Ultrasound of Groin Pain and Around

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Imaging review of groin pain and around: An anatomic approach

- Groin Pain or Athletic Pubalgia
  - Abdominal Wall Weakness / Hernias
  - Osteitis Pubis
  - Adductor’s Tendinopathy
- Ilio psoas
- Proximal Rectus femoris
- Lateral hip pain syndrome
  - Gluteal Aponeurotic Fascia and Proximal Iliotibial Band
  - Greater Trochanteric Pain Syndrome
1 Athletic Pubalgia
Groin Pain in Athletes or Athletic Pubalgia

- Groin pain in athletes accounts for 5% to 23% of all sports injuries.
- These injuries are attributable to kicking or twisting mechanisms and are most common in soccer or rugby players.
- It can occur either as a single acute episode or as a culmination of repetitive microtrauma.
- Athletic pubalgia represents a constellation of pathologic conditions occurring at and around the pubic symphysis.
- The Doha agreement was formulated to promote a standard characterization of groin pain etiology, composed of adductor-, iliopsoas-, inguinal-, and pubic-related groin pain in addition to hip or other causes of groin pain.
Doha agreement meeting on terminology and definitions in groin pain in athletes *Br J Sports Med.* 2015

- Inguinal-related groin pain
- Abdominal Wall Weakness / Hernias
- Osteitis Pubis / Clefts
- Adductor-related groin pain
A hernia is “the protrusion of a part or structure through the tissues normally containing it”

External abdominal hernias are usually found in the inguinal region, where most are direct and indirect inguinal hernias and femoral hernias.
The three lateral muscle layers (external oblique, internal oblique, and transversus abdominis) form an aponeurosis that extends toward midline over the rectus abdominis muscle.

The transversalis fascia is located deep in relation to these structures.

The inguinal canal traverses these muscle and fascial layers, containing vascular and neural structures, and the spermatic cord (in men) or round ligament (in women).

Inguinal canal borders are:
- Deep ring within the fascia transversalis
- Superficial ring within the external oblique aponeurosis.
The **inguinal ligament** (Poupart's ligament or groin ligament) is a band running from the pubic tubercle to the anterior superior iliac spine.

- **superior border** = internal oblique & transverse muscles
- **inferior border** = the inferior border of Inguinal canal.

The **inferior epigastric artery** originates from the external iliac artery proximal to the inguinal ligament, initially passing along the medial boundary of the deep inguinal ring, and ascends obliquely and medially to the rectus abdominis muscle aponeurosis.
The inguinal ligament and the inferior epigastric artery divide the inguinal region into three primary anatomic areas:

- The inguinal or **Hesselbach’s triangle** is bounded inferiorly by the inguinal ligament, medially by the lateral margin of the rectus abdominis, and superiorly by the inferior epigastric artery.

  ➔ Direct Hernia

- The **femoral region**: lateral to lacunar ligament (L) and inferior in relation to medial inguinal ligament.

  ➔ Femoral Hernia

- The **deep inguinal ring**: lateral to the inferior epigastric artery and just above the inguinal ligament.

  ➔ Indirect Hernia

View from within the Abdomen

L : Lacunar Ligament = medial reflection of the inguinal ligament

C : Conjoint Tendon = Condensation of the internal oblique and transversus abdominis aponeuroses
The several sites prone to herniation are:

1. the deep inguinal ring:
   - → Indirect Hernia (most common regardless of sex)
   - lateral to the inferior epigastric artery and superior to the inguinal ligament

2. the inferior aspect of the Hesselbach’s triangle:
   - → Direct Hernia
   - Lateral to the conjoint tendon and medial to the inferior epigastric artery

3. under the inguinal ligament:
   - → Femoral Hernia (♀)
   - medial and adjacent to the femoral vessels. and lateral to the lacunar ligament
Sonographic Technique and Appearances

Because the inguinal region structures are superficial, a linear transducer of **12 MHz or greater** is effective,

I begin the examination with the patient **standing**, arms in the back.

The examination of the inguinal region is done with the patient **supine**

It is essential to ask the patient to increase abdominal pressure (**Valsalva maneuver**) at each of the sonographic steps to identify transient hernias.

In many patients the hernia may be completely **reduced at rest**

It is also important to evaluate for **reducibility** and **bowel viability** identified by peristalsis or mucosal blood flow.
Direct Inguinal Hernia

- Probe horizontal starting on the Rectus Abdominis muscle.
- Elevator technique down to follow the inferior epigastric artery.
- Landmarks: Rectus Abdominis Muscle, Inferior Epigastric Artery
- Post-Valsalva maneuver sonogram shows direct inguinal hernia between the Rectus Abdominis Muscle and the inferior epigastric artery medially.
- Acquired hernia, linked to a muscular weakness with "direct" path, perpendicular to the skin.
Indirect Inguinal Hernia

- Probe horizontal starting on the Rectus Abdominis muscle.
- Elevator technique down to follow the inferior epigastric artery up to its origin from the external iliac artery.
- Landmarks: External Iliac Artery, Inferior Epigastric Artery, Spermatic Cord.
- Post-Valsalva maneuver sonogram shows indirect direct inguinal hernia lateral to the inferior epigastric artery. Extends inferomedially follows the spermatic cord, presents an external oblique path, may reach the pubic tubercle and exit the superficial ring and may enter the scrotum in a man.
- Congenital hernia in the young patient, acquired in the older subject.
Femoral Hernia

Probe parallel to the inguinal ligament

Landmarks: Inguinal Ligament  Superior Pubic Ramus  Pectineus Muscle  Femoral Vein

Post-Valsalva maneuver sonogram shows dilated femoral vein (V) lateral to femoral hernia (arrows).
Sports Hernia

- Misnomer as there is no classical herniation of soft tissue
- Typically affect young males who actively participate in sport
- Weakness without hernia of the abdominal wall
- May lead to ilio-inguinal and ilio-hypogastric nerve entrapments.
- Poor imaging signs
The pubic symphysis = midline sagittal joint comprised of an articular disc bordered by the bodies of the pubic bones, which are lined by hyaline cartilage.

The joint is stabilized by a 4 ligaments, the anterior, superior and posterior pubic ligament, the arcuate ligament inferiorly.

Muscular interconnected attachments include the anterior abdominal musculature (external oblique, internal oblique, rectus abdominis, and transversus abdominis) and adductor muscle groups (adductor brevis, adductor longus, adductor magnus, gracilis and pectineus).
The rectus abdominis and adductor longus provide the greatest stability to the pubic symphysis.

The rectus abdominis and adductor longus share a common aponeurosis over the anterior pubic body and counterbalance one another particularly during cutting motions.

The rectus abdominis and adductor longus both attach to the capsule and disc of the pubic symphysis.
The rectus abdominis adductor aponeurosis changes direction at the pubic symphysis. He merges with the pubic symphysis capsular tissues and extend inferiorly in a sheet of tissue in continuous with the origin of both adductor longus tendons.
Rectus Abdominis

- Anatomical and functional imbalances in these muscle chains will repeatedly expose Pubic Bodies to supraphysiological shear stresses and cause overload injury to adjacent non-contractile structures.

- The Rectus Abdominis can be damaged by imbalances of strength or endurance.

- Their small area of attachment on the pubis makes them vulnerable.
Pubic symphysis disorders

- Microtraumatic - Occurs in more than 50% of patients suffering from pubalgia
- May be asymptomatic
- Only seen by MRI
- Common signs: erosions, osteophytes, joint space narrowing
- Subchondral bone marrow edema if active lesions
Adductor’s tendinopathy is one of the main causes of athletic pubalgia.
Adductor Longus tendinopathy represents one third of pubalgia with surgical issue.
Adductor Longus is the thickest and most anterior tendon and has a major functional role. Its anatomic relationships explain why tendinous disorders and symphysic pubitis are often associated.
Others adductors structures are less involved:
- Gracilis and Pectineus enthesopathies are less common
- Adductor magnus and brevis have a muscular insertion
The medial muscular group is organized into 3 levels:

- **Superficial plane**: Pectineus, Adductor Longus, Gracilis
- **Midplane**: Adductor Brevis
- **Deep plane**: Adductor Magnus
Origin of the adductor longus
- 40%: tendinous
- 60%: muscular

Origin of the adductor brevis, adductor magnus and pectineus
- myo-periosteal
- no tendon +++

Proximal origin of the adductor muscles is mainly muscular

Tendinous structures are anterior
Adductor Longus and medial Gracilis
Anatomic and functional unity $\iff$ continuity Rectus Abdominis/Adductor Longus

Fusion between tendinous fibers of gracilis and adductor brevis
Superficial layer

- Fusion between superficial aponeurosis of the external oblique and RA

Deep layer

- Fibrocartilaginous enthesis of the Adductor Longus
- Fusion with the capsular fibers of the symphysis
Adductor-related groin pain: Ultrasound assessment

Lower limb in abduction and external rotation
Longitudinal-axial planes
Many lesions can be highlighted at ultrasound:

- At US, **anisotropy artefact** should be avoided and may be due to the oblique course of the AL tendon.
- Care should be taken when assessing the tendons: it is important to assess the fibers the most parallel to the probe.
- the Adductor Longus tendon is **not fibrillar but hypoechoic and heterogeneous**. Such abnormalities may be due to prior fibrosis and microtearing due to over-stretching forces.
- **Superficial irregularities** of the tendons are common. They may be due to the decussation of the fibers from the superficial layer or caused by a superficial tear of the tendon.
Many lesions can be highlighted at ultrasound:

- **Cortical erosions** may be due to pubic symphysis osteoarthritis. They are a common finding in athletes with pubalgia. Associated with soft tissue abnormalities in 50% and isolated in 40% of patients suffering from pubalgia.

- **Calcifications** are common, usually multiple, thin without acoustic shadow and undetectable at X-rays or MRI.

- **Hyperemia** is an uncommon finding in adductor’s tendinopathy.
② Iliopsoas-related groin pain
Underestimated pathology - Complex anatomy

The medial (Med) fibers of the iliacus muscle join the psoas major tendon to form the iliopsoas tendon distal to the superior pubic ramus, while the lateral (Lat) fibers of the iliacus muscle insert directly onto the anterior aspect of the lesser trochanter.
US assessment of the iliopsoas

- The patient lies supine, and the probe is placed between the AIIS and superior pubic ramus in a transverse oblique plane.

Main pathology:
- Musculotendinous Injuries
- Tendinosis
- Internal Snapping Hip Syndrome
- Iliopsoas Bursitis
Musculotendinous Injuries

- rare in the general population (prevalence of 0.66%)
- associated with sports that involve kicking and jumping, such as football, basketball, and gymnastics
- Partial tendon tears and strains are more common in younger individuals,

Iliopsoas tendinopathy = described after acute and overuse injuries, as well as in association with osteophyte or hip arthroplasty impingement and internal snapping hip syndrome.
Iliopsoas bursitis:

- in conjunction with a primary intra-articular disease extending into the bursal space
- or secondary from adjacent pathologic processes such as iliopsoas musculotendinous injuries or internal snapping hip syndrome

As the patient performs combined hip flexion, abduction, and external rotation, the medial fibers of the iliacus muscle (MI) become trapped between the psoas tendon (PT) and Superior Pubic Ramus (SPR).

On hip extension and adduction, the medial iliacus suddenly disengages from underneath the psoas tendon, causing the psoas tendon to return abruptly against the SPR, thus producing the snapping phenomenon.
③ Proximal Rectus femoris
Proximal Rectus femoris

- The most superficial and anterior part of the quadriceps muscle group

- The rectus femoris has two components:
  - a direct (straight) head that originates at the anterior inferior iliac spine (AIIS)
  - an indirect (reflected) head that attaches along the superolateral aspect of the acetabulum

- Both heads join just inferior to the AIIS, forming the conjoint tendon.

- The musculotendinous junction of the direct head is flat and thin; its tendinous fibers blend with the proximal fascia superficially.

- The indirect tendon component has a horizontal ovoid or comma-like shape, and extends to the inferior third of the muscle.
US assessment of the Rectus Femoris

- The patient is placed in a supine position with the hip in extension and the probe in a longitudinal plane over the Antero Inferior Iliac Spine (AIIS).
- The hyperechoic direct head (D) insert on the AIIS.
- The indirect head (I) is obliquely oriented toward its origin along the lateral aspect of the acetabulum and appears hypoechoic because of anisotropy.
Most commonly injured muscle of the hip flexors and ranks second behind the hamstrings in athletes

Sports injuries tend to occur in activities involving sprinting and kicking, especially when the hip is hyperextended and the knee is flexed, such as in rugby and football, with the dominant leg often preferentially involved

Traumatic injuries are classified according to the location of the abnormality.

- Proximal tendon injuries near the muscle origin are less common in adults (0.5% of all rectus femoris injuries)
- Musculotendinous strains of the indirect head (central aponeurotic strain) are the most common pattern of injury
- Musculotendinous injuries of the direct head are uncommon
**Tendinosis** is based on encountering a thickened and hypoechoic appearance with loss of fibrillar structure compared with the other side.

**Calcific tendinitis** occurs mainly in the direct head and is due to hydroxyapatite deposits.

A proximal tear can be partial or complete. In the case of partial tear, there may be a discrete amount of fluid around the tendons and the MTJ but the continuity remains intact. In complete tear of direct head there is important muscle retraction and hematic effusion. Partial tears of the DH are more common than those involving the IH.
Variable appearance of injuries

An **acutely injured central tendon** may appear at US as ill defined, thickened, and heterogeneous, and the edema around the tendon may confer a classic bull’s-eye appearance on transverse US images.

**High-grade strains** may manifest as complete disruption of the musculotendinous junction, with varying degrees of tendon retraction, and may sometimes mimic a soft-tissue mass.

![Normal](image1)

![Normal](image2)

![Normal](image3)
Musculotendinous injuries of the direct head are uncommon.
④ Lateral Hip Pain Syndrome
In the younger, more athletic population, lateral hip pain syndrome has different etiology, often related to overuse injuries resulting in:

- gluteus minimus or medius tendon tears,
- traumatic trochanteric bursitis,
- snapping hip syndrome,
- and proximal iliotibial band.
The iliotibial band (ITB) has an insertion at the iliac tubercle and passes along with the gluteus maximus (red outline) superficial to the greater trochanter.

The gluteus maximus superior fibers insert into the posterior aspect of the iliotibial band (ITB).
The great trochanter consists of four facets: anterior, lateral, superolateral, and posterior.

The gluteus medius has two insertions on the greater trochanter: the main more posteriorly located tendon inserts onto the superolateral facet, while its anterior portion inserts onto the lateral facet.

The gluteus minimus has an insertion onto the anterior facet of the greater trochanter.

The gluteus maximus muscle does not have an attachment on the greater trochanter but courses superficially over the posterior facet and is separated from it by the trochanteric bursa.
US assessment of the lateral hip region.

The patient lies in the lateral decubitus position with the knees in slight flexion.

For assessment of the peritrochanteric region, the probe is placed in a transverse and longitudinal plane over the lateral aspect of the greater trochanter.

- To explore the Gluteus Minimus, the probe is oriented toward the Antero Superior Iliac Spine (ASIS).
- To explore the anterior portion of the Gluteus Medius, the probe is strictly longitudinal.
- To explore posterior portion of the Gluteus Medius, the probe is oriented toward the Postero Superior Iliac Spine (PSIS).

For assessment of the proximal ITB, the probe is placed in a longitudinal plane over the iliac tubercle (longitudinally oriented probe).
Greater Trochanteric Pain Syndrome

- most commonly associated with gluteus medius and minimus tendinous derangements and much more rarely involves the peritrochanteric bursae
- classically found with sports-related injuries more common in runners
- Calcific tendinopathy of the gluteal tendons associated with hydroxyapatite deposition disease is another cause of GTPS
Greater Trochanteric Pain Syndrome

- **Gluteal tendinopathy** identified as hypertrophy of the tendons and a diffuse hypoechoic appearance.
- Foci of dystrophic **calcification** can also be identified, while findings of neoangiogenesis at color or power Doppler US are less common.
- Greater **trochanteric bursitis** = hypoechoic fluid collection located deep to the gluteus maximus muscle and ITB and superficial to the greater trochanter.
Proximal ITB Syndrome

- Described in athletes presenting with isolated pain at the iliac tubercle and the inferior lip of the iliac crest
- = overuse-associated enthesopathy of the ITB fibers originating at the iliac tubercle
- female preponderance
- US: thickened hypoechoic ITB observed at the iliac tubercle in comparison with that of the normal contralateral side
External Snapping Hip Syndrome

- Represents abnormal transient “subluxation” of the junction between the ITB and the anterior margin of the gluteus maximus muscle, over the greater trochanter of the femur, accompanied by a painful clicking or popping sensation at the lateral hip.

- During normal movement, the ITB and the anterior margin of the gluteus maximus glide smoothly anteriorly over the lateral facet of the greater trochanter on hip flexion and posteriorly on extension.
External Snapping Hip Syndrome

In external snapping hip syndrome, during the early phase of flexion, the ITB and the anterior aspect of the gluteus maximus are transiently caught over the posterolateral aspect of the greater trochanter; as the flexion angle increases, the two structures are then released and produce the audible snap.

A similar mechanism may occur when the hip is moved from flexion to extension.
Three external abdominal hernias are found in the inguinal region: direct and indirect inguinal hernias and femoral hernias.

With three landmarks: the rectus abdominis, the Inferior Epigastric Artery, the inguinal ligament.

The rectus abdominis adductor aponeurosis merge with the pubic symphysis capsular tissues and extend inferiorly with the origin of both adductor longus tendons.

Adductor Longus tendinopathy represents one third of pubalgia with surgical issue.
Take Home Points 2

Main pathology of ilio psoas are: Musculotendinous Injuries Tendinosis Internal Snapping Hip Syndrome Iliopsoas Bursitis.

The rectus femoris has two components:
- a direct (straight) head that originates at the anterior inferior iliac spine blend with the proximal fascia superficially
- an indirect (reflected) head that attaches along the superolateral aspect of the acetabulum and has a horizontal ovoid or comma-like shape, and extends to the inferior third of the muscle

lateral hip pain syndrome has different etiology, resulting in gluteus minimus or medius tendon tears, traumatic trochanteric bursitis, snapping hip syndrome, and proximal iliotibial band.