The diagnostic challenge of Groin Pain in adults: Review of imaging modalities and differential diagnoses

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Learning objectives

Groin pain is a yet challenging diagnostic and management dilemma for the sports clinician.

It accounts for approximately 5-18% of all athletic injuries. Nevertheless, pubalgia is not only seen among athletes but can also occur among a wide category of patients.

Disorders of pubic symphysis have been poorly understood due to the complexity of the anatomy of this region.

After a brief anatomical and biomechanical review, this article discuss imaging findings of the principal pathological aspects including traumatic injury to the adductor and rectus abdominis muscles, osteitis pubis, septic arthritis, insufficiency fractures of the pelvis, and hernias.
A. Anatomy:

Although the groin specifically lacks formal and distinct anatomic boundaries, for practical purposes it may be considered to be the area of the body that encompasses:

- Both inguinal regions
- The pubic symphysis
- The proximal aspect of the adductor compartment of both thighs.

We review fundamental anatomical features that are imperative to accurately interpret imaging findings when assessing groin pains.

The anatomy of the groin consists of a complex array of musculoaponeurotic supporting structures.

1. **Rectus abdominis muscles**:

Both lateral and medial head of each rectus abdominis muscle arise from the superior aspect of the pubic symphysis. Inferiorly, the medial head blends with its contralateral fellow. *Fig. 1 on page 7 Fig. 2 on page 7*

Anteriorly and adjacent to the rectus abdominis origin, the anterior rectus sheath covers the entire anterior aspect of each rectus abdominis and attaches onto the periosteum of the pubic bone.

2. **Adductor muscles:** *Fig. 3 on page 7*

The adductor longus arises from periosteum free bone. The anterior aspect of the adductor longus origin is usually entirely tendinous. Deep in relation to its tendon, lies a broad muscular origin of the adductor longus exists in all cases.

The adductor longus tendon has its origin almost directly in line with the origin of the more superiorly placed tendon of the rectus abdominis, with the superficial fibers of these two tendons in direct continuity, coursing over the pubic crest *Fig. 4 on page 8*. 
The tendon of the adductor longus, however, can always be identified by its characteristic triangular configuration, a constant finding in all imaging planes; it meets the opposite adductor longus. These two structures on coronal imaging become continuous (and thus continuous with both rectus abdominis muscles), resulting in a "moustache" appearance Fig. 1 on page 7.

The tendons of origin of the adductor longus and rectus abdominis form a single continuous structure, appropriately called the "common adductor-rectus abdominis" origin Fig. 4 on page 8.

The adductor brevis muscle lies farther posteriorly and slightly laterally to the origin of the adductor longus. Its separate origin may be discerned as a predominantly muscular origin posterior to the triangular moustache appearance of the adductor longus tendon.

The pectineus muscle is a flat quadrangular muscle that arises from the portion of the pubic bone lateral to the pubic tubercle, the superior pubic crest.

Of critical importance, the origin of the adductor brevis, adductor magnus and pectineous is only myo-periosteal, without any proper tendon. Some muscular fibers of adductor brevis blend with the gracilis proximal tendon. Thus, only two adductor muscles have their own tendons: adductor longus and gracilis.

The adductor longus and adductor brevis muscles possess an extensive insertion onto the femur. Combined with the distal insertion of the gracilis onto the tibia, these three tendons converge superiorly and obtain an origin close to each other on a narrow portion of the pubic body just lateral to the symphysis.

Differentiating between the tendons of these muscles at their origin is difficult; it is only further inferiorly that they are adequately discerned.

3. Pubic Symphysis:

The pubic symphysis is a complex non synovial amphiarthrodial articulation composed of a 4-mm-thick fibrocartilaginous disk interposed between the medial aspects of both pubic bones, which are in turn covered by hyaline cartilage.

A minimal amount of fluid exists within the joint and a small primary cleft, the latter developing in the disk during skeletal maturation.

The joint capsule is reinforced by the superior, inferior, anterior, and posterior pubic ligaments; however, the inferior pubic (arcuate) ligament is of the greatest functional significance. Fig. 5 on page 9
4. **Inguinal Canal:**

The inguinal canal is an oblique tunnel traversed by the spermatic cord, the floor of which is formed by the inferior margin of the external oblique aponeurosis, known as the inguinal ligament.

Laterally, the external oblique muscle attaches to the iliac crest, where it is strong.

The medial fibers of the external oblique muscle are thin and aponeurotic, forming the anterior inguinal wall and splitting medially into two fascicles at its insertion onto the pubic tubercle to form the external (superficial) inguinal ring, which allows passage of the spermatic cord.

The posterior inguinal wall is laterally formed by the weak transversalis fascia, which possesses a defect, the internal (deep) inguinal ring.

**B. Biomechanics:**

Groin pain in athletes is typically mechanical in nature, which if severe enough results in pubic bone overload. Overload of the pubic bone may be caused by a single acute traumatic event, repetitive micro trauma, or a combination of the two.

1. **In the vertical plane:**

Because the symphysis is flat and longitudinally orientated, it is most susceptible to shear stress in the vertical plane during the normal gait cycle.

The common adductor-rectus abdominis origin forms a critical anatomic and biomechanical axis, acting as dynamic stabilizers of the pubic symphysis.

Any disorder of either the common adductor-rectus abdominis origin or the pubic symphysis, as may occur with athletes exposed to repetitive micro trauma, predisposes the other to failure.

Typically, the adductor longus fails first, resulting in an overwhelmingly increased load on the smaller rectus abdominis tendon. Ultimately, when these two fail, the poor osseous congruity of the symphysis provides little resistance to instability.
Furthermore, traumatic injury of the common adductor-rectus abdominis origin may also disrupt the attachment of the posterior wall of the inguinal canal onto the anterior rectus sheath, resulting in posterior inguinal wall deficiency and, ultimately, direct inguinal hernia formation.

2. In the horizontal plane:

Horizontal compressive forces imparted by the action of the transversely orientated fibers of the internal oblique and transverse abdominis muscles combine to result in apposition of the pubic rami and hence stabilize the joint.

With excessive exercise though, the repeated action of the transversus abdominis may result in excessive compression and therefore disruption of the pubic symphysis, its disk, and surrounding structures.

Delayed or insufficient contraction of the transversus abdominis muscle has been associated with groin pain.
Fig. 1: (A,B) : coronal T2-weighted image showing medial (M) and lateral (L) heads of rectus abdominis muscle. Note inguinal ligament (IL), superior to which is the spermatic cord (S). Also note triangular tendon (T) that provides origin of right adductor longus tendon. Both of triangular tendons form the moustache appearance that is continuous with correspondent rectus abdominis muscles. Immediately lateral to pubic tubercle, is the origin of pectineus muscle (P). (C) : Soft tissue Volume rendered image showing how both medial heads of right and left rectus abdominis blends inferiorly (*) and attach onto pubic tubercle.

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Fig. 2: (A) Axial T2 weighted image in asymptomatic 51-year-old male patient and (B) tranverse cadaveric section showing rectus abdominus muscles (medial and lateral head). Note lateral abdominal muscles ( Transversus abdominis(T), interna oblique(I), external oblique(E) )

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Fig. 3: Axial T2 weighted images (A, and further inferiorly C) in asymptomatic 51 year-old patient confronted with correspondent transverse cadaveric sections (B, D) depicting anatomy of adductor muscles: Adductor longus (AL), Adductor brevis (AB), Adductor magnus (AM), Pectineus (P), Obturator externus (OE)

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**Fig. 4:** Schematic drawing and MR imaging presentation of adductor anatomy in a sagittal plane through the ramus of the pubis (P). the adductor longus (AL) attaches proximally via both muscular and tendon fibers. The insertions of the adductor brevis (AB) and adductor magnus (AM) consist of only muscular fibers. The tendon of the adductor longus (AL) blends into the distal tendon of the rectus abdominis (RA) via a common aponeurosis.

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**Fig. 5:** (A): Axial T1 weighted image of the pubic symphysis showing anterior and posterior pubic ligaments. (B): Axial proton density fat sat weighted image showing superior and accurate pubic ligament. the latter is an important stabyliser of pubis.

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Findings and procedure details

I. Procedure details: imaging approach and technique:

Assessment of patients referred to us with groin pain relied on a multitechnique approach.

1. Radiographs:

Frontal pelvic radiographs is used in the first line. Although often normal, radiographic assessment allows evaluation of symphyseal alignment and screening of the hips, sacroiliac joints, and lower lumbar spine for any disorders, which if detected, may initiate more advanced imaging of the relevant region. Focal osseous lesions of the pelvis as well as arthropathy may be detected.

The early signs of origin of common adductor-rectus abdominis’ enthesopathy can be seen. This appears as ill definition of the cortical bone at the origin of either muscle, which, if severe enough, may form distinct erosion.

Also signs of osteitis pubis can be distinguished, characterized by the presence of erosions or osteosclerosis centered at the subchondral bone on either side of the symphysis.

2. Ultrasonography:

Sonography is a primordial technique in evaluating the groin.

It has the ability to assess the common adductor-rectus abdominis origin in detail.

Careful pressure with the probe further increases the specificity of the examination should the patient complain of pain in this region.

Dynamic sonography with Valsava’s maneuvers may reveal helpful to exclude a hernia or inguinal wall deficiency with great confidence.

Overall, sonography may also be used for performing imaging guided intervention, such as PRP-injection of the common adductor-rectus abdominis origin for the treatment of tendinosis or partial-thickness tears Fig. 6 on page 17 Fig. 7 on page 17

3. MRI:
MR imaging may be performed if ultrasound is inconclusive or for presurgical assessment. It is performed in a comfortable supine position to avoid motion artifacts with an empty bladder and a surface coil. We started with assessment of wide field-of-view (FOV) to visualize the whole pelvis and first exclude various differential diagnoses (tumors, coxo-femoral disorders). Smaller FOV sequences and 40°oblique axial slices are then used to assess how the symphysis interacts with adjacent musculotendinous structures. Injection of gadolinium-based contrast agent is performed to enhance inflammatory tissue or for post-operative assessment. Table 1 on page 41

4. CT:

CT scan rarely is used to investigate groin pain in our cases. Osteitis pubis is sometimes randomly found when performing a CT scan for other causes.

II. Findings:

To categorize groin pain etiologies, we followed recent Doha consensus terminology and which is based on patient history and physical examination, and that is particularly suitable for clinical practice.

We divided findings into 5 major categories: adductor-related, iliopsoas-related, inguinal-related, pubic-related groin pain and Hip-related groin pain.

A. Adductor-related groin pain:

1. Adductor muscle tendon dysfunction:

   a) Acute tears and muscle strains:

   Acute tears may also involve the proximal musculotendinous junction of the adductor muscles, most commonly the adductor longus. If severe enough, an acute injury may result in full-thickness disruption of the adductor longus and secondary retraction of the tendon distally, resulting in loss of the moustache appearance of the common adductor origin.

   Sonography allows a satisfying assessment of muscle injuries. MRI is nevertheless considered as the imaging of choice in this field, and is used to target the location, and to accurately assess the severity and the extent of the strain. It is also crucial for monitoring complications and for evaluating treatment response objectively.
Muscle strains (grade 1 or 2) occur most commonly at the anteriorly located musculotendinous junction of the adductor longus; however, strains may also affect other surrounding muscles in isolation, such as the pectineus muscle. If an episode of trauma is severe enough, multiple muscles may be injured.

Fig. 9 on page 19  Fig. 10 on page 20  Fig. 11 on page 20  Fig. 12 on page 21  Fig. 13 on page 21  Fig. 14 on page 22  Fig. 15 on page 23  Fig. 16 on page 23

b) Tendinosis:

Sonography is able to assess adductor tendinosis. Areas of decreased echogenicity tendon origin may be noted, which is the hallmark sonographic finding of tendinosis.

Discrete anechoic clefts are consistent with partial-thickness tears.

Erosions of pubic body may also be shown as areas of interruption of the smooth hyperechoic line of the cortex of either the superior or the inferior pubic ramus. Care should be taken when assessing erosions. In fact, they may be revealing:

- Pubic symphysis arthritis, which is a common finding in athletes with pubalgia.
- Late fusion of secondary ossification centers of pubic rami that may last till the age of 26 year-old.

Tendinosis without any tear is pretty uncommon and may be seen at MR imaging as a diffuse increased signal intensity of the tendon.

Although IV gadolinium was rarely used, enhancement after its administration at the proximal enthesis and anterior pubic region correlates strongly with the clinically symptomatic side. Fig. 17 on page 24  Fig. 18 on page 24  Fig. 19 on page 25

The "secondary cleft" is indicative of chronic micro avulsion injury of the tendon fibers and possibly the inferior pubic ligament. It may be shown MRI and has a high correlation with the side of reported pain

Fig. 20 on page 25  Fig. 21 on page 26

c) Other adductor muscles injuries:

Fig. 22 on page 26  Fig. 23 on page 27  Fig. 24 on page 28
2. **Rectus abdominis Strain:**

Acute tears may also involve the rectus abdominis and are classically seen in tennis players, where asymmetric hypertrophy of the rectus abdominis muscle contralateral to the serving arm occurs. Isolated injury to the rectus abdominis origin occurs in 27% of cases, with combined common adductor-rectus abdominis origin injury occurring in 15-30% of cases.

![Fig. 25 on page 28](image)
![Fig. 26 on page 29](image)
![Fig. 27 on page 29](image)

**B. Pubic related groin pain:**

Osteitis pubis is a condition of the pubic symphysis secondary to repetitive microtrauma that induces inflammatory mediated inappropriate osteoclastic activity, ultimately resulting in osseous resorption.

Radiographic changes include irregularity of the subchondral bone plate, erosions, fragmentation, and areas of alternating osteopenia and sclerosis. If severe enough, the resorptive process may result in joint space widening (> 7 mm). With time, the symphysis may undergo accelerated degenerative changes, known as premature symphyseal degeneration.

The CT findings of osteitis pubis mirror the radiographic manifestation but may be detected earlier because of the cross-sectional nature of CT.

Pubic bone marrow edema, the earliest manifestation of osteitis pubis, is shown on MRI as an area of subchondral marrow hyperintensity on fluid-sensitive sequences. It can also be considered as an indirect sign of enthesopathy.

Pubic bone marrow edema may be subcortical, involve entire pubic body or diffuse if superior to 2cm.

- Grade I: < 2cm area at the pubic symphysis
- Grade II: >2cm area at the pubic symphysis
- Grade III: both rami of the pubic symphysis.

If osteitis pubis is allowed to progress with ongoing athletic activity, subchondral cysts and erosions may occur. The hypointense subchondral bone plate may become irregular...
or completely disappear, resulting in symphyseal irregularity, joint widening, and an effusion.

C. Hip-related groin pain:

A wide variety of hip disorders account for anterior groin pain. A thorough patient history should be taken, including incidence of trauma and exercise frequency. MR imaging as well as CT scan are complementary in the diagnostic process.

Hip-related groin pain causes are mainly represented by coxarthrosis that can also involve young adults. Avascular femoral head necrosis along with femoro-acetabular impingement have been increasingly recognized as a potential precursor and an important contributor to hip pain.

These etiologies, if non or misdiagnosed, will ineluctably lead to severe osteoarthritis.

D. Inguinal-related groin pain:

Acquired inguinal wall deficiency is an overuse phenomenon occurring in approximately 15% of athletes with groin. It is best conceptualized simplistically, involving either the anterior inguinal wall (external oblique muscle and aponeurosis), the posterior inguinal wall (transversus abdominis and internal oblique muscles), or both.

The advantage of MRI is that it allows direct visual comparison of the contralateral side; however, findings should be interpreted with caution because of the possibility of bilateral abnormalities. Treatment is the same as for anterior inguinal wall deficiency.

E. Ilio-psoas related groin pain:

1. Post traumatic iliopsoas muscle injuries: Fig. 36 on page 35

2. Snapping iliopsoas tendon:
Ultrasound may demonstrate a psoas tendon sudden jerking when investigating patient with lateralized groin pain that may occur when walking or when practicing sports especially those involving large amplitude movements (Dance, Karate).

This jerking can be sometimes secondary to coxofemoral pathology (osteocondromatosis, labral cyst). It generally engages psoas tendon and the medial head of iliac muscle. Jerking movement of the tendon in dynamic sonography is synchronous with the patient's pain and often accompanied by an audible snap.

3. **Iliopsoas bursitis**:

It generally occurs in patients with moderate coxarthrosis. Diagnosis can be made by either ultrasonography or MRI. *Fig. 37 on page 36 Fig. 38 on page 36*

F. **Other conditions causing groin pain:**

1. **Infectious causes**:

   - **Septic arthritis**:

     The predisposing factor are the same as those of spondylitis: a complication of interventions mainly urologic, contiguous spread of regional septic process, septic dissemination following blood transfusion or intravenous drug use, and during the postpartum period.

     - **Prostatitis** *Fig. 39 on page 37*

2. **Stress fracture**:

They are believed to reflect abnormal chronic repetitive stress that outstrips the bone's ability to remodel itself. The most common pelvic site of stress fractures is the inferior pubic ramus; however, stress fractures of the femoral neck are more common and also may cause groin pain.

*Fig. 40 on page 38 Fig. 41 on page 39*

Parasymphysisal stress fractures are less commonly encountered but usually are oriented parallel to the articular surface. They frequently occur with sacral stress fractures.
Parasympyseal fractures may mimic a neoplasm or infection, with areas of fragmentation or osteolysis.

3. **Insufficiency fracture:**

Fig. 42 on page 40

4. **Referred pain:**

Always remember that groin pain may be referred from other regions, such as compression of upper lumbar nerves, sacroiliitis, knee pain and thus further imaging may be necessary if no local abnormality is shown.
Images for this section:

Fig. 6: Transducer position during US examination of adductor longus

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**Fig. 7:** Normal ultrasonography of adductor muscles in the sagittal (a) and transverse (b) planes. The adductor longus tendon (ALt) lies superiorly to the bodies of the adductor longus (ALm), adductor brevis (ABm) and adductor magnus (AMm) muscles. In the axial plane, anisotropy artifacts are common due to the oblique course of the fibers of the common RA-AL aponeurosis. Note the smooth appearance of the upper side of the tendon.

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Fig. 8: Sagittal T2 turbo spin-echo weighted localizer showing orientation of the plane (lines) prescribed for axial oblique MR imaging of the pubic region (nearly 40 ° to the horizontal which should be parallel to the arcuate line)

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**Fig. 9:** US images of longus adductor full-thickness tear with proximal tendon retraction

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**Fig. 10:** US images of a small partial left longus adductor tear adjacent to central aponeurosis.

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**Fig. 11:** Adductor longus tendinopathy with a tear. Ultrasonography in the sagittal (a) and transverse (b) planes showing a proximal tear of the adductor longus tendon (white arrows).

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**Fig. 12:** Adductor longus tendinopathy with a tear. Ultrasonography in the sagittal plane (a) and fat suppressed T2-weighted image in the sagittal plane (b). A small partial tear on the deep side of the tendon

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Fig. 13: Tear of the right adductor longus with left-sided athletic pubalgia. (A) Sagittal STIR image of the pelvis demonstrates proximal full thickness tear of left AL with tendon retraction. (B-D) Axial T2-weighted fat-suppressed images show a hyperintense fluid-filled gap in relationship with AL tendon, with a fluid-fluid level consistent with an acute hematoma. E: Hematoma US guided ponction: relieves pain, warrants quick healing and reduces the risk of fibrous process.

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**Fig. 14:** Proximal rupture of the adductor longus. Fat-suppressed coronal (a) and sagittal (b, c) STIR -weighted images showing bloodpooling (white arrows) and tendon retraction (star). Note the continuity of the common RA-AL aponeurosis (arrowheads) with the tendon of the rectus abdominis

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**Fig. 15:** Axial (a) and Sagittal (b) US images : Peripheral myofascial injury in the aspect of the longus-adductor muscle.

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**Fig. 16:** PRP injection under ultrasound guidance. The tip of the needle is positioned within the tear (a, arrowheads) before PRP injection is initiated (b, arrows).

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**Fig. 17:** Areas of disorganization and decreased echogenicity of proximal insertion of adductor tendons along with microcalcification and hyperemia at color Doppler. (C): Surgical view of adductor longus tendinopathy with fibrosis and calcifications

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Fig. 18: Enthesopathy of longus adductor (A) and gracilis (B) muscles.

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Fig. 19: Bilateral chronic adductor tendinosis. (A) : Axial STIR image of the pubic symphysis demonstrates a deep lesion of rectus abdominis-adductor longus aponeurosis (arrowhead) associated with a mild hypersignal of the right adductor tendons (arrow) and associated marrow edema in the pubic body (arrowhead). (B) Axial T1-contrast enhanced image shows marked enhancement in the proximal insertion of adductor tendons, particularly on the left side, which was not clear on STIR images (dotted arrow). This finding is accounted for by the presence of fibro-cicatricial tissue.

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**Fig. 20:** Accessory cleft sign alongside the pubic body: Coronal (A) and axial (B) STIR-weighted image of the pubic symphysis in a male patient shows a broad tear of the rectus abdominis-adductor longus aponeurosis that involves both sides of the pubic symphysis (arrows)

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**Fig. 21:** Secondary cleft sign in a male patient with inguinal pain. Coronal proton density fat suppressed weighted images of the pubic symphysis depict a crescentlike area of hyperintense signal (arrows) that adjoins the high-signal-intensity of interpubic disk (dotted arrow) along anterior-inferior margins of the medial pubic body, near the rectus abdominis-adductor longus aponeurosis, and extends more posteriorly to the right (B).

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Fig. 22: Axial (A), sagittal (B) and coronal (C) STIR MR images showing Inferior pubic ramus bone marrow edema associated with a proximal tear in the left obturator externus muscle. US performed did not reveal any anomalous finding.

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Fig. 23: Fibrous scars of longus adductor muscle: linear hyperechoic lesions attached following an old muscle strain.

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**Fig. 24:** Muscle injury Type 3A. Area of intra muscular high echogenicity consistent with diffuse haematoma of pectineus muscle following a contusion.

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**Fig. 25:** Tear of the left rectus abdominis- adductor longus aponeurosis in a 20 year old man with right-sided athletic pubalgia. Sagittal STIR images of the pubic symphysis.
shows important thickening and edema at the origin of the right rectus abdominis muscle (arrow) extended to the origin of the homolateral adductor tendons (dotted arrow) and associated with muscle strain.

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**Fig. 26:** MR imaging appearance of athletic pubalgia in male. Axial (a) and sagittal (b) proton density weighted images of the pubic symphysis in a X-year-old long-distance runner show injury of both common rectus abdominis-adductor longus aponeurosis (a,b: arrows), extending to pubic periosteum (a,b: head arrows).

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**Fig. 27:** Proton-density weighted axial and coronal oblique images: Acute distal left rectus abdominis tear with mild thickening with intrasubstance signal intensity changes.

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**Fig. 28:** Radiographic of pubic symphysis: Sclerosis, erosions and irregularity of the right subchondral bone plate. Widening of the joint space attests of the severity of lesions.

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**Fig. 29:** Mild osteitis pubis in a male athlete. Coronal STIR-weighted image of the pubic symphysis shows grade III marrow edema (asterisks) that extends the both pubic bodies.

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**Fig. 30:** Axial STIR image of the pubic symphysis demonstrates grade II marrow edema to the anterior aspect of the pubic body. Adductor tendinosis must be suspected.
**Fig. 31:** Osteitis pubis in a male athlete. Coronal (A) and axial (B) STIR images show grade III marrow edema in the pubic body (asterisks). (B) Axial STIR image show the localization of marrow edema to both anterior and posterior aspect of the pubic body. Note also capsular and ligamentous hypertrophy (dotted arrows).
**Fig. 32:** Subchondral stress fracture of the right femoral head in 44 year-old male military trainer. Pelvic MRI was performed 8 weeks after onset of inguinal and groin pain. (A, B): coronal and sagittal T1-weighted image show a diffuse low signal intensity area of the left femoral head without any other apparent abnormalities. (C): Coronal STIR weighted image of the pelvis and (D) sagittal T1 enhanced non-fat-suppressed of the left femoral head depict a diffuse bone marrow edema pattern of the femoral head, with a band-like low signal intensity band convex and parallel to the articular surface, consistent with a subchondral fracture (arrowhead). Note the absence of subchondral collapse of the femoral head. (E) Coronal CT scan image performed retrospectively clearly depicts the crescent sign in the lateral portion of the left femoral head.

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**Fig. 33:** Anterior superior labral tear: coronal and axial T1-weighted arthro MR image demonstrate a tear of the anterior superior acetabular labrum at the labrocartilaginous junction (arrow). It is highlighted by a thin band of increased signal, corresponding to the contrast-filled cleft (arrows).

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**Fig. 34:** Intermittent right inguinal hernia in a 27-year-old male soldier with pubalgia. (A,B) :Axial US images show small direct inguinal hernia (medial to the inferior epigastric vessels) with protrusion of mesenteric fat after Valsalva’s maneuver(B).

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Fig. 35: Direct right inguinal hernia: US and MR images

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Fig. 36: Myofascial injury of right iliac muscle after sudden hip movement of a young dancer. (1,2) Successive axial US images of right iliac muscle demonstrate that the fascia between medial and lateral heads of iliac muscle along with their respective fibers are not correctly distinguished. Note also a hematic collection in the myotendinous junction of medial head. Psoas tendon bellow is normal.
Fig. 37: Iliopsoas bursitis US appearance: Well circumscribed homogeneous fluid collection in contact with iliopsoas muscle.
Fig. 38: Right iliopsoas bursitis in a 28 year-old male patient with mechanical inguinal and groin pain: Proton density coronal and axial MR images show a well-defined homogenous cystic mass (arrows) encasing the right iliopsoas tendon (curved arrow) at the level of its inguinal course.

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Fig. 39: Advanced septic arthritis of pubic symphysis in a 61-year-old male occurring weeks following transurethral resection of benign prostatic hyperplasia. (A) Axial US image of pubic symphysis showing erosions and cortical irregularities of pubic body (arrowheads) associated with an anterior heterogeneous fluid collection. (B,C) Coronal proton-density-weighted images demonstrate pubic symphyseal widening with intraarticular effusion and marked irregularities in the pubic articular surfaces (arrows). Note also marrow edema that extends throughout both pubic bodies, into the superior pubic rami and more importantly to the adductor muscles and to rectus abdominis muscles. (D, E) Axial and coronal oblique contrast-enhanced MR images shows marked enhancement in this area with multiple rim enhancement collections in adductor muscles consistent with intra muscular abscesses (arrowheads). (F) Axial contrast enhancement image and (G) corresponding axial contrast enhancement fused image depict the presence of a fistula (arrow) originating from the prostate gland.

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**Fig. 40:** Fracture of the inferior and superior pubic rami after recurrent high energy traumas in a 34- year-old male recruit mimicking a neoplastic lesion. (A) Plain radiograph shows fractures with of left pubic rami beginning of callus formation (arrows). (B) Coronal T2-weighted fast spin-echo MR image and (C) coronal T1-weighted image show an oblique irregular fracture line through the overlying callus formation and high signal intensity around the adductor muscles. (D) Coronal enhanced non fat-suppressed T1-weighted image doesn't show any suspicious enhanced lesion.

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Fig. 41: A traumatized ischiopubic synchondrosis (IPS) in a 13 year old female amateur cyclist: Pelvic MR imaging performed 2 months after onset of mechanic groin pain. (A,B) respectively coronal T1 and T2 FAT SAT sequence showing edematous signal alteration of left inferior ischiopubic ramus and to adjacent muscles (obturador muscles, and the proximal adductor magnus). (C) Axial STIR sequence showing bone marrow edema centered by a heterogeneous lesion in left ischiopubic synchondrosis. (D) Sagittal oblique reformation CT image show lines of fracture( arrows) visible through an overlying callus formation of ischiopubic synchondrosis. Follow-up MRI performed after months of bed rest showed gradual disappearance of imaging abnormalities.

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**Fig. 42:** Left sacral alar insufficiency fracture in a 61-year-old female patient complaining of chronic inguinal pain. Frontal pelvic radiograph showed diffuse bone demineralization. (A,B): Coronal T2-weighted MR image shows high-signal-intensity marrow edema throughout the left sacral alar. (C): Axial T1-weighted MR image and (D) axial T1 non-fat-suppressed contrast enhancement MR image demonstrate complete fracture line paralleling the sacroiliac articular surface (arrow).

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Conclusion

The radiologist plays a pivotal role in the assessment of patients with groin pain and it is entirely appropriate that a multitechnique approach is commonly used.

A knowledge of the anatomic framework of the structures present and familiarity with the imaging manifestations allow either an accurate diagnosis to be made or a relevant list of differential diagnoses to be formulated.

Diagnostic imaging will allow in most cases timely and appropriate treatment in this clinical setting.

The treatment is generally conservative, initially with a period of rest, followed by progressive strengthening muscles. Surgery is rarely used, being reserved for full-thickness tears or in a setting in which conservative measures have failed.
References


