Functional Anatomy and Exam of the Hip, Groin and Thigh

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**GENERAL PRINCIPLES**

**Overview**

The last decade has brought a pronounced increased awareness and understanding of disorders around the hip and pelvis. More accurate diagnoses have led to more specific treatment strategies. Proper management can allow athletes to successfully recover and resume their activities.

**Anatomy**

The constrained bony architecture of the hip provides it with greater stability, but less mobility, than the shoulder (Fig. 48-1).

- Acetabulum
  - The articular surface of the acetabulum is encompassed by the fibrocartilaginous labrum, which is contiguous with the transverse acetabular ligament bridging the fossa inferiorly.
  - Unlike the shoulder, the labrum in the hip is of lesser importance to joint stability.
  - The abduction angle of the acetabulum relative to the horizontal plane averages 35 degrees with 20 degrees of forward flexion.
- Femoral head
  - The neck shaft angle averages 130 degrees and the femoral neck is antverted 14 degrees relative to the bicondylar axis at the knee.

**Arteries of the femoral neck.** The femoral head receives arterial blood flow from an anastomosis of three sets of arteries: (1) the retinacular vessels, primarily from the medial circumflex femoral artery and, to a lesser extent, the lateral circumflex femoral artery; (2) terminal branches of the medullary artery from the shaft of the femur; and (3) the artery of the ligamentum teres from the posterior division of the obturator artery.

**Figure 48-1** Anatomy of the Pelvis, Hip, and Thigh.
• Capsule
  - The hip capsule is comprised of the stout iliofemoral ligament anteriorly, the ischiofemoral ligament posteriorly, and the relatively weak pubofemoral ligament inferiorly (see Fig. 48-1).

• Muscles
  - The action of individual muscles may change depending on joint position. The region is simplified by viewing the muscle groups as a superficial and a deep layer.
  - The superficial layer consists of the tensor fascia lata, sartorius, and gluteus maximus (see Fig. 48-1).
  - The gluteus medius is transitional between the superficial and deep layers.

• The deep layer includes posterior, lateral, anterior, and medial groups (see Fig. 48-1).

• The lower extremity receives its innervation from the lumbar-sacral plexus, which forms the sciatic femoral and obturator nerves as well as various smaller branches.

• The hip receives innervation from L2 to S1 of the plexus, but principally from L3. This explains the presence of medial thigh pain often accompanying hip pathology because symptoms may be referred to the L3 dermatome.

• The lateral femoral cutaneous nerve, providing sensation to the lateral thigh, exits the pelvis under the inguinal ligament, close to the anterior superior iliac spine.
History and Physical Examination

Onset of Symptoms
- A history of significant trauma is a more favorable indicator of a potentially correctable problem.
- Insidious or gradual onset symptoms reflect underlying degenerative disease or predisposition to pathology and can reflect a less favorable long-term outcome.
- Onset from a modest acute event, such as twisting, should still lead one to suspect underlying predisposition to injury (Box 48-1).

Inspection
- Examine stance and gait.
- Observe patient's posture, standing and seated, checking for splinting or protective maneuvers used to alleviate stresses on the hip.

BOX 48-1 Characteristic Hip Symptoms

| Symptoms worse with activities                                                                 |
| Twisting, such as turning changing directions                                                |
| Seated position may be uncomfortable, especially with hip flexion                            |
| Rising from seated position often painful (catching)                                         |
| Difficulty ascending and descending stairs                                                    |
| Symptoms with entering/exiting an automobile                                                  |
| Dyspareunia                                                                                    |
| Difficulty with shoes, socks, hose, etc.                                                     |

- Look for any asymmetry, gross atrophy, spinal alignment, or pelvic obliquity that may be fixed or associated with a gross leg length discrepancy.

Measurements
- Leg lengths are measured from the anterior superior iliac spine to the medial malleolus.
- Thigh circumference is an indicator of muscle atrophy associated with chronic conditions.
- Range of motion should be recorded in a consistent fashion, including rotational motion, flexion, extension, abduction and adduction.

Palpation
Ask the patient to point with one finger to the spot that hurts the worst. Palpation should begin away from this area to avoid exacerbating pain, which could compromise the exam. Palpation must be systematic, including the lumbar spine, sacroiliac (SI) joints, ischium, iliac crest, lateral aspect of the greater trochanter and trochanteric bursa, muscle bellies, and pubic symphysis.

Special Tests
- Log roll test is the most specific test for hip joint pathology.
- Forced flexion, adduction, and internal rotation is a more sensitive maneuver to detect hip joint irritability (Fig. 48-2); also referred to as the impingement test.
- Forced abduction with external rotation may similarly elicit hip joint symptoms (see Fig. 48-2).

Figure 48-2 Special Tests. (Photographs reprinted with permission from J. W. Thomas Byrd, M.D.)
• Patrick, or FABER (flexion, abduction, external rotation), test may provoke symptoms from either the hip or the SI joint.
• Straight leg raise test is used to assess tension signs associated with lumbar nerve root irritation. An active straight leg raise, or leg raise against resistance, may elicit hip symptoms because of the loading across the joint (see Fig. 48-2).
• Ober testing is used to assess tightness of the iliobial band and the Trendelenburg test is useful for gross functional deficits of the abductor mechanism (see Fig. 48-2).

SPECIFIC INJURIES

Contusions

Contusions represent the most common injury of this region. The degree of injury is variable and most contusions resolve with minimal intervention. The key to treatment is proper recognition because some circumstances can have lasting consequences if neglected or mismanaged.

Iliac Crest Contusion

Description: This is referred to as a “hip pointer” in football (Fig. 48-3).
Mechanism of injury: Direct blow incurred from a fall or collision; occasionally, periostitis or exostosis may develop.
Presentation: History of trauma with acute onset of pain.
Physical exam: Pain, swelling, and ecchymoses will be evident along the iliac crest (see Fig. 48-3).
Differential diagnosis: Iliac crest fracture or abdominal wall injury.
Diagnostics: An anteroposterior (AP) radiograph is usually all that is necessary to rule out a fracture.
Treatment: Reduce swelling and pain and then gently implement range of motion followed by strengthening. Occasional judicious use of local corticosteroid injection has sometimes been advocated.
Prognosis and return to play: Generally excellent; return to play dictated by sufficient resolution of pain.

Quadriceps Contusion

Description: Trauma to the quadriceps; sometimes referred to as a “thigh bruise.”
Mechanism of injury: Direct blow to the quadriceps region.
Presentation: History of trauma with acute onset of pain.
Physical exam: Pain and localized tenderness are evident. Significant swelling may occur but can be obscured by the volume of the thigh compartment. Superficial ecchymoses may be less evident or appear several days later. Stretching with passive knee flexion is painful, especially when combined with hip extension.
Differential diagnosis: Quadriceps rupture or strain.

Diagnostics: Although not always necessary, magnetic resonance imaging (MRI) may help to quantify the size and severity of the contusion.
Treatment: Modalities to reduce inflammation, swelling, and pain with gentle range of motion followed by strengthening. If necessary, crutches may be used to normalize gait. Resting the extremity with the knee in flexion maintains tension on the quadriceps, which reduces pooling of blood and lessens the likelihood of contracture and scar. During the acute phase, it is important to monitor for the rare but serious complication of thigh compartment syndrome. Gentle range of motion is emphasized but aggressive passive stretching is avoided because this can potentiate the development of myositis ossificans.
Prognosis and return to play: Full recovery is generally excellent. If myositis ossificans develops, this can usually be managed conservatively. Occasionally surgical excision may be considered, but should be delayed many months until the lesion has fully matured to minimize recurrence.

Muscle Strains

Strains usually occur at the myotendinous junction. An exception to this is a previously contused muscle. With incomplete healing, the injury may occur at the site of previous muscle contusion. Most strains occur from a violent eccentric force while the muscle is attempting to contract. Muscles that cross two joints often contract eccentrically and have higher percentages of type II (fast twitch) muscle fibers and are more susceptible to this injury.

Hamstring Strain

Description: As a hip extensor and knee flexor, injury to the hamstring can occur anywhere along its course in the posterior thigh, including complete avulsion of its tendinous origin from the ischium.
Mechanism of injury: Occurs during sprinting with hip flexion and knee extension; complete avulsion of the tendinous origin usually involves a more violent force.
Presentation: Sudden severe stabbing pain; feeling of pop usually indicates a more severe injury.
Physical examination: Because of the variable location of the musculotendinous junctions, the site of involvement can be anywhere along the posterior thigh. A palpable defect indicates a more severe injury. Resisted contraction of the hamstring group will demonstrate diminished tone and pain.
Differential diagnosis: Sciatica or an injury to the popliteal region may create posterior thigh symptoms.
Diagnostics: MRI is helpful at grading the severity of the injury and may have prognostic value in estimating the length of recovery.
Treatment: Early management focuses on reducing pain and swelling with compression, ice, elevation, and rest while maintaining normal muscle length. With subsidence of acute symptoms, gentle flexibility followed by conditioning is implemented. Strengthening begins with isometric exercises and then progresses to isotonic and isokinetic methods as symptoms allow. For select cases, judicious use of corticosteroid injection into the injured area has occasionally been proposed as a method for facilitating recovery. For complete avulsions of the tendinous origin from the ischium, early surgical repair may provide more favorable outcomes. Surgical repair has resulted in significant improvement among chronic cases with residual dysfunction.
Prognosis and return to play: Recovery is favorable; return to sport is mostly dictated by the athlete’s functional performance. General guidelines include full pain-free range of motion and 90% strength. In general, reinjuries tend to be more severe and recovery longer. Therefore, good judgment is necessary in determining when the athlete should return to play. Reflective of the highly variable nature of these injuries, mild strains may result in minimal lost playing time whereas more severe injuries may take months to recover.

Figure 48-3 Iliac Crest Contusion. (Photographs reprinted with permission from J. W. Thomas Byrd, M.D.)
Adductor Strain
Description: “Pulled groin muscle”; adductor injuries are especially common in ice hockey and soccer. The adductor longus is the most frequently injured (see Fig. 48-1). Adductor involvement may be a component of athletic pubalgia (see “Athletic Pubalgia”).
Mechanism of injury: Forceful resisted abduction resulting in eccentric failure of the adductors is most common.
Presentation: Acute injury with pulling sensation or a pop.
Physical exam: Swelling, pain, and tenderness is present in the medial thigh. Resisted adduction is painful with diminished strength. Location of the injury is variable and can be determined by palpation. A defect may be present depending on the severity of the strain.
Differential diagnosis: Athletic pubalgia, osteitis pubis, hip flexor injury, hernia, thrombosis, fracture.
Diagnostics: Radiographs rule out a fracture or bony avulsion. MRI is useful to confirm and quantify the injury.
Treatment: Most respond to a conservative rehabilitation program regardless of the severity of injury. Rarely is surgical repair beneficial.
Prognosis and return to play: Prognosis for a full recovery is excellent but the time frame is variable; most recover within 3 to 6 weeks.

Rectus Femoris Strain
Description: As a two-joint muscle, the rectus femoris is the most injury-prone of the quadriceps group. Acute injuries tend to occur distally in the thigh; chronic injuries occur more often near its origin at the hip. Avulsion of the anterior inferior iliac spine may occur in adolescents.
Mechanism of injury: Eccentric loading of the hip flexors and knee extensors.
Presentation: Typically precipitated by an acute event but often without a specific action.
Physical exam: Pain is generated with either resisted hip flexion or knee extension. Careful palpation will elicit the location of the injury; a palpable defect is indicative of more severe involvement.
Differential diagnosis: Proximal, hip joint pathology or iliofemoral injury; distally, quadriceps tendon rupture.
Diagnostics: Imaging may not be necessary although MRI will aid in defining the injury.
Treatment: Most respond to a standard conservative protocol.
Prognosis: Prognosis for full recovery is generally excellent although variable depending on the severity and location of the injury. Mild strains may recover in 2 weeks whereas more severe injuries may take 2 months.

Iliopsoas Strain
Description: Not a common injury; can be a source of lingering, slowly resolving dysfunction.
Mechanism of injury: Forceful hip extension against a contracting iliopsoas muscle.
Presentation: Symptoms develop following an acute injury although it may not be incapacitating.
Physical exam: Pain occurs with resisted hip flexion and tenderness to palpation is present along the course of the iliofemoral anterior to the hip.
Differential diagnosis: Hip joint pathology, injury to the origin of the rectus femoris, adductor injury, occult hernia, athletic pubalgia, stress fracture, osteitis pubis.
Diagnostics: For recalcitrant cases, MRI may be helpful to detect inflammation and injury within the iliopsoas structure.
Treatment: Standard conservative protocol. For recalcitrant cases, judicious use of cortisone injection within the iliopsoas bursa bathing the tendon may be appropriate.

Prognosis and return to play: Prognosis for a full recovery is excellent, but can be protracted, sometimes taking 2 to 3 months for recalcitrant cases.

Bursitis
There are 13 consistent bursae and numerous other variable ones around the hip region (Fig. 48-4). Bursitis may coexist with tendinitis, tendinosis, and other friction syndromes and be difficult to differentiate.

Trochanteric Bursitis
Description: Commonly seen in association with friction of the overlying iliotibial band.
Mechanism of injury: Classically described in runners training on banked surfaces and more common in females, which is attributed to the wide pelvis and prominence of the trochanter.
Presentation: Lateral hip pain usually develops from overuse although occasionally there may be a history of acute trauma.
Physical exam: Pain is elicited with palpation of the bursa directly over the lateral aspect of the greater trochanter. Ober testing is performed to check for associated tightness of the iliobibial band.
Differential diagnosis: Iliotibial band friction syndrome, abductor tendinopathy, stress fracture, L2 to L3 radiculopathy.
Diagnostics: Radiographs may be helpful to assess for bony abnormalities or soft tissue calcification. Further workup is not necessary except for recalcitrant cases to rule out other causes of symptoms.
Treatment: Oral anti-inflammatory medications, modification of training program, local modalities, and emphasis on stretching/flexibility of the iliobibial band. Judicious use of corticosteroid injections into the bursa can have therapeutic and diagnostic value. Surgical excision of the trochanteric bursa is rarely indicated with variable results. Careful scrutiny for other causes must be given for cases that fail conservative treatment.
Prognosis and return to play: Symptoms are rarely disabling but can be lingering. Sports participation to tolerance is acceptable, but may necessitate continued training modifications.

Iliopsoas Bursitis
Description: A cause of anterior hip pain, the iliopsoas bursa is the largest in the body and usually accompanies inflammation of the iliopsoas tendon.
Mechanism of injury: Typically occurs in conjunction with mechanical irritation of the iliopsoas tendon.

Figure 48-4 Location of Major Pelvic Bursae.
Presentation: Anterior hip and groin pain.
Physical exam: Localized tenderness to palpation is usually present. Pain with resisted hip flexion is usually present, but variable. Absence of significant discomfort with passive hip flexion with internal rotation distinguishes this from an irritative hip joint.
Differential diagnosis: Hip flexor strain, intra-articular pathology, occult hernia, athletic pubalgia.
Diagnostics: Radiographs are unrevealing, but important to assess the bony structures. MRI may be necessary to distinguish excessive fluid within the bursa from intra-articular pathology.
Treatment: A standard conservative protocol is usually effective. For recalcitrant cases, judicious use of a corticosteroid injection may have therapeutic and diagnostic value.
Prognosis and return to play: Prognosis for recovery from iliopsoas bursitis is excellent. However, in the presence of bursal swelling, other contributing factors should be considered, such as involvement of the iliopsoas tendon, that can alter the prognosis and return to play.

**Ischial Bursitis**
Description: Located adjacent to the origin of the hamstrings from the ischium, symptoms can be difficult to differentiate.
Mechanism of injury: Direct trauma or prolonged sitting.
Presentation: The athlete will localize symptoms to this area.
Physical exam: Tenderness to palpation directly over the ischium is present and is distinguished from hamstring involvement by less pain with stretching.
Differential diagnosis: Ischial stress fracture, sciatica, hamstring enthesopathy, inferior cluneal nerve entrapment.
Diagnostics: Radiographs may be helpful to rule out a bony lesion of the ischium. Further studies are rarely necessary except to rule out other causes in recalcitrant cases.
Treatment: Nonsteroidal anti-inflammatory medications, avoidance of offending activities, and other standard conservative modalities are usually effective. Judicious use of corticosteroid injections may be appropriate for recalcitrant cases.
Prognosis and return to play: Symptoms may linger, but athletic participation to tolerance is appropriate. More extensive investigation for other sources may be necessary in cases that fail to recover.

**Nerve Entrapment**
Any nerve arising from the lumbar sacral plexus can be susceptible to entrapment around the hip (Fig. 48-5). Often no motor dys-

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**Figure 48-5 Nerve Entrapment.**

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function is present and the areas of sensory innervation overlap, making the symptoms confusing and the diagnosis elusive. Treatment is sometimes controversial.

**Lateral Femoral Cutaneous Nerve**
Description: Referred to as “meralgia paresthetica,” this is the most easily recognized of the nerve conditions around the hip.
Mechanism of injury: As the nerve exits underneath the anterior superior iliac spine, it is susceptible to compression from thick belts or pads, or prolonged periods of hip flexion (see Fig. 48-5).
Presentation: Athlete presents with pain or dysesthesias in the distribution of the lateral femoral cutaneous nerve along the lateral thigh.
Physical exam: Tenderness or Tinel’s sign may be present as the nerve becomes superficial, distal to the anterior superior iliac spine. Dysesthesias, or diminished sensation, may be evident in the distribution of the nerve.
Differential diagnosis: Lumbar nerve root irritation.
Treatment: Elimination of the offending activity may be helpful. The value of localized injection is uncertain but may be considered for recalcitrant cases. Surgical release is rarely necessary.
Prognosis and return to play: Although painful, this usually does not prevent full activities.

**Obturator Nerve**
Description: Reported as a cause of medial thigh pain in athletes.
Mechanism of injury: Attributed to a fascial band compressing the nerve as it exits the obturator canal.
Presentation: Dysesthesias in the medial thigh distribution of the nerve are worsened with exercise.
Physical exam: Symptoms will be described in the distribution of the obturator nerve in absence of any other structural findings around the hip and groin. Adductor weakness may be present.
Differential diagnosis: Lumbar nerve root irritation, hip or groin pathology.
Diagnostics: Radiographs are normal. MRI may demonstrate atrophy of the adductor longus, brevis, and gracilis. Electromyogram (EMG) studies reflect chronic denervation of the adductor longus and brevis. Radionuclide scanning may demonstrate increased activity in the region of the pubic ramus at the origin of the adductors.
Treatment: Surgical release at the obturator foramen has been successfully reported for properly selected cases, but should be undertaken cautiously.
Prognosis and return to play: Participation to tolerance is appropriate and successful return has been reported following surgical release.

Pudendal Nerve
Description: Common in cyclists; reported as a complication of hip arthroscopy.
Mechanism of injury: Caused by direct compression of the pudendal nerve.
Presentation: Sensory loss in the perineum and impotence in severe cases.
Physical exam: Diminished sensation is present in the distribution of the pudendal nerve.
Differential diagnosis: Lesion of the sacrum or sacral plexus.
Treatment: Avoidance of offending activity and observation.
Prognosis and return to play: Although not a problem with sports participation, the consequences of pudendal nerve neuropaxia are concerning. Most experience is that this will resolve spontaneously, usually within a few weeks, but it can take months. Permanent dysfunction, while rare, has serious personal implications.

Sciatic Nerve
Entrapment may occur anywhere along its course, from the abdomen to the knee. Compression may occur from the piriformis muscle (discussed later) or, less commonly, attributed to the fibrous edge of the biceps femoris origin at the level of the ischial tuberosity.

Syndromes
Several conditions with consistent constellations of symptoms and pathomechanics warrant distinction as syndromes.

Snapping Iliopsoas Tendon
Description: Referred to as “coxa saltans interna,” this is often an incidental finding present in approximately 10% of an active population.
Mechanism of injury: The snapping occurs as the tendon flips across the anterior femoral head and capsule and the pectineal eminence; lying lateral when the hip is flexed, abducted, and externally rotated, and moving medial when the hip is extended with internal rotation.
Presentation: Following an injury or repetitive activity, an athlete may present with painful snapping, which is often audible but sometimes more of a sensation that they experience.
Physical exam: The characteristic test is bringing the hip from a flexed, abducted, externally rotated position into extension with internal rotation, eliciting the snap (Fig. 48-6). The snap consistently occurs when bringing the hip from a flexed to extended position.
Differential diagnosis: Intra-articular pathology or snapping of the iliotibial band.
Diagnostics: MRI may be helpful to assess for associated inflammation and to evaluate for intra-articular pathology. Iliopsoas bursography with fluoroscopic examination is specific but only about 80% sensitive in providing visual confirmation of the snapping phenomenon. Concomitant injection of Marcaine adds diagnostic value although it is not completely specific and accompanying use of cortisone may have some therapeutic value. Ultrasonography has sensitivity similar to bursography with the advantage of being noninvasive, but lacks therapeutic value.
Treatment: Assurance to the athlete that the snapping is not harmful is often all that is needed. Stretching and stabilization exercises may be beneficial. For recalcitrant cases, surgical release of the tendinous portion of the iliopsoas can be effective at eliminating the painful snapping.
Prognosis and return to play: Snapping does not contraindicate full sports participation. For surgical cases, return to sports can be anticipated at 3 to 4 months.

Figure 48-6 Syndromes. (Photographs and maneuver for snapping of the iliopsoas tendon; a. The hip is initially placed in abduction, flexion and external rotation. b. The hip is then brought into extension with internal rotation, producing the snap of the iliopsoas tendon.

Snapping Iliotibial Band
Description: Referred as to “coxa saltans externa,” this may be present as an incidental finding without consequences.
Mechanism of injury: Snapping may occur from trauma, but often develops without injury. The snapping is created by the site of convergence of the tensor fascia lata and gluteus maximus, flipping across the prominence of the greater trochanter.
Presentation: Sense that the hip is subluxing.
Physical exam: Snapping of the iliobial band creates a visually evident phenomenon. With the athlete on his or her side, the snapping can sometimes be provoked as the hip is passively maneuvered between extension and flexion. The Ober test assists in checking for tightness of the iliobial band.
Differential diagnosis: Hip instability, which is rare.
Diagnostics: Imaging studies are rarely beneficial in substantiating the diagnosis of iliotibial band, but may be useful to rule out other causes.

Treatment: It is difficult to cure the snapping, but modification of offending training activities may be beneficial in diminishing the associated symptoms. Stabilization exercises and modalities to diminish inflammation and discomfort are helpful. Judicious use of corticosteroid injections may aid in pain control as a supplement to a formal supervised rehabilitation regimen. Recalcitrant cases can often be successfully treated with surgical relaxation of the iliotibial band.

Prognosis and return to play: Snapping of the iliotibial band does not preclude full unrestricted sports participation. Return following surgery can take 2 to 4 months depending on associated conditions.

Piriformis Syndrome

Description: Uncommon condition that likely gets overdiagnosed and overlooked in equal proportions. Piriformis muscle compresses the sciatic nerve as it exits the sciatic notch.

Mechanism of injury: Often, there is a history of trauma with a direct blow to the area of the piriformis. An anomalous relationship of the piriformis muscle with the sciatic nerve may be a factor, but is often present as a normal variant.

Presentation: May be a history of trauma, and sitting is typically uncomfortable, creating both buttoc k pain and sciatica symptoms.

Physical exam: Provocative tests to compress the piriformis against the sciatic nerve include passive internal rotation and resisted external rotation of the extended hip; resisted abduction of the flexed hip (Pace's sign); and stretching with flexion, abduction, and internal rotation (piriformis stretch) (see Fig. 48-6). Pain on posterior palpation is present but nonspecific because of the large overlying gluteal muscle. The most characteristic physical finding is the re-creation of symptoms on palpation of the piriformis from inside the pelvis with either rectal or vaginal examination.

Differential diagnosis: Lumbar nerve root disorder, biceps syndrome, tumor, vascular anomaly.

Diagnostics: Workup should always include the lumbar spine, which is the most likely source of sciatica symptoms. MRI of the pelvis is used to rule out a soft tissue mass effect at the level of the sciatic notch. Neurodiagnostic studies are important for recalcitrant cases.

Treatment: Nonsteroidal anti-inflammatory medications and even a brief course of oral prednisone may be appropriate. Conservative measures include stretching of the piriformis muscle to reduce its compressive effect on the sciatic nerve. Injection of the piriformis muscle may have therapeutic value. Temporary alleviation of symptoms has diagnostic significance, substantiating involvement of the muscle. Precise placement of the injection is important and can be facilitated with computed tomography (CT) guidance. Surgery is rarely necessary but may be appropriate for patients that experience only temporary relief from injections.

Prognosis and return to play: Sports participation is allowed to tolerance. For rare surgical cases, alleviation of sciatica pain may be prompt but restriction of activities is still necessary for 2 to 3 months.

Athletic Pubalgia

Description: Tendinopathy characterized by breakdown of the pelvic stabilizers at a confluence of the rectus abdominis insertion, adductor origin, and pelvic floor at the pubic rami. Common in sports such as ice hockey and soccer. Acute injury is associated with extension of the trunk and concomitant abduction of the hip. There is a significant correlation with hip disease, especially femoroacetabular impingement. It is speculated that diminished rotational motion of the hip is compensated by increased pelvic motion, placing more stress on the pelvic stabilizers and resulting in soft tissue breakdown of these structures.

Presentation: Groin pain following an acute injury or a repetitive mechanism that eccentrically loads the trunk flexors and hip adductors.

Physical exam: Tenderness is localized around the pubic rami and there is absence of a detectable inguinal hernia. Pain is variously elicited with resisted adduction and resisted sit-ups. With acute injuries, there is associated swelling.

Differential diagnosis: Hernia, stress fracture, osteitis pubis, hip flexor strain, intra-articular pathology, nerve entrapment.

Diagnostics: Radiographs rule out bony abnormalities. MRI may show evidence of tendinopathy but is often unrevealing.

Treatment: Nonsteroidal anti-inflammatory medication and modification of offending activities is important. Therapeutic modalities may be beneficial to diminish discomfort and inflammation. Gradual restoration of flexibility and core strengthening is integral to a functional recovery. Judicious use of corticosteroid injections may be helpful for recalcitrant cases. Surgical takedown and restoration of the involved tendinous structures is advocated for those that fail conservative treatment.

Prognosis and return to play: Prognosis is highly favorable, although some may experience recalcitrant incapacitating symptoms. If the symptoms are not severe, continued sports participation may be allowed. For severe cases, recovery can take months. Following surgery, the best results have been reported in high-level athletes with lesser success among recreational athletes.

Sources of Referred Hip or Groin Pain

Upper Lumbar Disc

Nerve root irritation associated with an upper lumbar disc is less common and more easily overlooked than lower discs. Sciatica is absent as pain radiates to the anterior groin. Straight leg raising is negative, but hip extension may exacerbate nerve root irritation.

Hernias

An inguinal hernia is characterized by tenderness, fullness, or a bulge localized to the inguinal canal. The less common femoral hernia extends underneath the inguinal ligament, occupying the space medially to the femoral vein within the femoral triangle. A tender mass can be palpated. An index of suspicion is necessary to avoid overlooking this entity.

Vascular Disorders

Disease, dysfunction, and neoplasm of gastrointestinal, genitourinary, and gynecologic systems are all capable of producing hip and groin type pain. An index of suspicion must be maintained when thorough assessment does not reveal an obvious source of pathology.

Stress Fractures

Description: Occur when the forces on the bone exceed its remodeling capacity: Proximal femoral lesions usually occur in the femoral neck; pelvic-sided lesions can occur in the sacrum or the rami. Stress fractures are twice as common among females and may be part of the female athlete triad of eating disorder, osteoporosis, and amenorrhea.

Mechanism of injury: Excessive forces applied to normal bone or normal forces applied to abnormal bone (insufficiency fractures).

Presentation: Onset usually occurs in association with increased intensity or some significant alteration in the athlete’s training program. Symptoms are typically worsened with weight-bearing and impact-loading activities and relieved with cessation.

Physical exam: Examination findings may be minimal in absence of impact loading; but are usually indicative of joint

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irritability and can be difficult to distinguish from intra-articular pathology.

**Differential diagnosis:** Intra-articular pathology, muscle strain, avascular necrosis (AVN), or neoplasm.

**Diagnosis:** Radiographs are important but may fail to detect a lesion in almost half of cases. Radionuclide scanning is highly sensitive and relatively inexpensive. MRI has comparable sensitivity with excellent specificity and allows the advantage of assessing other soft tissue structures in the hip region. A history of multiple stress fractures may require a more extensive workup and a proper dietary and menses history should be obtained from women.

**Treatment:** Location of the lesion is important in determining proper treatment.

- Pelvic stress fractures are managed symptomatically with modification of activities below the threshold of pain.
- Femoral neck stress fractures require a more diligent strategy.
- Medial-sided lesions on the compressive surface are inherently stable. These can be treated with protected weight bearing until asymptomatic, but require close monitoring for complete resolution. Surgical fixation may occasionally be indicated for protracted conditions.
- Lateral-sided stress fractures are on the tensile surface of the neck and are "at risk" fractures for displacement. These are more properly managed with surgical fixation.

**Prognosis and return to play:** With proper management, most will heal completely. Complete healing takes several months, although return to sports may be sooner for stable pelvic lesions.

**Osteitis Pubis**

**Description:** Breakdown and inflammation of the symphysis pubis.

**Mechanism of injury:** Micromotion occurs from repetitive trauma, especially in sports that involve kicking or repetitive hip abduction/adduction activities. Occasionally observed in conjunction with breakdown of the pelvic stabilizers encountered in athletic pubalgia. Symptomatic conditions can also occur during or after pregnancy or as a sequel of infection or urologic or gynecologic pathologies.

**Presentation:** Vague lower abdominal, adductor, or groin symptoms that fail to localize specifically to one side.

**Physical exam:** Examination is characterized by point tenderness directly over the symphysis pubis.

**Differential diagnosis:** Inflammation or infection independent of the repetitive microtrauma of sport should be considered. Athletic pubalgia.

**Diagnoses:** Radiographs are important and, with chronic conditions, will usually demonstrate alterations in the symphysis pubis with variable combinations of sclerosis and lucency. However, these findings may be seen even among asymptomatic individuals. Radionuclide scanning will demonstrate increased activity in this region and MRI will show edema.

**Treatment:** Management is symptomatic including use of oral anti-inflammatory medication and efforts to modify the athlete’s activities to diminish associated pain. Pelvic stabilization exercises can be helpful as tolerated. Corticosteroid injection is appropriate for recalcitrant cases. Various surgical procedures have been described, ranging from simple debulking to fusion, depending on the degree of instability and dysfunction. However, these are salvage procedures with limited clinical experience and reserved only for the most desperate circumstances.

**Prognosis and return to play:** Recovery is generally expected with conservative treatment but can take months for resolution. Sport participation is allowed as long as symptoms are tolerable. There is little evidence to support return to sports following surgical intervention because this is generally reserved for conservative failures even with inactivity.

**Dislocation/Subluxation**

**Description:** Dislocation of the hip requires substantial force. The resultant injury is incapacitating to the athlete and evident on initial assessment. Subluxation of the hip and concomitant damage may have a more subtle presentation.

**Mechanism of injury:** The hip is inherently stable to posterior translation yet most injuries occur in this direction because of the mechanism of injury. With the hip flexed, the leg is axially loaded, driving the femoral head posterior. Among collision sports, this commonly occurs in a pile-up of players and, in motor sports, is the classic dashboard injury. Subluxation can occur as a noncontact injury, especially with sudden deceleration when the leg is planted to stop while the hip is flexed and the knee extended. Commonly with dislocation and subluxation, there may be an associated fracture of the posterior lip of the acetabulum that does not compromise the stability of the joint.

**Presentation:** With a dislocation, the incapacitating nature of the injury will be evident. With subluxation or fracture-subluxation, the athlete will recount a specific injury but the amount of disability can be variable. Some athletes will be unable to bear weight whereas others may continue to participate until it becomes evident that the accompanying symptoms do not subside.

**Physical exam:** With a posterior dislocation, the leg will be in abduction and internal rotation and appear foreshortened. With the less common anterior dislocation, the leg will be externally rotated. Examination findings associated with a subluxation will be those characteristic of a painful hip joint. Posterior symptoms may be present because of injury to the short external rotators and posterior musculature.

**Differential diagnosis:** A dislocation may be difficult to distinguish from an interrocanthic, femoral neck or complex acetabular fracture. Symptoms from subluxation will share common features with other types of intra-articular pathology or groin injuries. The presence of posterior pain may suggest an SI joint or gluteal injury.

**Diagnoses:** Radiographs are important to assess for concentric reduction and associated bony injury. An MRI will help to reveal the associated soft tissue injury around the joint as well as intra-articular pathology. If a bony injury is suspected, a CT scan provides better assessment of the bony architecture and fracture than that provided by MRI.

**Treatment:** Prompt reduction of a dislocated hip is important to lessen the likelihood of developing avascular necrosis. Whether to attempt reduction on the field without benefit of radiographs is controversial. If the clinician is experienced in the assessment and treatment of hip dislocations, then it is generally accepted that a one-time gentle attempt at reduction is appropriate. If reduction is not easily accomplished, repeated attempts are not recommended. With a documented subluxation episode, the athlete should be kept on a protected weight-bearing status until a thorough evaluation has been completed. For dislocations and subluxations, careful follow-up is important to assess for the presence of associated intra-articular pathology or the subsequent development of avascular necrosis.

**Prognosis and return to play:** Outcome variable, dictated by the severity of damage incurred at the moment of injury. The uncertain outcome necessitates a conservative, thoughtful approach in its management. With successful resolution of symptoms and absence of intra-articular damage or AVN, return to play can occur as early as 2 to 3 months.

**Avulsion Fractures**

**Description:** Characteristically occur in adolescent males at a period during which the growth plates remain open while muscle power is markedly increased in conjunction with the appearance of an-
drenses. Sites of involvement in order of decreasing frequency include the anterior superior iliac spine, ischium, lesser trochanter, anterior inferior iliac spine, iliac crest, and greater trochanter.

**Mechanism of injury:** As with strain, the injury is usually the result of a sudden ballistic maneuver with accompanying eccentric loading of the tendinous insertion site to bone. Prior to physeal closure, this is the weakest site for injury to occur.

**Presentation:** An acute episode in association with spraining or other sudden acceleration activities.

**Physical exam:** Tenderness will be localized to the site of involvement with pain on resisted contraction of the involved muscle group.

**Diagnosis:** Muscle strain or contusion.

**Radiographs** typically demonstrate the avulsed fragment. For subtle findings with minimal displacement, MRI can be helpful at substantiating the injury but is usually not necessary. The amount of initial displacement rarely widens over time, although follow-up radiographs may be prudent.

**Treatment:** Most are treated nonoperatively. Crutches may be necessary to develop a painless gait. Gentle range of motion and conditioning exercises are implemented as symptoms allow. Surgery is occasionally proposed for large fragments with significant displacement but is rarely necessary.

**Prognosis and return to play:** The prognosis for return to unrestricted activities is excellent. Recovery can take 6 to 10 weeks, depending on the location, severity of injury, and age of the athlete.

### Apophysitis

**Description:** Disorder of the skeletally immature athlete; may occur anywhere within the hip girdle, but the most common site is the iliocrest.

**Mechanism of injury:** Overuse disorder of the skeletally immature athlete.

**Presentation:** Onset of symptoms may be acute or associated with a period of intense activity.

**Physical exam:** Pain and tenderness to palpation on the iliac crest.

**Differential diagnosis:** Hip pointer, contusion, or apophyseal avulsion.

**Diagnosis:** With chronic involvement, radiographs may demonstrate slight asymmetric physeal widening on the side of involvement.

**Treatment:** Symptomatic, modifying offending activities while the discomfort subsides.

**Prognosis and return to play:** Excellent, and return to play is allowed as symptoms tolerate but may necessitate a period of modification.

### Osteonecrosis

**Description:** Avascular necrosis of the femoral head with diminished blood supply, resulting in osteocyte death. Because this is a disorder encountered in young adults, an index of suspicion must be maintained because it can coincidentally be present in athletes.

**Mechanism of injury:** Although often idiopathic, there is a causal relationship with trauma, such as dislocation or subluxation. Other systemic factors include alcohol abuse, catabolic steroids, and decompression sickness, among others.

**Presentation:** Symptoms usually occur insidiously without a specific precipitating event.

**Physical exam:** Clinical findings of hip joint irritability will be present.

**Differential diagnosis:** Chondral or osteochondral injury, transient regional osteoporosis and osteoarthritis.

**Diagnosis:** Radiographs may vary from normal to advanced collapse depending on the stage of the disease. MRI is the study of choice for diagnosis and accurate staging. Acute chondral and osteochondral injuries may demonstrate significant marrow and subchondral signal changes that can mimic AVN.

**Treatment:** Variable and sometimes controversial depending on the stage of the disease. Goal is to prevent progression, which may sometimes remain stable for years. Surgical options range from palliative procedures, such as core decompression, to more aggressive procedures to revascularize the bone, such as free vascularized fibular grafting. Arthroscopy has a limited role. It can help to stage the disease by assessing the integrity of the femoral articular surface and address coexistent intra-articular pathology.

**Prognosis and return to play:** Prognosis is guarded. Successful results in preserving the joint have been reported, but this is rarely suited for return to competitive sports.

### Tumors

**Description:** 10% to 15% of primary musculoskeletal tumors arise within the pelvis and hip. Among older adults, metastatic disease is the most likely neoplasm.

**Presentation:** Neoplasms around the hip are uncommon but must be considered in cases of unexplained pain or circumstances in which the episode of trauma may seem trivial or coincidental.

**Physical exam:** Because of the deeply situated anatomy of this area, lesions may gain considerable size before being noticed by the patient or becoming discernable on examination.

**Diagnosis, Treatment, and Prognosis:** Variable based on the nature of the neoplasm.

### Intra-articular Disorders

**Description:** Labral tears, chondral lesions, and rupture of the ligamentum teres are the three most common lesions encountered among athletes (Fig. 48–7).

**Mechanism of injury:** Violent blow or twisting injury (see Fig. 48–7). Training errors, pushing the joint beyond its physiologic limits, may result in breakdown in absence of major trauma. Joint morphology such as femoracetabular impingement or dysplasia may play a significant role in many cases. Intrinsic tissue disease may also result in failure at physiologic forces.

**Presentation:** Onset is variable but a history of significant trauma is a more favorable indicator of a correctable problem; mechanical symptoms such as sharp, stabbing pain, catching, or locking are more favorable findings.

**Physical exam:** Groin pain or a C-sign may be present. Log roll test is the most specific test for an intra-articular disorder. Forced flexion with internal rotation and abduction with external rotation are more sensitive maneuvers to elicit symptoms of an irritable joint (see Fig. 48–2).

**Differential diagnosis:** Stress fracture, AVN, athletic pubalgia, snapping hip syndrome, nerve entrapment.

**Diagnosis:** Radiographs are important to assess for bony or joint changes as well as evaluate the hip morphology. High-resolution MRI is improving at detecting intra-articular pathology. Gado-linium arthrography with MRI is often more sensitive. Injection of a long-acting anesthetic along with the contrast is an important diagnostic maneuver to distinguish the amount of associated pain relief.

**Treatment:** A period of rest or observation may be appropriate, with close monitoring of symptoms. Persistent symptoms may warrant arthroscopic intervention. Neglect may lead to further joint damage but will be indicated by worsening pain.

- Labral lesions can be selectively debrided (see Fig. 48–7). In-discriminate resection is avoided because this can result in poor outcomes.
- Labral repair can be performed for appropriately selected tears (see Fig. 48–7).
- Chondral lesions are addressed with chondroplasty or microfracture for appropriate grade IV lesions (see Fig. 48–7).
Disrupted fibers of the ligamentum teres can be selectively debrided (see Fig. 48-7).

Careful evaluation must be performed to assess for associated etiologic factors such as impingement or dysplasia, which may need to be addressed.

**Prognosis and return to play:** Prognosis is variable.

- Simple isolated labral tears are uncommon but have a highly favorable outcome; return to play within 2 months.
- Labral tears usually have a variable amount of associated articular damage, which is a more limiting factor on the outcome with regard to duration and completeness of recovery.
- Microfracture may necessitate a protected weight-bearing status for 2 months before gradual resumption of functional activities.

- More complex procedures for impingement may obviate a 4- to 6-month recovery period.

**Femoroacetabular Impingement**

**Description:** Condition that leads to intra-articular pathology and subsequent early onset osteoarthritis. Cam type is caused by a nonspherical femoral head associated with subclinical slipped capital femoral epiphysis or premature physeal closure; most prevalent among young adult males. Pincer type is caused by overcoverage of the anterior acetabulum associated with numerous conditions including acetabular retroversion and protrusion; more commonly seen in mature females.

**Mechanism of injury:** Culmination of cyclical repetitive microtrauma during hip flexion as the joint is subjected to the abnor-
mal forces created by the altered morphology. With cam impingement, the bump on the anterolateral femoral head glides underneath the labrum, engaging the articular surface, resulting in delamination with a variable amount of associated labral pathology. With pincer impingement, the labrum becomes crushed against the neck of the femur, resulting in primary labral pathology and secondarily articular failure.

**Presentation:** Athlete may describe an acute injury, but close questioning will often elicit a prior history of less severe intermittent symptoms.

**Physical exam:** In addition to joint pain, diminished internal rotation is often present. Forced flexion, adduction and internal rotation is described as the impingement test.

**Differential diagnosis:** Impingement morphology may be a coincidental finding and other causes of hip pain must be considered.

**Diagnostics:** Properly oriented radiographs are essential to interpreting the joint morphology. MRI and magnetic resonance angiography (MRA) help to elicit the associated intra-articular pathology and aid in interpreting the joint morphology. CT with 3-D reconstruction is very helpful at clearly discerning the bony architecture of the joint.

**Treatment:** Activity modification and observation may be appropriate to monitor for resolution of the athlete’s symptoms. Surgical intervention is proposed when symptoms persist in the presence of impingement and associated intra-articular pathology.

- An open technique with surgical dislocation of the hip can precisely correct the bony abnormalities with acetabular rim trimming and recontouring of the femoral head (femoroacetabulum) as dictated by the joint morphology. However, these extensive open procedures are not well suited for athletes returning to sports participation.
- Much of this can also be accomplished with arthroscopic methods (Fig. 48-8). Precision of the bony recontouring comes close to that which can be accomplished with the open method, although the morbidity of the arthroscopic approach is substantially less.

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**Figure 48-8** Femoroacetabular Impingement. (Photographs reprinted with permission from J. W. Thomas Byrd, M.D.)
Prognosis and return to play: Surgical intervention has a high success rate at diminishing symptoms. However, returning to the rigors of competitive sports is more variable and is dictated by the severity of damage at the time of surgery. Whether or not these procedures alter the natural history of the disorder remains to be seen.

RECOMMENDED READINGS