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Hip Injuries in Kicking Athletes

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Groin pain is a common complaint in kicking athletes and must be recognized by the treating orthopaedic surgeon. A consensus statement during the Doha Agreement has defined 3 types of groin pain: defined clinical entities for groin pain, hip-related groin pain (femoroacetabular impingement, chondral, or labral tears) and other causes (such as anterior inferior iliac spine, ischial pathology). Clinical entities for groin pain are the most common, and strains/pain from the adductors, iliopsoas, and pubic areas are typically successfully treated with conservative treatment. Often, pain from inguinal-related groin pain requires surgical intervention from a general surgeon. Femoroacetabular impingement often coexists with a variety of other pathology and may result in labral tears and chondral damage. Open or arthroscopic osteoplasty is typically successful at alleviating symptoms and has high rates of return to sport. AIIS impingement from chronic hypertrophic overuse of the rectus femoris or trauma has recently been discovered as a cause of FAI that responds well to arthroscopic decompression and osteoplasty. Ischiofemoral impingement usually responds to conservative treatment with heel lifts, physical therapy and activity modification or image-guided corticosteroid injections into the quadratus femoris. The various causes of athletic groin pain if not recognized can cause significant disability and impair athletic performance. Further study is needed in this field to further clarify the relationship between clinical syndromes, determine optimal treatment/management algorithms and the most efficacious surgical techniques. The purpose of this article was to review the current evidence of hip injuries in kicking athletes.
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Introduction

Kicking sports (soccer and rugby) are among the most popular sports in the world. In the United States, soccer accounts for the fourth highest number of sports injuries with an incidence of 228,000 injuries per year.[1] Of these, hip and groin injuries are common and range from 11% to 16% of all injuries in elite male soccer players.[2] A high level of suspicion is necessary to make a correct diagnosis, along with a variety of imaging techniques including ultrasound and magnetic resonance imaging. The literature regarding its treatment is heterogenous with advocates on both sides for nonsurgical and surgical intervention.

Due to the complexity of the hip and groin anatomy, a previously reported consensus statement (the Doha Agreement) defined 3 areas of potential pathology: (1) defined

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clinical entities for groin pain (adductor, iliopsoas, inguinal, and pubic-related groin pain); (2) hip-related groin pain (femoroacetabular impingement, chondral, or labral tears); and (3) other causes (such as anterior inferior iliac spine, ischial pathology).[3] This review paper will examine the different causes of hip and groin pain in kicking athletes with an emphasis on some of the less described and more recently discovered pathologic conditions.

Defined Clinical Entities

Adductor and Psoas-Related Groin Pain

The most common causes of groin pain in kicking athletes result from acute muscles strains of the adductors, psoas, and rectus femoris.[4] Adductor and psoas strains are typically noncontact injuries and usually result from eccentric loading when attempting to kick a ball.[4-6] Though uncommon, when these injuries occur in elite athletes, the consequences can be important often resulting in significant time out of competitive play. These injuries can be difficult to distinguish from a typical groin strain; however, failure to make the appropriate diagnosis is common and thus it is important to have a high index of suspicion in patients presenting with acute groin pain following a sports injury. Diagnosis is made through physical exam. Adductor strains cause tenderness with palpation over the adductor origin and pain with resisted adduction, while psoas strains cause reproducible pain with resisted hip flexion or passive stretch.[3] MRI is the most reliable and useful imaging study to confirm the diagnosis (86% sensitivity and 89% of specificity).[4] Conservative treatment is typically successful with anti-inflammatory medication, core strengthening with physical therapy, and activity modification with an average return to sport in 2 weeks.[7] Proximal avulsion fracture or complete tears with significant retraction may need surgical treatment. The argument for surgical fixation, especially in athletes, is the potential for returning the player back to a high level of play with little to no deficit in function and ideally at an equal or faster rate than nonoperative management (Fig. 1). The literature has shown poor outcomes following adductor tenotomy for chronic pain in high-level athletes, with decreased muscle strength and level of activity.[18,19] Also, theoretically the post-injury hematoma may lead to complications such as myositis ossificans, as mentioned above, and surgery allows for evacuation of this fluid collection.

Pubic-Related Groin Pain

Pain with palpation over the pubic symphysis is defined by the Doha Agreement as Pubic-related groin pain.[3] A commonly described form of pubic groin pain includes osteitis pubis, which typically presents with chronic groin pain from micro trauma to the rectus abdominus or adductors.[8,9] The most common mechanism for injury is chronic noncontact twisting, running, or kicking.[9] Diagnosis is made clinically; however, radiographs, if performed, may show characteristic symphysis widening, sclerosis, and lysis.[8] The vast majority of pubic-related groin pain is treated successfully with conservative treatment consisting of anti-inflammatory medications, injections, heat, activity modification, and gentle stretching after symptoms have resolved.[9,10]

Inguinal-Related Groin Pain

Inguinal-related groin pain is a common cause of groin pain, accounting for up to 50% of chronic groin pain.[11,12] It is defined by the Doha Agreement as “pain in the location of the inguinal region with associated tenderness of the inguinal canal,” which “is more likely if the pain is aggravated with resistance testing of the abdominal muscles or on Valsalva/cough/sneeze.”[3] This classification of groin pain encompasses

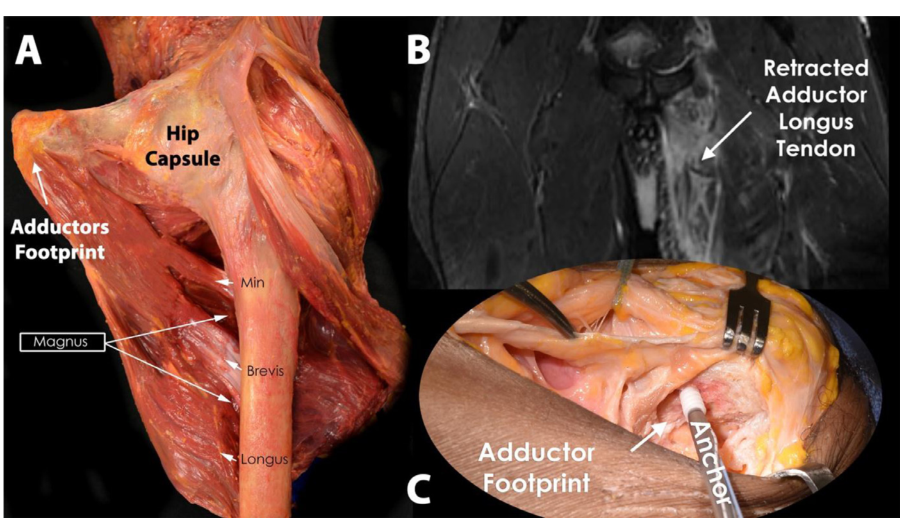

Figure 1 (A) Anatomic dissection demonstrating the adductor minimus, brevis, longus, and magnus and their attachment on the pubis. Anatomical landmarks are also shown to demonstrate spatial relationship between structures. (B) Coronal T2 MRI image showing a left retracted adductor longus tendon tear and (C) anchor insertion over the anatomic adductor footprint for an adductor repair.

a group of condition with a wide range of eponyms and nomenclature including athletic pubalgia, sports hernia, sportsman's hernia/groin, core muscle injury, and inguinal disruption among others.[6,13-22] Inguinal-related groin pain is characterized by dysfunction of the adductors, core musculature, and abdominal muscles. The pathomechanics in the development of pain is strongly associated with femoroacetabular impingement. Cam deformities have been shown in cadaver models to increase the motion at the pubic symphysis by 35%.[23] Increased shear at the symphysis causes repetitive stress, micro trauma, and imbalances in the anterior pelvic musculature.[9,24,25]

Physical Examination and Diagnosis

Patients typically present with chronic groin pain. Pain with coughing or Valsalva is present in 10% of patients, while pain with resisted sit-ups is present in 46% of patients.[12,26,27] Tenderness over the adductor origin and pubic symphysis is seen in 36% and 22% of patients.[12,26] While most commonly considered a clinical diagnosis, certain imaging modalities can help distinguish inguinal-related groin pain from pubic- and hip-related groin pain. Once such test involves radiographic dye injection into the pubic symphysis. The test is considered positive for inguinal-related groin injury if the dye travels down the adductor sheath or up the rectus abdominus.[12] MRI is less helpful as there are no hard diagnostic findings that have proven reliable.[28]

Treatment

At this time, initial treatment is controversial. Many perform a trial of conservative management with anti-inflammatory medication, core strengthening/physical therapy, and activity modification.[12] However, a study by Paajanen et al demonstrated extraperitoneal laparoscopic mesh repair of the pubic symphysis to have earlier and higher rates of return to sport compared to conservative treatment (50% vs 97% at 12 months).[29] Surgical intervention is typically performed by a general surgeon and may include laparoscopic or open procedures. A variety of different surgical interventions have been proposed, including repairs of the pelvic floor, abdominal fascia, adductor releases among others. There has been no comparison of techniques that definitively proves the superiority of one technique/intervention. By 3 months postoperative, 95.3% of athletes had returned to sport.[27,30] Overall rates of return to sport are high regardless of technique used, and range from 80% to 100%.[26]

Hip-Related Groin Pain

Femoroacetabular impingement (FAI) has been identified as an important cause of hip pain in athletes, which often results in reduced range of motion and impaired performance.[31-33] FAI is caused by Cam deformities of the femoral head/neck junction and acetabular pincer deformities that increase contact and shear forces during hip flexion ultimately causing chondral and labral damage.[12,34] Cam-type deformities in the athletic population are common with studies demonstrating a prevalence of up to 68% in young male athletes, which is significantly higher than the general population.[35,36]

Physical Examination and Diagnosis

Athletes will typically present with chronic groin pain. On physical exam, decreased hip internal rotation is characteristic as well as pain with provocative impingement tests. A study performed by Wyss et al found athletes with FAI to have significantly less hip internal rotation (4°) when compared to asymptomatic athletes (28°).[37] Provocative tests have good sensitivity, but are not specific for FAI.[3] A study by Reiman et al performed a meta-analysis on the physical exam testings for FAI and found the most sensitive tests to be the Flexion-Internal rotation test (sensitivity 96%) and the Flexion-adduction-internal rotation test (FADIR) (sensitivity 94%-99%).[38] Athletes with physical exam finding suspicious for FAI should receive radiographic evaluation with measurement of the femoral alpha angle (greater than 55 indicates FAI).[28] Concurrent labral tears and chondral lesions can be diagnostic with an MRI arthrogram.

Treatment

Athletes with chronic pain despite conservative treatment are typically treated with open or arthroscopic osteoplasty to reshape the femoral head/neck junction and/or acetabulum. Neither open nor arthroscopic intervention has been demonstrated superiority over the other.[39] High rates of return to sport are observed, reaching around 96% in professional soccer players at an average of 9.2 months after surgery.[40]

Other Causes of Groin Pain

Anterior Inferior Iliac Spine Impingement

The anterior inferior iliac spine impingement (AIIS) has been recently recognized as a cause of extra-articular femoroacetabular impingement and pain in the athletic population from abnormal bony anatomy and tendon irritation. Normally, the subspine area of the ilium between the AIIS and acetabular rim is 21.8 mm long and smooth, which allows for un-impinged hip motion and tendon gliding.[41,42] The normal AIIS was termed a type I by Hetsroni et al who reviewed AIIS morphology in 53 patients and developed a qualitative classification method.[41] A type II AIIS extends to the level of the acetabular rim and type III AIIS extends distal to the acetabular rim.[41] There are several causes of AIIS impingement including a childhood AIIS avulsion fracture, trauma to the direct head of the rectus femoris or from traction hypertrophy in kicking athletes.[43] Nawabi et al[44] reported on 26 soccer players (34 hips) in comparison to nonkicking athletes. Eighty-four percent of soccer players demonstrated some abnormality of the AIIS extending to (type II, 52%) or below the anterior acetabular rim (type III, 32%), compared to 52% nonkicking athletes ($P < 0.001$). Both type II and III morphologic variations decrease the space available for soft tissue recoil and may cause mechanical impingement of hip motion (mainly hip flexion and internal rotation).[41,45] The repetitive microtrauma from mechanical impingement may lead to labral and chondral lesions.[43] Characteristic lesions include an injured, congested, and hyperemic labrum anteriorly at the level of the AIIS, which may manifest as a "wave" sign at the chondrolabral junction and correspond to low AIIS morphology.[46]

Clinical Examination and Diagnosis

Athletes with AIIS impingement typically present with chronic anterior hip/groin pain. On physical examination, patients will typically have tenderness over the AIIS with weakness and pain with a resisted straight leg raise.[43] Patients may have limitation of range of motion in hip flexion and internal rotation with the hip at 90° of flexion.[43] Hetsroni et al created a computerized simulation of hip range of motion based on AIIS morphology and demonstrated terminal hip flexion to be 107° for type II AIIS and 93° for type III AIIS morphology, while internal rotation for was 11° for type II and 8° for type III morphology.[41] Radiographic evaluation can be used to confirm the diagnosis with a standard AP pelvis and false profile view.[43] The "double cross-over sign," which represents a prominent AIIS next to the lateral acetabular ridge, may be visible on AP pelvis radiographs. The false profile view demonstrates the clearest profile of the AIIS. Signs of acetabular retroversion (cross-over sign, iliac spine sign, and high lateral center edge angle) are often found in association.[43] MRI can be supplemented if there is suspicion for concurrent intra-articular pathology (Fig. 2).

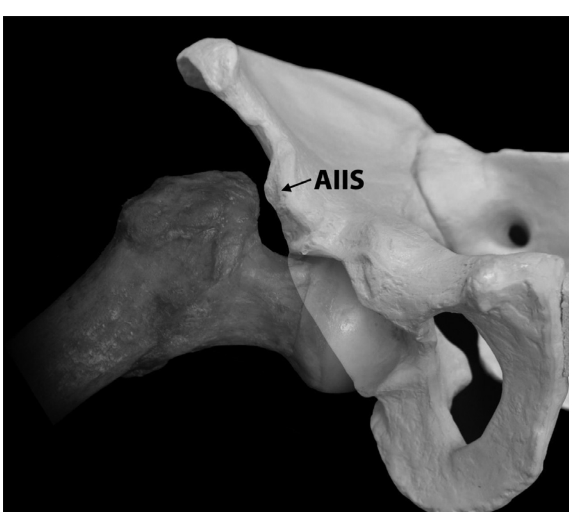

Figure 2 Anatomical bony anatomy demonstrating a normal AIIS anatomy with the hip in abduction. When the AIIS is more prominent or directed anteriorly significant impingement can occur, limiting range of motion and producing debilitating symptoms.

Treatment

Initial management of AIIS impingement should consist of conservative treatment with anti-inflammatory medications, physical therapy, and activity modification. If conservative treatment proves ineffective, case series have suggested good efficacy of arthroscopic and open decompression and osteoplasty.[41,47] Subspinal impingement constitutes an under addressed pathology, since nonresected impinging AIIS has been reported in up to 46% of revision hip arthroscopy cases.[26] Surgical management of FAI aims to address the soft-tissue and bony abnormalities that result in abnormal impingement during hip range of motion and recontouring the subspine region is critical for an adequate treatment as well.

When performing the procedure itself, after routine preparation and draping of the affected hip, the arthroscopic procedure is performed with the patient in the supine position. Standard anterolateral and mid-anterior portals are established to allow access to the central compartment. A diagnostic arthroscopy is performed using a 70° arthroscope and an AIIS impingement is actively sought. The diagnosis of low AIIS is performed intraoperatively, first by probing the bony protuberance under fluoroscopy, using AP and 30°-45° tilt views. An interportal capsulotomy is performed with a combination of a beaver blade and radiofrequency, ensuring preservation of at least 10 mm of medial capsular leaf. The camera is positioned in the mid-anterior portal and an arthroscopic shaver in the anterolateral portal to open the supraacetabular and AIIS subspinal capsulolabral space in the anterior-superior portion of the acetabulum. Next, the interval between the proximal capsule and labrum is developed using a radiofrequency probe.

After cleaning the capsulolabral space, rim trimming and focal subspine decompression are performed with a 4.5-mm round burr positioned in the anterolateral portal and the camera in the mid-anterior portal without labral detachment. Based on the false profile view, the focal subspine decompression is performed aiming to make the subspine area a flat surface without bony prominences. It is important to avoid excessive proximal bone resection to preserve the direct head of the rectus femoris and the superior capsular insertion. After acetabular rim resection and AIIS decompression, if labral tear was diagnosed, debridement and labral repair should be performed at this point. Any concomitant intra-articular pathology should be addressed as necessary.

Larson et al reported on 3 cases of arthroscopic AIIS decompression, with a minimum follow-up of 1 year.[48] The authors demonstrated improvement in Harris Hip Score (HHS) for function and the Visual Analogue Scale (VAS) for pain.[43] In 2012, Hetsroni et al also reported short-term outcomes of arthroscopic AIIS decompression in 10 patients with a mean follow-up of 14.7 months.[49] Of note, in 9 patients, an anterior cam lesion was identified and decompressed before the AIIS decompression. Significant improvement in hip flexion after surgery, and in HHS scores (64 ± 18 before surgery to 98 ± 2 after surgery) at the latest follow-up was found. The authors concluded that arthroscopic decompression of symptomatic subspinal impingement is a reproducible procedure that can provide excellent outcome at short-term follow-up. Similar studies by Nwachukwu et al and Michal et al reported that arthroscopic subspinal decompression of low AIIS yielded significantly improved outcome measures and high patient satisfaction at a minimum of 13 months follow-up on 34 patients.[50,51] When conservative treatment fails, there is evidence that hip arthroscopic or open surgery for decompression and osteoplasty may be an effective treatment for AIIS impingement.

Ischiofemoral Impingement

Ischiofemoral impingement (IFI) is a rare cause of groin (or buttock) pain that often goes undiagnosed.[52,53] The impingement is defined by a progressive narrow of the ischiofemoral space that leads to impingement of the lesser trochanter and posterior ischium, and is believed to entrap the quadratus femoris muscle, producing edema and fatty infiltration.[34,54-56] Several acquired forms of ischiofemoral narrowing have been reported sporadically in the literature (eg, as a result of fractures of the proximal femur, intertrochanteric osteotomy, or in older patients with superior and medial migration of the femur due to hip osteoarthritis);[53-55,57] however, the etiology and pathogenesis of IFI remain unclear. IFI has been reported to be more common in women and is associated with bilateral involvement in one-third of patients.[52,55,57,58] (Fig. 3)

Clinical Examination and Diagnosis

Presenting symptoms of IFI are typically progressively worsening chronic groin, lower buttock, and/or inner thigh pain that worsens with weight bearing.[53,55,59] The quadratus femoris is in close proximity to the sciatic nerve and may cause a similar radiating pain toward the knee.[53,60] The pain may be accompanied by a clunking or snapping sensation during hip extension, walking, or running caused by the forceful passing of the lesser trochanter by the ischium.[58] Physical exam should consist of 2 main tests. First, the long-stride walking test, which may elicit pain or clunking and has a reported sensitivity of 94% and specificity of 85%.[61] Second, the IFI test which consists of hip adduction, extension, and external rotation of the hip, which has a sensitivity of 82% and specificity of 85%.[52,54,61] Magnetic resonance imaging (MRI) is very helpful for diagnosis and can also help rule out mechanical causes of IFI (tumors/exostosis). A measurement of 15 mm or less in the ischiofemoral space has shown a sensitivity of 74.9% and a specificity of 81%.[62] Edema and partial tearing are commonly seen in the quadratus femoris muscle and atrophy/fatty infiltration is seen in up to 94% of patients.[57] The diagnosis can be confirmed with ultrasound or CT-guided corticosteroid and local anesthetic injections into the quadratus femoris muscle.[54,58]

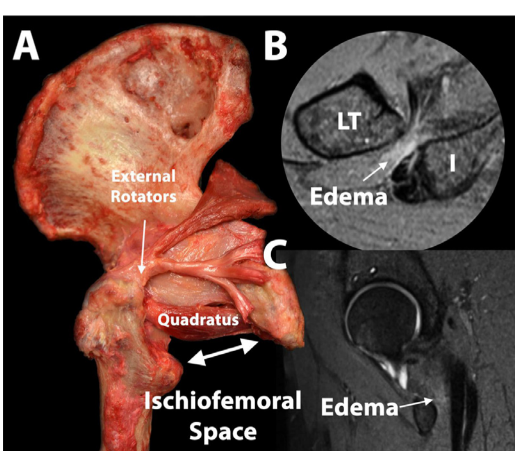

Figure 3 (A) Anatomic dissection of a right hip demonstrating the relationship between the lesser trochanter and the posterior ischium that can entrap the quadratus femoris muscle, producing (B and C) edema and fatty infiltration in cases of narrow ischiofemoral space (axial and sagittal images, respectively).

Treatment

A treatment algorithm was recently proposed by Gollwitzer et al, which begins with conservative treatment (given tumor has been ruled out).[63] The proposed conservative treatment includes the use of insoles or shoe modifications to correct any leg length discrepancy, physical therapy with hip abductor strengthening and anti-inflammatory medication or gabapentin.[63] If the patient fails to respond, the second-line treatment is initiated, which consists of CT or US-guided corticosteroid injection.[63] If the patient fails to respond, the algorithm suggests the clinician should reexamine alternative causes of pain.[63] If the patient has temporary relief, they suggest evaluating for concomitant pathology to be treated surgically (gluteal tear, hamstring, or morphologic/mechanical pathology).[63] If the patient has isolated IFI with no concomitant pathology, the algorithm suggests surgical treatment.[63] Surgical treatment most commonly consists of partial resection of the lesser trochanter. Partial resection avoids detaching the psoas muscle and causing weakness in hip flexion. Arthroscopy resection is commonly described in the literature and has demonstrated improved clinical outcomes in case series.[59,60,64,65]

Conclusions/Summary

Groin pain is a common complaint in kicking athletes and must be recognized by the treating orthopaedic surgeon. A consensus statement during the Doha Agreement has defined 3 types of groin pain: defined clinical entities for groin pain, hip-related groin pain (femoroacetabular impingement, chondral, or labral tears) and other causes (such as anterior inferior iliac spine, ischial pathology).[3] Clinical entities for groin pain are the most common, and strains/pain from the adductors, iliopsoas, and pubic areas are typically successfully treated with conservative treatment. Often, pain from inguinal-related groin pain requires surgical intervention from a general surgeon. Femoroacetabular impingement often coexists with a variety of other pathology and may result in labral tears and chondral damage. Open or arthroscopic osteoplasty is typically successful at alleviating symptoms and has high rates of return to sport. AIIS impingement from chronic hypertrophic overuse of the rectus femoris or trauma has recently been discovered as a cause of FAI that responds well to arthroscopic decompression and osteoplasty. IFI usually responds to conservative treatment with heel lifts, physical therapy, and activity modification or image-guided corticosteroid injections into the quadratus femoris. The various causes of athletic groin pain if not recognized can cause significant disability and impair athletic performance. Further study is needed in this field to further clarify the relationship between clinical syndromes, determine optimal treatment/management algorithms and the most efficacious surgical techniques.

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