Imaging and Sports-Related Injuries of the Hip and Groin

- Diagnoses of injuries to the hip and groin are challenging to diagnose because of complex anatomy and overlapping symptoms
- Radiography is most suitable for initial imaging examination to evaluate for fractures, joint space, alignment, and some soft tissue anomalies
- MRI is well-suited for evaluating soft tissue injuries, including stress injuries, muscle strain, tendon tears, muscular contusion, musculofascial defects, and bursitis
- CT can be helpful for detecting radiographically occult fractures or other bone lesions, multiplanar reconstructions of complex fractures, and tissue calcification

The musculoskeletal anatomy of the hip and groin region is very complex and is vulnerable to many kinds of sports-related injuries that can result from activities such as sprinting, kicking, and rapid changes of direction. In addition, the hip, which combines an extensive range of motion with constant weight bearing, is particularly vulnerable to repetitive stresses. Injuries can be acute or chronic and may involve muscles, tendons, bones, joints, or nerves. The resulting clinical signs and symptoms can have considerable overlap. A more thorough evaluation, including imaging, is often needed before a specific diagnosis can be made.

Radiography and CT

Conventional radiography is the most suitable modality for an initial imaging examination, which typically entails a standard anteroposterior view of the pelvis and anteroposterior and frog-lateral views of the symptomatic hip. These images can show fractures, including those that are subtle or non-displaced (Figure 1), and can be used to evaluate joint space, alignment, cortical integrity, acetabular angle, and femoroacetabular impingement (FAI). Radiographs of the surrounding soft tissues can also provide some useful information. For example, periartricular fat pads can be displaced or effaced as a result of a joint effusion. Muscles, such as the gluteals, iliopectos, obturators, or adductor muscles, can appear to be asymmetric as a result of an injury. Soft tissue calcifications can indicate myositis ossificans, synovial osteochondromatosis, or crystalline depositions.

CT can be helpful in several situations in which more information is needed. For example, CT can detect or confirm non-displaced or radiographically occult fractures. Multiplanar CT reconstructions are helpful for evaluating complex fractures, and soft tissue calcifications are also optimally localized with CT. In addition, CT and CT of the hip can be useful in patients with contraindications to MRI.
Figure 2. (A) Frontal radiograph of the pelvis in a 23-year old man with bilateral hip pain shows bilateral hip degenerative changes with prominence of the lateral femoral neck and bony proliferative changes of the lateral acetabulum. These findings are consistent with cam type FAI. (B) Cone down radiograph of the left hip. (C) Coronal T1 weighted MR image of the left hip confirms osseous findings and demonstrates labral tear and degeneration (arrow).

MRI
MRI is the best imaging modality for evaluating the soft tissue anatomy. At Mass General, imaging generally includes a survey of the pelvis, including the sacrum, acetabula, and proximal femora. Imaging protocols include multiplanar T1, T2, and proton density-weighted sequences with and without fat saturation. Direct MR arthrography may also be used to evaluate the intra-articular structures of the hip (in the absence of a joint effusion) with the aid of intra-articular contrast material.

Stress-related bone injuries, which are a common cause of pain among athletes, can be demonstrated in MR images as poorly margined regions of bone marrow edema, which appear hypointense on T1-weighted images and hyperintense on T2-weighted fat-suppressed images, with or without a discrete hypointense fracture line.

MRI can clearly demonstrate avulsion fractures if a tendon is attached to a bone fragment that includes some bone marrow; however, pure cortical avulsions may be difficult to appreciate. Laxity of the distal tendon and retraction may also be observed. If the sciatic nerve is compressed by an avulsed fragment or healing callous, the nerve may
show enhancement on post-contrast images. If the pubic symphysis appears to be abnormally aligned, this can indicate an avulsion of the common adductor origin, which incorporates the adductors and gracilis muscles as well as the aponeurosis of the rectus abdominis muscle. In these cases, patients may present with a palpable mass at the external inguinal ring that mimics a hernia.

Although both cam-type and pincer-type femoroacetabular impingement (FAI) can be detected on radiography, MRI with or without intra-articular contrast is the best technique for evaluating these conditions, which are thought to predispose athletes to articular cartilage and/or labral tears. MRI can confirm or exclude labral tears and cartilage damage (Figure 2), as well as subsequent damage that can result in synovitis, synovial herniation pits, bone marrow edema, and intra-articular osteochondral fragments. 3D imaging, especially CT, clearly depicts osseous anatomy such as bumps at the femoral head-neck junction that are commonly associated with cam-type impingement. In patients considering surgery, MRI is essential to evaluate conditions that might adversely affect surgical success, such as osteoarthritis, dysplasia, or instability.

Injuries to the musculotendinous structures, including avulsions, muscle strains, tendon tears, muscle contusions, and musculofascial damage, are the most common types of injury in competitive athletes. MRI can evaluate these types of injuries through examination of an entire musculotendinous unit in multiple planes and is a sensitive method of detecting subtle injuries as well as visualizing accompanying abnormalities such as hemorrhage or muscle atrophy.

Muscle strains, which usually occur due to a single traumatic event, occur at the myotendinous junction, a structure that extends well into the belly of the muscle and is proximal to the apparent tendon termination. In the pelvis and hip, the most commonly strained muscles are the hamstrings and the rectus femoris, both of which span two joints and can be injured during sprinting or kicking. Adductor muscle dysfunction may result from myotendinous strain or tenoperiosteal disease. Distinguishing between the two is important because aggressive rehabilitation of adductor strain injuries can be effective, whereas enthesopathic disease often progresses to chronic groin pain. On MRI, first-degree strains are characterized by hemorrhage at the myotendinous junction and a feathery pattern of edema (Figure 3). Second-degree strains show hemorrhage and increased fluid adjacent to the fascicles. Third-degree strains show complete disruption of the myotendinous unit, and MRI is useful for assessing the extent of tendon retraction in preparation for surgery (Figure 4).
Figure 5. (A) Axial T2 fat saturated MR image of the right hip from a hip arthrogram in a 28 year old baseball player, showing T2 hyperintensity in the gluteus minimus tendon (arrow) near its attachment on the greater tuberosity consistent with tendinosis. The adjacent gluteus medius tendon (arrowhead) is normal in appearance. (B) Axial T2 fat-saturated MR image of the left hip in a 35-year-old man, showing fluid signal hyperintensity within the gluteus medius tendon at its insertion on the greater trochanter (arrow), consistent with a partial thickness tendon tear.

Tendon tears typically occur as a result of chronic overactivity, which leads to progressive tendinosis, degeneration, and decreased tensile strength. Runners and dancers often experience acute pain to the hip and buttock due to tendinosis and tears of the gluteus medius and minimus muscles (Figure 5), accompanied by inflammation of the adjacent trochanteric bursa. On MRI, tears appear as partial- or full-thickness defects filled with T2 hyperintense fluid. Tendon retraction and muscle atrophy may also be observed.

On MRI, contusions appear as ill-defined areas of diffuse edema with asymmetric enlargement of the affected muscle. The appearance of the accompanying hematoma depends on the age of the injury. Acute hematomas appear isointense on T1-weighted images and hypointense on T2-weighted images. As the hematoma ages, T1 hyperintensity increases and T2 hypointensity decreases as the hemoglobin is metabolized to methemoglobin and hemoseridin.

Inflammation of the bursa can result from direct blunt trauma or from the chronic irritation associated with friction. For example, repeated rubbing of the iliotibial tract over the greater trochanter can cause bursitis of the superficial or deep trochanteric bursae. In this case, MRI shows a T2 hyperintense fluid collection covering the superior or lateral aspects of the greater trochanter (Figure 6). Bursitis can also occur as a result of degenerative joint disease of the hip or a hip joint effusion, which affects the iliopsoas bursa as this bursa is in contiguity with the hip joint in approximately 10-15% of people. Friction from the long head of the biceps femoris tendon over the ischial tuberosity can cause ischiogluteal bursitis.

Image-Guided Treatments

Image-guided treatments can relieve pain due to some types of sports-related injuries in the hip. A common treatment is ultrasound- or fluoroscopy-guided aspiration of fluid accumulated in bursa, which may be accompanied by injection of a steroid. Ultrasound or fluoroscopy is also used to guide the injection of local anesthetic agents and corticosteroids into the iliopsoas bursa or ischiogluteal bursa among other locations when the origin of the symptoms appears to be due to adjacent tendon or bursal abnormalities. Image-guided steroid and/or local anesthetics can also be used therapeutically to treat pain due to osteoarthritic degeneration of the hip joint or diagnostically to assess the hip joint proper as a pain generator.
**Figure 6.** Coronal T2 fat-saturated coronal MR images of the right hip in a 33-year-old woman after a fall onto the hip during ultimate Frisbee. (A) shows fluid signal hyperintensity in the superficial greater trochanteric bursa (arrow) and (B) shows fluid signal hyperintensity (arrowhead) in the deep greater trochanteric bursa. These findings are consistent with superficial and deep trochanteric bursitis.

**Scheduling**

Radiography is an appropriate first step for a suspected fracture or for a general overview of the osseous structures of the hip, including initial assessment for FAI or osteoarthritis. If an occult fracture or osteonecrosis is suspected, MRI or CT should be considered. If the clinical assessment points towards a soft tissue, intra-articular, or bursal etiology of pain, MRI with or without intra-articular should be ordered. Additionally, image-guided procedures can be used for both diagnostic and therapeutic evaluation of the groin.

Radiographic imaging for suspected sports-related injuries of the hip and groin can be performed at all Mass General facilities. MRI and CT can be performed at Mass General Imaging Waltham, Mass General Imaging Chelsea, or the main Mass General campus in Boston. Image-guided therapies are performed on the main campus only. Both diagnostic studies and procedures can be ordered online via the Radiology Order Entry (ROE) system (http://mghroe) or by calling **617-724-XRAY (9729)** for diagnostic studies or **617-724-PAIN (7246)** for image-guided procedures.

**Further Information**

For more information about imaging for sports-related injuries, please contact, **F. Joseph Simeone, MD**, Musculoskeletal Imaging, Massachusetts General Hospital, at **617-726-7717**.

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References


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Janet Cochrane Miller, D. Phil., Author
Raul N. Uppot, M.D., Editor