Hip and Core Muscle Injuries in Soccer

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Take-Home Points

- Groin injuries in soccer players can cause significant decreases in athletic performance, result in lost playing time, and may ultimately need surgical intervention.
- Groin pain can be separated into 3 categories: (1) defined clinical entities for groin pain (adductor-related, iliopsoas-related, inguinal-related [sports hernias/athletic pubalgia], and pubic-related groin pain), (2) hip-related groin pain (hip morphologic abnormalities, labral tears, and chondral injuries), and (3) other causes of groin pain.
- Acute groin pain in soccer players is most commonly caused by muscle strain involving the adductor longus, the iliopsoas or the rectus femoris.
- Inguinal-related groin pain is a common cause of chronic groin pain and typically is the most challenging to treat with a complex pathophysiology and a high association with femoroacetabular impingement.
- Hip-related groin pain (femoroacetabular impingement, labral tears, and chondral injuries) usually respond well to surgical intervention and has high rates of return to sport.

Each year, the global audience for soccer grows. Soccer has long surpassed all other sports as the most popular sport in the world, reaching 3.2 billion viewers during the 2014 World Cup.[1] In the latest Fédération Internationale de Football Association (FIFA) Big Count survey, the organization estimated that 265 million people are actively involved in soccer, accounting for approximately 4% of the world's population.[2] Moreover, the number of people playing soccer increased by 9.5% within 6 years after the previous Big Count Survey.[2] In the United States, soccer accounts for the fourth most common cause of sports injuries next to basketball, exercise, and

football with approximately 228,000 injuries per year.[3] The total cost of treatment related to worldwide soccer injuries tops $30 billion.[4] The most common body parts injured are the thigh (25%), knee (18%), and hip and/or groin (14%).[5]

Hip and groin injuries in soccer players can be separated into 3 main categories based on the Doha Agreement:[6] (1) defined clinical entities for groin pain, (2) hip-related groin pain, and (3) other causes of groin pain in athletes. Defined clinical entities include adductor-related, iliopsoas-related, inguinal-related (sports hernia/athletic pubalgia), and pubic-related groin pain; while hip-related groin pain includes hip morphologic abnormalities, labral tears, and chondral injuries. Included in other causes of groin pain are injuries not clinically defined. The Doha Agreement has acknowledged that not all causes of groin pain fit into the classification system including injuries of the rectus femoris, but they will be included under defined clinical entities for groin pain in this review. While they are not a cause of groin pain, proximal hamstring and gluteal and piriformis injuries are important causes of posterior and lateral hip pain in soccer players and will also be covered in the first section of this review.

Defined Clinical Entities for Groin Pain in Soccer Athletes

Adductor-Related Groin Pain

Acute groin pain in soccer players is most commonly caused by muscle strain.[7] Of the muscle strains, 66% involve the adductor longus, 25% the iliopsoas, and 23% the rectus femoris.[7] The Doha Agreement defines adductor-related groin pain as adductor tenderness and pain on resisted adduction.[6] Adductor longus strains in soccer players are typically noncontact injuries (62.5%) and most commonly the result of kicking (40%).[7-9] Many athletes will remember a pop at the time of the original injury.[9] The combination of history and physical examination is usually sufficient for diagnosis; however, magnetic resonance imaging (MRI) may be helpful in complicated situations with a reported 86% sensitivity and 89% specificity.[10] The average playing time lost is 2 weeks.[5] Management includes rest, anti-inflammatory medication, physical therapy with core strengthening, and avoidance of aggressive stretching. While partial and distal avulsions can heal with conservative measures, proximal osseous and retracted avulsions of the adductor longus can be treated surgically.[11]

Iliopsoas-Related Groin Pain

Iliopsoas strains account for 25% of acute groin strains and typically result from an impact that causes eccentric overload while kicking the ball.[7,12] Iliopsoas-related groin pain is defined by the Doha Agreement as groin pain that is reproducible with resisted hip flexion or hip flexor stretch.[6] Iliopsoas strains respond well to conservative treatment such as rest, anti-inflammatory medication, and physical therapy. Rarely do these athletes become surgical candidates in the acute setting. Chronic cases of iliopsoas pathology occasionally require an arthroscopic intervention.

Inguinal-Related Groin Pain

Inguinal-related groin pain is one of the most misleading diagnoses in sports because of its poorly defined and under-researched nature. The varying nomenclature of this entity illustrates the heterogeneity and includes sports hernia,[9,13-15] athletic pubalgia,[16] core muscle injury,[17] athletic hernia,[18] Gilmore's groin,[15] osteitis pubis,[19] sportsman's hernia,[20,21] sportsmen's groin,[22] symphysis syndrome,[23] and inguinal disruption.[24] It is important to realize that in inguinal-related groin pain, regardless of the nomenclature, there is no true hernia present. The

Doha Agreement has defined inguinal-related groin pain 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."[6] The condition is a painful soft tissue injury in the groin or inguinal area, involving a constellation of various anatomic areas including the abdominal musculature, sacroiliac joint, neural structures, pubic symphysis, adductors, and hip joint. This may account for up to 50% of chronic groin pain.[25,26]

One important theory in the development of inguinal-related groin pain is its relationship with femoroacetabular impingement (FAI). Cadaver studies demonstrate that cam deformities cause a 35% increase in motion at the pubic symphysis altering the biomechanics of the adductors and abdominal musculature and, with repetitive stress, may lead to tearing or attenuation of the transversalis fascia, rectus abdominis, internal obliques, and/or external obliques.[12,27,28] Another prevailing theory of this is that the increased pubic stress causes weakness in the posterior portion of the inguinal canal, which then stretches and entraps the genitofemoral, ilioinguinal, lateral femoral cutaneous, or obturator nerves, ultimately causing pain.[28,29]

Physical examination findings include pain over the conjoined tendon, pubic tubercle/symphysis (present in 22% of patients), adductor origin (36%), and inguinal ring.[25,30] Pain with resisted sit-ups is present in 46% of patients and pain with coughing/Valsalva is present in 10%.[25,30,31] Selective injections can be a critical part of the evaluation to differentiate inguinal-related groin pain from FAI, osteitis pubis, and adductor strains while helping to determine the appropriate treatment.[25,32] The role of advanced imaging is unclear as the clinical entity is still uncertain and the standard imaging findings have not been definitively established.[33] However, several studies have reported MRI findings suggestive of inguinal-related groin pain. One of the more common MRI findings is the "secondary cleft sign," which requires injecting a dye into the pubic symphysis.[34] Several studies have shown that the radiographic dye extravasates preferentially into the side where the groin symptoms exist and are thought to be secondary to micro-tearing at the common attachment of the musculotendinous structures to the anterior pubis.[34,35] However, it should be noted that the lack of imaging findings does not exclude the possibility of inguinal-related groin pathology.

Initial treatment consists of rest, anti-inflammatory medication, injections, and physical therapy with core strengthening.[25] A study by Paajanen and colleagues[36] suggested that early surgical intervention may be preferred over conservative management in a randomized trial comparing physical therapy, injections, anti-inflammatory medication, and rest vs an extraperitoneal laparoscopic mesh repair behind the pubic symphysis. In the conservative group, 20% of athletes returned to sport at 1 month, 27% at 3 months, and 50% at 12 months.[36] In comparison, the surgical group had 67% return to sport at 1 month, 90% at 3 months, and 97% at 12 months.[36] If surgical management is chosen, there are a variety of surgical options including laparoscopy, open or mini-open repairs of the abdominal musculature/fascia or pelvic floor with and without mesh, neurolysis, and adductor release. Muschawek and Berger[37] described a series of 129 patients that had an open-suture repair of the posterior wall of the inguinal canal with 67% of professional athletes returning to sport within 2 weeks and 83.7% of athletes returning to sport overall. The rates of return to play are consistently 80% to 100% without demonstrated superiority of one technique over another up to this point.[30]

Pubic-Related Groin Pain

Pubic-related groin pain is defined as tenderness to palpation over the pubic symphysis and adjacent bone.[6] Osteitis pubis is a chronic overuse injury characterized by localized pain to the pubic symphysis and is believed to be caused by repetitive microtrauma from a dynamic rotation of the sacroiliac joint with suggested imbalances between the rectus abdominis and the adductor musculature.[12,38] In soccer players, the condition may be related to

the constant torsional stresses of kicking, running, or twisting.[12] If performed, radiographs often show lytic areas of the pubic symphysis, widening of the symphysis, sclerosis, and cystic changes, while bone marrow edema may be present on MRI.[38] Management consists of rest, anti-inflammatory medication, and corticosteroid injections with gentle stretching once asymptomatic.[12,39]

Rectus Femoris Injuries

The most common injury to the rectus femoris is a strain as a result of an eccentric overload while a soccer player is hit trying to extend his or her leg to kick a ball.[12] In pediatric soccer athletes, an avulsion of the anterior inferior iliac spine from the direct head of the rectus femoris is the second most common avulsion injury.[40] Radiographs are diagnostic and can help determine treatment. Most avulsions are minimally displaced and can be treated conservatively, but surgical intervention should be considered for an avulsion >2 cm.[12]

Proximal Hamstring Injuries

Proximal hamstring injuries are important causes of acute posterior hip pain and are caused by an eccentric overload in hip flexion and knee extension.[25] In soccer players, the typical mechanism is that the planted leg slipping on the playing turf creates a sudden violent flexion of the hip with the knee in an extended position. While relatively uncommon, when a significant avulsion occurs in a professional athlete, surgical intervention is often necessary. In general, these injuries may involve partial or full avulsions off the ischial tuberosity or separation of the bony apophysis in pediatric athletes. A physical examination in the acute setting typically demonstrates massive posterior thigh ecchymosis, a palpable defect, and/or weakness with knee flexion. Imaging is helpful to confirm the diagnosis and evaluate for surgical repair. Radiographs may show a bony avulsion, which is more commonly seen in pediatric apophyseal avulsions. MRI can be used to differentiate a complete tear (involving all 3 tendons) vs a partial tear and evaluate for retraction of the tendon distally. Complete and partial tears of 2 tendons with retraction of >2 cm should be surgically repaired.[25] Partial tears without tendon retraction may be treated conservatively with rest, anti-inflammatory medication, and physical therapy and then followed later by a hamstring prevention program.[25] We have found that biologic augmentation with platelet-rich plasma can help accelerate healing in partial thickness injuries; however, the evidence is conflicting.

Gluteal Injuries

Chronic overuse injuries of the gluteal musculature are common causes of lateral hip pain. Abductor overuse caused by weakness in the gluteus medius with a normal tensor fascia lata can cause pain with sitting and side-lying.[25] Overuse of the gluteal muscles with muscular imbalances along with increased tension on the iliotibial band can lead to greater trochanteric pain syndrome.[25] A physical examination may demonstrate tenderness over the greater trochanter bursa and positive flexion, abduction, and external rotation testing.[25] Abductor overuse syndrome and greater trochanteric pain syndrome are best treated with anti-inflammatory medication and physical therapy to balance the core/pelvic musculature.[41]

Piriformis Injuries

Piriformis syndrome is a compressive neuropathy of the sciatic nerve. The mechanism of injury in the athlete is through a minor trauma to the buttock or pelvis.[25,42,43] Presenting symptoms include pain with sitting and internal rotation of the hip.[12] Zeren and colleagues[42] published the only study that includes 2 cases of bilateral piriformis syndrome in professional soccer players. The diagnosis was confirmed with electromyography that was negative at

rest and positive when measured after running.[42] The athletes exhausted conservative treatment with physical therapy, anti-inflammatory medications, injections, and rest and were treated with surgical decompression.[42] Both players returned to professional soccer after 6 months and played for an average of 7 years.[42]

Hip-Related Groin Pain in Soccer Athletes

Hip-related groin pain has garnered more attention in the last several years after being a previously underdiagnosed entity. One study found that practitioners treated groin pain in athletes for 7 months on average before recognizing that the pathology was intra-articular.[44] FAI, labral tears, and chondral injuries are the major intra-articular pathologies that cause groin pain in athletes and ultimately impaired performance.[45,46]

Femoroacetabular Impingement

FAI is caused by pincer-type, cam-type, or combined-type deformities. Pincer lesions are defined as an increased acetabular overhang, while cam lesions are described as an increased bone at the femoral head/neck junction. These deformities in isolation or in combination cause decreased hip motion and increased contact pressures between the anterolateral acetabulum and femoral head-neck junction, which may ultimately lead to labral tears, chondral lesions, and osteoarthritis.[47] During hip flexion, cam deformities impact the anterolateral acetabulum, preferentially causing articular cartilage damage, while sparing the labrum.[25] Conversely, pincer deformities cause repetitive microtrauma to the labrum, crushing it between the acetabular rim and femoral neck with secondary damage to the articular cartilage.[25] Over time, the damage to the labrum and articular cartilage may lead to premature osteoarthritis, which occurs at a much younger age in the athletic population.[48]

We know from previous studies that soccer athletes have a high prevalence of morphologic abnormalities of the hip, most commonly FAI. Gerhardt and colleagues[49] documented the prevalence of hip morphologic abnormalities in elite soccer players and found abnormalities in 72% of men and over 50% of women. It should be noted that this series looked at asymptomatic athletes; however, it has been shown that hip dysmorphia is a risk factor for hip and groin injuries and may provide an opportunity for injury prevention strategies.[50]

Physical examination findings in FAI include decreased hip internal rotation and pain with provocative testing. Wyss and colleagues[51] measured hip internal rotation in athletes with and without FAI. They found that the athletes with FAI have an average of 4° of internal rotation compared with that of the non-FAI athletes with 28°.[51] A worsening internal rotation deficit has been linked to increasing severity of the deformity and when <20° was correlated with joint damage.[51] Provocative testing has a high sensitivity with a recent meta-analysis demonstrating the most sensitive tests to be the anterior impingement test (flexion-adduction-internal rotation) with 94% to 99% sensitivity and the flexion-internal rotation test with 96% sensitivity.[52] While provocative tests are sensitive, there is no current consensus on physical examination findings that are specific in the diagnosis of FAI.[6] Diagnosis is made with both positive physical examination and radiographic morphologic findings (alpha angle >55°).[33] Advanced imaging with an MRI arthrogram can be helpful in diagnosing underlying injuries such as labral tears in athletes presenting with compatible symptoms.

Symptomatic patients are typically treated surgically through either open or arthroscopic procedures, which have favorable and comparable functional results, biomechanics, and return to sport.[53] In soccer players, return to sport at the professional level after arthroscopic surgery was found to be 96%.[54] Players returned to sport on average 9.2 months postoperatively and played an average of 70 games after surgery.[54]

Labral Tears

Labral tears present with groin pain, limited hip range of motion, and symptoms of catching, locking, and instability.[25] Causes of labral tears include trauma, FAI, hip dysplasia, capsular laxity, and degeneration.[55] Labral tears rarely occur in isolation and have a high association (87%) with morphologic abnormalities of the hip, most commonly FAI and occasionally dysplasia.[56,57] Physical examination findings include positive anterior impingement tests (flexion-adduction-internal rotation) in athletes with anterior labral tears and, less commonly, positive flexion, abduction, and external rotation tests for athletes with lateral and posterolateral labral tears.[57] Radiographic imaging is used to evaluate for concurrent morphologic abnormalities of the hip, and MRI arthrogram is used to confirm the diagnosis of a labral tear with a sensitivity of 76% to 91%.[58] Initial treatment consists of conservative treatment, which includes rest, anti-inflammatory medication, activity modification, and physical therapy. In patient refractory to conservative treatment, arthroscopic surgery is effective with high rates of return to sport.[59] It is important to note that when treating labral tears surgically, any morphologic abnormality needs to be addressed to prevent recurrence of the tear.

Chondral Injuries

Focal chondral lesions in the hip are commonly found in athletes with FAI and labral tears during arthroscopic evaluation.[60] Full-thickness defects and unstable flaps in weight-bearing areas are indications for surgical intervention with microfracture.[60] There are no studies examining the efficacy of microfracture in isolation; however, Locks and colleagues[54] have demonstrated a 96% return to professional soccer after an arthroscopic treatment for FAI and found that severe chondral damage with microfracture did not lengthen the return to sport.

Relationship Between Inguinal-Related Groin Pain and Femoroacetabular Impingement

The altered biomechanics and restricted range of motion in athletes with FAI cause an increase in compensatory motion at the pelvis and lumbosacral areas, which may contribute to the development of inguinal-related groin pain, bursitis, adductor, and gluteal dysfunction.[25] In athletes with concurrent intra-articular hip pathology and inguinal-related groin pain, treating 1 condition in isolation will result in poor results. Larson and colleagues[61] found that when only inguinal-related groin pain or FAI were addressed, return to sport was only 25% and 50%, respectively, while concurrent surgical treatment resulted in a return to sport of 89%.

Discussion and Future Directions

Groin injuries in soccer players can cause significant decreases in athletic performance, result in lost playing time, and may ultimately need a surgical intervention. Efforts are underway to determine the role and efficacy of identifying high-risk athletes that may benefit from targeted prevention strategies. Wyles and colleagues[48] identified adolescent athletes with hip internal rotation of <10° and found at 5-year follow-up that 95% had abnormal MRI findings compared with 54% in the age-matched control group. Wollin and colleagues[62] developed an in-season screening protocol using adductor strength reductions of 15%, adductor/abductor strength ratio <0.9, and hip and groin outcome scores <75 as indicators of at-risk individuals. By employing preseason and in-season screening protocols, we can identify high-risk athletes for further workup and close follow-up throughout the season. Pelvic radiographs in these high-risk athletes may help us determine the presence of abnormalities in

hip morphology, which would place an athlete into a high-risk group where prevention strategies could then be employed. There are no data available to determine the most effective prevention strategy at this time. However, levels II and III evidence exists indicating that exercise programs may reduce the incidence of groin injuries.[63] Additional strategies, like limiting adolescent playing time similar to strategies employed in baseball pitches with pitch counts, could potentially reduce the potential for injury. Further studies on preseason screening and in-season monitoring protocols, targeted exercise therapy, early surgical intervention, and potential biologic intervention are needed to determine the most effective methods of preventing groin injuries in athletes.

Key Info

Figures/Tables

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Multimedia

Product Guide

Product Guide

- STRATAFIX™ Symmetric PDS™ Plus Knotless Tissue Control Device
- STRATAFIX™ Spiral Knotless Tissue Control Device
- BioComposite SwiveLock Anchor
- BioComposite SwiveLock C, with White/Black TigerTape™ Loop

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