Role of MRI in diagnosis of acute groin pain in football players

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Purpose

**Purpose:** To analyze input of MRI in case of acute groin pain in professional football players and to determine the contribution of MRI in diagnosis and management of this pathological condition.

**Background:** Groin pain is typically an overuse injury due to excessive athletic activity [1-2]

The term groin pain is the preferred label that refers to a spectrum of musculoskeletal injuries that occur in and around the pubic symphysis and that share similar mechanisms of injury and common clinical manifestations [3]

Athletic pubalgia (sports hernia) is a cluster of distinct injuries that are grouped together because of the common location of pain, overlapping activity triggers, and lack of physical exam findings.

Most injuries to athletes result from a single action or collision. [4]

Although groin injuries may be acute, they more often have an insidious onset and progress over a period of weeks or months. [5] Patients may experience alternating episodic exacerbations and periods of improvement, or they may have gradually progressive symptoms. [3]

The differential diagnosis of groin pain in athletes is complicated by the fact that various pathologic entities may cause similar clinical signs and symptoms. Moreover, there are often overlapping findings at physical examination. The pathophysiologic conditions that cause groin pain are complicated and poorly understood. [3]

MRI is necessary to can improve and accelerate to diagnosis of athletic groin pain.
Methods and Materials

Material and methods

MRI data of 28 professional football players that had complain of groin pain to their team doctor referred during a period from July 2014 through May 2016 (2 seasons) was used. The mean age of the study patients was 29.7 years (range 25-34 years).

MR imaging studies had been performed at radiology department with 1.5T and 3T MR Scanners

[Siemens Avanto 1.5T (Siemens, Germany), GE Optima MR 450 1.5T (GE Healthcare, USA), GE Discovery MR 750 3T (GE Healthcare, USA)]

The standard protocol includes large FOV (36-40cm) coronal T1-weighted spin-echo, coronal short # inversion-recovery (STIR), and axial and coronal T2-or proton-density weighted fat-suppressed imaging of the pelvis.

In players with muscle, strain sagittal proton-density-weighted fat-suppressed imaging of the affected hip were then performed addition to coronal and axial T2- or PD-weighted fat-suppressed images.

We acquired a Fluid-sensitive T2 fat-suppressed-WI in the coronal and axial plane to detect bone marrow edema in case of presence of osteitis pubis.

Real-time functional imaging of abdominal wall motion was obtained in case of inguinal hernia.

Image Analysis:

MR images were reviewed for bone marrow edema in and around the pubic symphysis. Any abdominal wall, inguinal, femoral, or internal hernia was recorded. Tendinous injury involving the rectus abdominis and the adductor tendons (pectineus, adductor longus, adductor brevis, adductor gracilis, and adductor magnus) were reviewed. Tendon findings were classified as pathologic when there was a tendon enlargement, peritendinous fluid with or without intratendinous fluid signal intensity, partial tear, and complete disruption.
Results

All cases of pubalgia were divided into two categories: acute traumatic pubalgia and exacerbation of pain caused by chronical conditions. The first group (39% of pts) consisted of traumatic lesions of muscles and tendons.

3 players had structural muscle injuries with partial tear of muscles and their tendons and intramuscular hematomas, 2 players had complete muscle tear with retraction and 6 players showed no visible signs of tissue damage and presented with mild edema. 3 players had acute Hip joint trauma (capsule injury, Acetabular labral tear).

The second group (61%) included players with groin pain as a manifestation of overuse syndrome induced by repetitive microtrauma. Hip joint related disorders were seen in 2 players and there were also spine related conditions in 2 players.

In 7 athletes with suspected inguinal hernia MRI showed spermatic cord edema. True Inguinal hernia were seen in 2 players, 3 players had an occult hernia presented and 2 more had mesh related edema after laparoscopic repair surgery. 6 player had signs of osteitis pubis on MRI.

The conditions were described the according to their etiology.

Muscle and tendon related

The anatomy of the pubic symphyseal region includes a number of interrelated muscle attachments that are located in close proximity to one another. The interrelation of these muscle attachments causes complex interactions between the forces exerted through the muscles across the pubic symphysis. [3]

Tendon injuries are often overuse injuries or a result of a single traumatic event. [6]

Athletic muscle injuries present a heterogeneous group of muscle disorders.

The most widely used classification at the present time is an MRI-based graduation defining four grades: grade 0 with no pathological findings, grade 1 with a muscle edema only but without tissue damage, grade 2 as partial muscle tear and grade 3 with a complete muscle tear [7].

Mueller-Wohlfahrt et al., 2012, provided an extended terminology and classification of muscle disorders, which is now used by sports medicine practitioners. The classification system differentiates between four types of muscle damage: functional muscle disorders
(type 1: overexertion-related and type 2: neuromuscular muscle disorders) describing disorders without macroscopic evidence of fiber tear and structural muscle injuries (type 3: partial tears and type 4: (sub) total tears/tendinous avulsions) with macroscopic evidence of fiber tear, that is, structural damage. Subclassifications are presented for each type. [8]. Fig. 1 on page 8

**Hip joint related conditions**

The differential diagnosis for groin pain originating from the hip is extensive and includes many disease processes.

The acetabulum labrum is a fibrocartilaginous structure attached to the acetabular rim, which increases the surface area of the hip joint, and helps prevent subluxation [9]

The labrum is relatively poorly vascularized, and its anterior-superior aspect is considered as most susceptible to injuries, particularly during hyperextension and external rotation [10]

The acetabular labrum is predisposed to damage via repetitive microtrauma and shear forces at the sites of impingement [11-12]

Femoroacetabular impingent (FAI) describes a morphological variant seen in approximately 20% of the general population and it is not in itself pathological. [13]. FAI occurs when there is an abnormal configuration between the acetabular rim and proximal femur. It is classified into cam FAI and pincer FAI depending on the presence of either a femoral or an acetabular abnormality respectively [14-15]. There has also been a third type of FAI described, where the first two co-occur.

In cam-type impingement, an aspherical portion of the femoral head (the cam deformity) leads to abnormal bone contact and joint damage. Athletes in high-impact sports have a higher risk of developing a cam deformity of the femur [16, 6].

In pincer-type impingement, abnormal bone contact occurs between the acetabulum and the femur owing to a focal or general acetabular over coverage. General acetabular over coverage is caused by an increased acetabular depth, as in coxa profunda and protrusio acetabuli [17]. Fig. 2 on page 8

**Inguinal Hernias**

Inguinal hernias, whether occult or obvious, and lipomas of the spermatic cord or round ligament are important etiologies to consider in the diagnosis of groin pain. Many patients
do not complain of a bulge, but instead complains chiefly of groin pain, unaware of the vast differential diagnosis list involved [4].

The terms *sports hernia* and *sportsman's hernia* were first used to describe inguinal pain experienced by athletes without evidence of an actual hernia at physical examination. [18,19]

An occult hernia is often termed athletic pubalgia, not because of its symptoms without physical exam findings, but rather its presentation in the age and demographics of the patient. [20]

These patients had suspicion of occult hernia based on signs and symptoms of inguinal pain radiating to the labia or thigh and reproduction of pain of the internal ring on external palpation or by bimanual exam.

Inguinal hernias, are often diagnosed with history and physical exam alone, and treated accordingly. [4, 21].

Occult hernia can be a cord lipoma or indirect hernia sac that tracks along the spermatic cord within the inguinal canal creating compression on the ilioinguinal or genitofemoral nerves. [4] Fig. 6 on page 10

Lipomas of the cord and round ligament cause similar pain to that of a hernia [4]. Lipoma of the spermatic cord and round ligament is understood as an extension of the preperitoneal fat in the majority of the anatomical and surgical literature. The pathogenesis is largely unknown, but it is thought that this projection of fat through the deep inguinal ring may cause it to dilate and predispose one to indirect hernia. These cord lipomas can nonetheless cause symptoms identical to that of a groin hernia [4, 22]. Fig. 3 on page 9

The incidence of chronic pain or discomfort after inguinal hernia repair is much higher than previously thought, and studies suggest it could be higher than 50 %. [4, 23] The sutures, fixation devices, and mesh may play a significant role. When mesh is used, it can significantly contribute to the development of chronic groin pain through an inflammatory response between the mesh and surrounding tissue. The inflammatory reaction can cause nearby nerves to become entrapped in the mesh directly or cause traction injury to nerves as tissues become scarred and contract. In some patients, mesh may be relatively inert, whereas in others it may migrate, fold, or erode through local structures.[4] Fig. 3 on page 9

**Spine related disorders - lumbar disc herniation**

The groin is innervated by the genitofemoral and ilioinguinal nerves; degeneration of the spinal canal can cause referred pain to the groin. In particular, patients with herniated
discs (most commonly in the L4-L5 or L5-S1 levels) have been known to report groin pain [24]  

These discs can cause compression on transversing sacral nerve roots (S1-S3). Additionally, herniation at the L1/L2 levels is rarer but can cause characteristic symptoms of groin pain, manifesting as buttock pain and anterolateral thigh pain. [25]

The proposed mechanism based on physiology studies in rats is the existence of overlapping segments of dorsal root innervation for the sensory nerve endings in the lower lumbar discs, with some of the sensory nerves from the L5 intervertebral disc coming from upper dorsal root ganglions of L2, which supply the genitofemoral and ilioinguinal nerves. [4, 26]. Fig. 4 on page 9

**Osteitis pubis**

Osteitis pubis is a noninfectious inflammatory process of the pubic symphysis commonly seen in football players. Previous trauma, overuse, and vaginal delivery are all risk factors. [4] It is believed to result from instability of the pubic symphysis because of chronic repetitive shear and distraction injuries and unbalanced tensile stress from the muscle attachments of the pubic symphysis. [3]

As radiographic technology has improved, osteitis pubis is now recognized as a cluster of different injuries to the muscles, tendons, and osseous structures of the lower abdominal wall and pelvis.

The mechanism of injury in athletic pubalgia combines two physical phenomena: repetitive motion injury and muscle development asymmetry. [4]

Substantial amounts of bone marrow edema at the pubic symphysis can occur in asymptomatic football players, and it is only weakly related to the development of osteitis pubis. [27] Therefore, MRI should be used to confirm the clinical suspicions provided by the history and physical exam. Fig. 5 on page 10
Images for this section:

**Fig. 1:** Muscle and tendon related disorders. 1A: Grade 1 strain on MRI (3A M-W, Minor partial muscle tear) is presented with hyperintense edema, hemorrhage within affected muscle group, subcutaneous tissue edema and intramuscular fluid. Axial T2-WI shows minor partial pectineus muscle tear presented with linear hyperintense signal (fiber disruption, red arrow) 1B: Grade 2 strain (3B M-W, Moderate partial muscle tear) is positive for significant fiber disruption, probably including some retraction, fascial injury and intermuscular hematoma. Coronal T2-weighted fat suppressed image shows partial tear of pectineus muscle in 27-YO football player presented with hyperintense hemorrhage and tearing up to 50% of muscle fibers (green arrow); focal defect shows partial retraction of muscle fibers. 1C: Grade 3 strain (4 M-W) is tear involving the subtotal/complete muscle diameter/tendinous injury involving the bone-tendon junction, possible wavy tendon morphology and retraction. With fascial injury and intermuscular hematoma. Coronal T2-weighted fat suppressed image of the pelvis demonstrates the typical appearance of full-thickness tear (blue arrow) with intramuscular edema and hematoma and a complete discontinuity of the tendon with tendon retraction.

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**Fig. 2:** Hip joint related conditions 2A: Acetabular labral tear Acetabular labral tear appears as an intermediate linear signal or diffuse abnormal signal on T1-WI and hyperintense signal on PD- and T2-WI with FS. The separation of the labrum at its base and diastasis between acetabular articular cartilage and labral attachment may be present. [7] Coronal PD weighted fat suppressed sequence# red arrow shows an acute
acetabular labral tear (hyperintense signal in the base of the labrum) 2B: pincer type FAI Coronal T2-weighted fat suppressed image of the hip shows the increased signal intensity of labrum and lateral acetabular ream due to edema (green arrow) associated with signal increase of cartilage. 2C: Cam-type FAI Coronal T2-weighted fat suppressed image of the hip shows the increased signal intensity of subchondral femur head due to edema and cystic changes (blue arrow).

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**Fig. 3:** Inguinal hernias 3A: Spermatic cord lipoma Axial T2-weighted image of pelvis# red arrow shows a spermatic cord lipoma 3B: Occult hernia Spermatic cord edema in 29-yo football player with suspicion of occult hernia based on signs and symptoms; Transversal T2-weighted fat suppressed image of pelvis shows hyperintensity of right spermatic cord (blue arrow) in contrary to the normal hypointense left spermatic cord; as showed in video, there is a contact between right spermatic cord and ileal loop (pink arrow). 3C: Spermatic cord edema after inguinal hernia mesh repair. Transversal T2-weighted fat suppressed image shows edema of right spermatic cord (green arrow) in player with mesh related groin pain after laparoscopic repair of inguinal hernia with mesh; the mesh appears as a thin hypointense line (yellow arrowhead)

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Fig. 4: Nerve root compression 4A: Similar to degeneration and herniation, nerve roots may be mechanically trapped due to spondylolisthesis and/or lumbar stenosis. Sagittal T2-weighted image of lumbar spine shows L5 root (red arrow) entrapped in subarticular (foramenal) disc protrusion combined with degeneration of the facet joints. 4B: axial T2-weighted image of L5-S1 segment: green arrow shows right-sided root canal narrowed by subarticular (foramenal) disc protrusion.

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Fig. 5: Mild osteitis pubis in a male 5A: Transversal T2-weighted fat suppressed image reveals para-symphseal hyperintensity extending from the subchondral plate of left pubic body reflecting edema due to increased stress response and areas of trabecular microtrauma. [28] 5B: Coronal T2-weighted fat suppressed image shows articular surface irregularity, erosions, osteophytes and subchondral cyst (green arrow). In addition, there is an edema of myotendinous attachments of adductor seen as a coexistent tendinopathy and grade 1 strain (yellow arrowhead).

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Fig. 6: Video: Occult hernia Dynamic MR imaging techniques allow direct visualization during provocative maneuvers such as Valsalva, which may help detect subtle hernias. [3] Functional real-time MRI shows on axial images a right-sided occult hernia revealed by Valsalva maneuver.

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Conclusion

Given complicated nature of groin pain diagnosis MRI is an essential tool for accurately determining the cause of patients complain, applying equally acute condition or repetitive trauma in players with overuse syndrome.
References

Personal Information

Personal information

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