Anatomical and pictorial review of MRI findings in patients with athletica pubalgia - A trainees guide

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Learning objectives

Athletica pubalgia is a clinical diagnosis describing chronic groin pain in physically active patients. The symptoms are often non-specific and poorly localised, and so the diagnosis of athletica pubalgia in fact incorporates a wide range of pathologies/injuries related to anterior pelvic stability.

Imaging therefore plays an important role in defining the causative pathology/injury. MRI and ultrasound are both used for this purpose, however in this poster we will concentrate solely on MRI imaging.

An increasing reliance on cross-sectional imaging and varied referral pathways for patients with non-specific chronic groin pain, means that radiologists with differing special interests (not just musculoskeletal) are requested to report these MRI examinations. For this reason, almost all radiologists need to be aware of key groin anatomy and characteristic MRI findings. In view of this, every trainee radiologist needs to have a good grasp of the relatively complex anatomy in this region.

Our aim is

1. To review the normal anatomy of the inguinal canal, common adductor: rectus abdominis aponeurosis, adductor muscles and trochanteric bursa.
2. To provide pictorial MRI examples of common and 'not to be missed' pathologies that are found on MRI groin examinations for chronic groin/pelvic pain.

Background

MRI is commonly requested for assessment of patients with non-specific chronic groin. This is partly because it gives good anatomical detail and soft tissue resolution but also because bones, joints and soft tissue structures can be assessed in one reproducible examination. Dynamic MRI imaging is also now possible, to also help differentiate reducible hernias. Most protocols incorporate axial, coronal and sagittal T1 weighted sequences and either T2 weighted fat saturated or STIR sequences.

Pelvic anatomy is complex with many musculotendinous attachments and aponeuroses to assess and many opposing/stabilising forces occurring in this region. However, our hope is that by the end of this poster you will have a good grasp of the important anatomy and signs of pathology/injury in this region.
Anterior/Medial Pelvic Anatomy

- **Pubic Symphysis and Common Adductor: Rectus Abdominis Aponeurosis:**

The anatomy around the pubic symphysis is complicated because of the multiple converging structures providing dynamic stability. Disruption of any of these elements could potentially upset this fine balance.

The pubic symphysis is designed to resist shearing and compressive forces. In order to do this, the pubic bones have serrated edges, and are lined with hyaline cartilage. These then articulate with a central fibrocartilaginous disc. There are also four pubic ligaments (superior, inferior, anterior and posterior) that pass across the symphysis providing further reinforcement. The underlying fibrocartilaginous disc blends with these ligaments.

The muscles of the anterior abdominal wall (rectus abdominis, transversus abdominis and internal and external obliques) and thigh adductors (adductor longus, brevis, magnus, pectineus and gracilis) attach around the pubic symphysis. Rectus abdominis and adductor longus are considered the most important component of anterior pelvic stability, and act as antagonists to each other. Fibres of these two muscle origins blend together forming a common aponeurosis, attached to the anterior periosteum of the pubic body and merging with the anterior pubic ligament (that blends with the interpubic fibrocartilaginous disc). **Fig. 1** on page 4 and **Fig. 2** on page 6

- **Adductor muscle group:**

The adductor longus, brevis, magnus, and gracillis in the medial thigh converge to insert very close to each other on the anterior pubic bone. The anatomy of the adductor tendons and muscular attachments can vary, but a consistent finding on MRI is of a triangular low signal structure that attaches to the anterior pubis, inferior to the pubic crest, representing the adductor longus tendon. **Fig. 3** on page 6

The attachment of these muscles is small relative to the load/stress on them during exercise making them more prone to injury.

- **Inguinal ligament and Inguinal canal:**

Anatomical knowledge of the inguinal canal, in particular, the position of the deep ring, is important to allow characterization of the different types of inguinal hernia (direct or indirect). The inferior epigastric arteries (IEA) are the key to this.
The inguinal ligament forms the base of the inguinal canal as it runs from the anterior superior iliac spine laterally, to the pubic tubercle medially. It is also the inguinal ligament that provides the anatomical division between the external iliac and common femoral vessels, thus splitting inguinal and femoral hernias by their relationship to it - inguinal hernias seen above the inguinal ligament and femoral hernias below.

The inguinal canal is shorter than the inguinal ligament, lying superior to only the medial half of it. Its purpose is to allow the passage of the spermatic cord (in males) and round ligament (in females) across the anterior abdominal wall musculature/aponeuroses. Fig. 5 on page 8

Why are the inferior epigastric arteries important?

The inferior epigastric arteries (IEA) arise from the external iliac arteries bilaterally and then run beneath the anterior abdominal wall musculature, towards the midline.

The position of the deep ring of the inguinal canal is really only identifiable on cross sectional imaging by its relationship to the IEAs; lateral and superior to their origin. Therefore, a hernia sac originating **lateral** to the origin of the IEA is a hernia through the deep ring of the inguinal canal; i.e. an **indirect** inguinal hernia. A defect in Hesselbach's triangle; an inherently weaker part of the lower abdominal wall, causes a **direct** hernia and is seen **medial** to the origin of the IEA.

**Relevant Lateral Pelvic Anatomy**

- **Trochanteric bursa complex**

The trochanteric bursa complex is situated between the greater trochanter and the gluteus tendon insertions on the greater trochanter and comprises three bursa:

1/ Subgluteus maximus bursa - lies posterior to posterior facet of trochanter

2/ Subgluteus medius bursa - lies between the lateral facet and gluteus medius tendon

3/ Subgluteus minimus bursa - lies anterior to anterior facet

**Images for this section:**
**Fig. 1:** Schematic diagram of a sagittal section through the pubic symphysis. The common adductor: rectus abdominis aponeurosis is seen attached to the anterior aspect of the pubic symphysis.

**Fig. 2:** Schematic coronal diagram of the common adductor: rectus abdominis aponeurosis (indicated by the arrow)
**Fig. 3:** Coronal STIR image at the level of the pubic symphysis. The arrow points at the low signal triangle of the adductor longus osteo-ligamentous attachment.
Fig. 4: Axial T1 MR image at the level of the inferior aspect of the pubic symphysis. This demonstrates the attachments of the adductor longus (AL), adductor brevis (AB) and adductor magnus (AM) from anterior to posterior, attaching to the inferior pubic ramus. Pectineus muscle (P) is also labelled.
Fig. 5: Schematic drawing of the inguinal canal. The inguinal ligament runs from the anterior superior iliac spine to the pubic tubercle providing the anatomical division between the common femoral artery (A) and vein (V) and external iliac vessels. The deep ring is seen lateral to the origin of the internal epigastric artery (IEA).
Athletica Pubalgia causes a clinical diagnostic challenge due to its non-specific and poorly localised symptoms, therefore imaging plays an important role. As discussed in the anatomy section, the anterior pelvic stability is a complex since it is reinforced by interconnecting ligaments, aponeuroses and pubic symphysis. However with the knowledge and imaging appearance of normal anatomy it is possible to guide your MRI reporting so that these structures are reviewed routinely and the patient receives the appropriate treatment for their injury/pathology.

**Anterior/Medial Pelvic Injury**

- **Common adductor: rectus abdominis aponeurosis (CA:RA) and adductor longus tendon origin tears**

A tear can occur anywhere within the sheet-like CA:RA aponeurosis i.e within the rectus abdominus tendon, adductor tendon, the aponeurosis itself or the aponeurosis can separate from the anterior surface of the pubic symphysis to which it is normally adhered. On axial imaging asymmetry of the lower rectus abdominis fibres is suggestive of a previous injury. Sagittal imaging is also useful in assessment of this region. Fig. 6 on page 12.

A marker of an adductor longus tear is a 'secondary cleft sign' (seen on fluid weighted coronal sequence) where high signal is seen to extend inferiorly and laterally from within the pubic symphysis (primary cleft), beneath the low signal triangle (adductor longus tendon osteoligamentous attachment), forming a secondary cleft. Fig. 7 on page 13

It is important to describe the exact location of the tear since rectus abdominus tears are often treated surgically whereas adductor tears are often conservatively managed with steroid injection.

- **Osteitis pubis:**

This is defined as inflammation at the pubic symphysis and is thought to be due to repetitive shear forces/injury across this region.

High T2/STIR signal are seen in the pubic bodies, either side of the pubic symphysis, indicating bone marrow oedema. If this is a chronic injury then reduction in joint space and osteophyte formation are often seen to accompany the bone marrow oedema. Fig. 8 on page 14
As described previously, the pubic symphysis/ pubic ligaments merge with the CA:RA aponeurosis. Therefore osteitis pubis is frequently associated with/ caused by an adjacent injuries (e.g. an adductor tear - see above).

- **Inguinal hernias**

These are usually suspected clinically however occasionally this is not clinically evident or needs further assessment regarding the contents, extent and location of the hernia sac.

Remember:-

* **Indirect** - the neck of the sack lies lateral to the internal epigastric artery origin Fig. 9 on page 15

* **Direct** - the neck of the sack lies medial to the internal epigastric artery origin Fig. 10 on page 16

**Lateral Pelvis/Hip Abnormalities**

- **Femoral Hernias:**

Femoral hernias can be differentiated from inguinal hernias by their relationship to the inguinal ligament. Unlike inguinal hernias, that lie above the inguinal ligament. A femoral hernial sac is also seen to follow the femoral vessels inferiorly and can compress the femoral vein within the femoral canal.

Differentiation between femoral and inguinal hernia is important because the location of incision for the hernia repair is different depending on the type of hernia.

- **Trochanteric bursitis**

Trochanteric bursitis is inflammation of one of the many trochanteric bursae. It characteristically presents with lateral hip pain and tenderness over the greater trochanter, however the pain can be non-specific and gluteus minimus/medius tendon tears can cause similar symptoms/signs, or indeed be responsible for the bursitis. For this reason recent literature tends to refer to greater trochanteric pain syndrome, encompassing all causes of pain in this region. However, treatment varies depending on the cause and therefore differentiation of the different pathological processes causing the pain is important (e.g. tendon tears, as these may require surgical repair).

On MRI it is seen as unilateral or asymmetrical increased signal on fluid weighted sequences in the region of the bursae. Fig. 11 on page 17
Other important findings

- **Paralabral cysts** are suggestive of a likely underlying labral tear. An MRI arthrogram examination would confirm. Fig. 12 on page 18

- **Avascular necrosis** of the hip is a relatively common finding with the characteristic findings of serpiginous linear low signal in the subchondral femoral head, with preserved central marrow fat, adjacent bone marrow oedema and later on depression/impaction of the femoral head. Often avascular necrosis is due to a systemic process and therefore this finding is frequently bilateral but may not be synchronous. Fig. 13 on page 19

- **Sacroiliitis** is another cause of pelvic pain - MRI findings of this include high T2/STIR signal in the bones either side of the joint, joint space reduction and joint line sclerosis. Commonest causes are seronegative inflammatory arthropathies and inflammatory bowel disease. Sometimes these MRI abnormalities are the presenting findings of unsuspected underlying disease. Fig. 14 on page 20

Due to the large number of possible different pathologies around this region, avulsion and stress fractures will not be included in the discussion although they are also a potential cause of non-specific groin pain.

**Images for this section:**
**Fig. 6:** Sagittal STIR image, just lateral the pubic symphysis, in a patient with imaging features of chronic osteitis pubis. There is oedema of the symphysis pubis. Fluid is seen tracking superiorly from the pubic symphysis (deep to the lower rectus abdominis (RA) fibres), and there is thickening of the CA-RA aponeurotic region (see arrow), that suggests a chronic injury. This could potentially be contributing to the instability that has caused osteitis pubis.
**Fig. 7:** Adductor longus tear with secondary cleft sign - Coronal STIR image demonstrates high signal extending from within the pubic symphysis (primary cleft) inferiorly and to the left (see wide arrow - the secondary cleft sign) beneath the (partially detached) dark triangular insertion of the adductor longus tendon. High signal within the insertional fibres of adductor longus is consistent with a partial tear (thin arrow).
Fig. 8: Coronal STIR image of the pubic symphysis. High signal is seen in the pubic bodies bilaterally consistent with bone marrow oedema. An osteophyte (see arrow) is seen on the superior aspect of the pubic symphysis suggesting that this is a chronic injury.
**Fig. 9:** Axial T1 image demonstrating the inguinal hernia neck seen originating lateral to the internal epigastric artery (IEA) origin meaning that this is an indirect inguinal hernia.
Fig. 10: Axial T1 sequence demonstrating the inguinal hernia neck seen medial to the origin of the internal epigastric artery (IEA) meaning that this is a direct inguinal hernia. This is probably due to weakness in this region secondary to the previous hernia surgery - note the fat stranding anterior to the hernia sac consistent with post-surgical scarring.
**Fig. 11:** Trochanteric Bursitis - STIR coronal image demonstrating asymmetrical increased signal intensity paralleling the left greater trochanter (see arrow)
Fig. 12: Paralabral Cyst - Coronal STIR image demonstrates a cyst adjacent to the superior labrum (see arrow), suggesting an underlying labral tear
Fig. 13: Avascular necrosis of the left femoral head - Coronal T1 image demonstrating the serpiginous subarticular low signal rim (see arrow) with fat in centre of the lesion.
Fig. 14: Sacroiliitis - Axial STIR image demonstrates high signal in the anterior aspect of sacral ala (see arrow) and ileum, either side of the left sacroiliac joint.
Conclusion

Although the pelvic anatomy is complex we hope that this poster explains clearly and concisely the important anatomy/structures to identify at MRI as well as the varied causes of chronic groin pain/athletic pubalgia and their image findings.

In particular, the importance of the relationship of the deep inguinal ring to the origin of the internal epigastric arteries and the difference between femoral and inguinal hernias. Also the idea of the common aponeurosis joining the rectus abdominus, pubic symphysis and adductor longus.

References


Personal Information