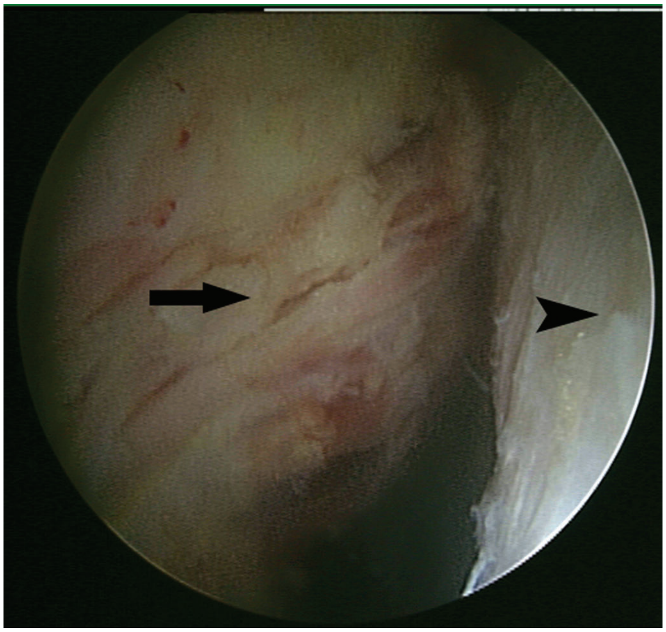

Fig. 14
Arthroscopic image of a left hip, demonstrating the hip abductors (arrow) and the iliotibial band (arrowhead).

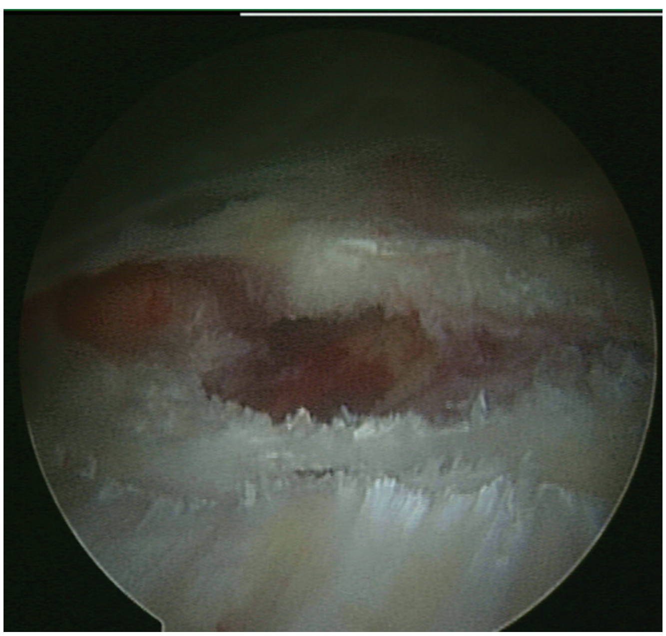

Fig. 15
Arthroscopic image of a left hip after release of the iliotibial band in a z-type manner to treat external coxa saltans.

the basis of instrumented palpation of the fibers under the greatest amount of tension.

The gluteus medius tendon can be examined in a manner similar to the examination of the subacromial space of the rotator cuff in the shoulder (Fig. 16). When a repairable tear is identified, the edges are débrided and the attachment site of the tendon to the greater trochanter is prepared with a full-radius shaver in a manner similar to preparation of the rotator cuff footprint. Suture anchors are placed into the footprint of the abductor in a standard fashion. Fluoroscopy is helpful in directing the anchors in the appropriate direction. Once the anchors are placed, the sutures are retrieved and passed se-

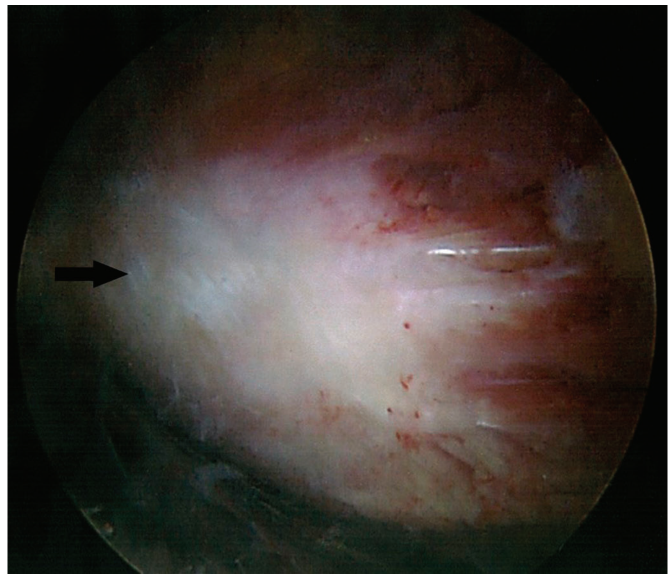

Fig. 16
Arthroscopic image of a left hip, demonstrating the insertion of the gluteus medius onto the greater trochanter (arrow).

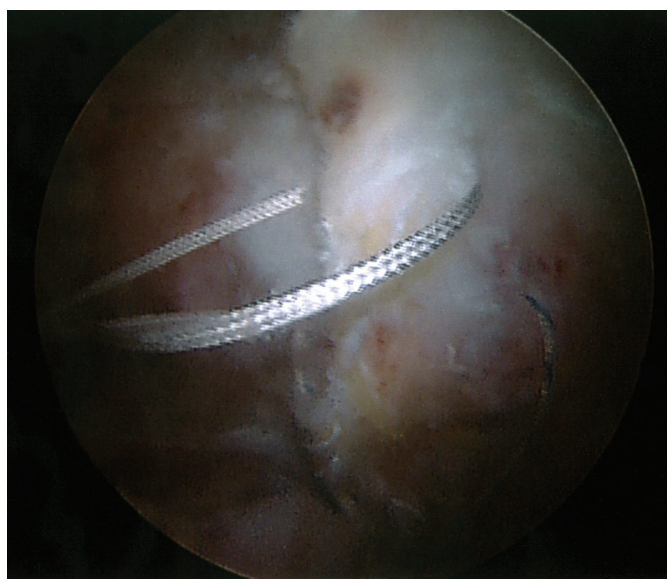

Fig. 17
Arthroscopic image of the gluteus medius and its tendon captured with sutures after they are passed sequentially through the edges of the prepared tendon with a suture-passing device. The sutures are then tied with a knot pusher under arthroscopic visualization.

quentially through the edges of the gluteus medius tendon with a suture-passing device and tied under arthroscopic visualization with an arthroscopic knot pusher (Fig. 17).

Our current experience has been promising with regard to the use of arthroscopic bursectomy in the treatment of recalcitrant trochanteric bursitis, iliotibial band release in the treatment of external coxa saltans, and decompression of the peritrochanteric space and suture-anchor tendon repair to the greater trochanter in the treatment of focal isolated tears of the gluteus medius and minimus tendons. These entities have classically been treated in an open surgical manner. As knowledge of arthroscopic anatomy of the hip, imaging modalities, and clinical examination improves, diseases of the lateral peritrochanteric space of the hip will be more effectively treated.

Discussion

Arthroscopy of the hip is a rapidly evolving field that has shown promising results in the short term. With use of this modality, conditions such as labral tears, loose bodies, femoroacetabular impingement, coxa saltans, ligamentum teres injuries, and capsular laxity have been treated successfully. As the indications for hip arthroscopy continue to increase, further studies are necessary in order to test the long-term effectiveness of these procedures. ■

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