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Groin Injuries and Groin Pain in Athletes: Part 1

Vincent Morelli, MD[a,*], Victor Weaver, MD[b]

[a]Primary Care Sports Medicine Fellowship, Louisiana State University Health Sciences Center, 200 West Esplanade Avenue, Suite 412, Kenner, LA 70065, USA
[b]Cherokee Health Systems, 815 West 5th North Street, Morristown, TN 37814, USA

Sports injuries to the hip and groin region have been noted in 5% to 9% of high school athletes [1,2]. These injuries occur most commonly in athletes participating in sports involving side-to-side cutting, quick accelerations and decelerations, and sudden directional changes. Symptoms may range from intermittent episodes of mild discomfort to severe and chronic career-ending pain.

Groin injuries may result from a variety of causes. Although this article deals mainly with athletic etiologies, the physician must keep in mind that many other medical conditions may also affect the groin. Differential diagnosis of nonathletic causes of groin pain is outlined below:

- Intra-abdominal disorders (eg, aneurysm, appendicitis, diverticulosis, inflammatory bowel disease)
- Genitourinary abnormalities (eg, urinary tract infection, lymphadenitis, prostatitis, scrotal and testicular abnormalities, gynecologic abnormalities, nephrolithiasis)
- Referred lumbosacral pain (eg, lumbar disc disease)
- Hip joint disorders (eg, osteoarthritis Legg-Calve-Perthes disease, synovitis, slipped femoral capital epiphysis and osteochondritis dissecans of femoral head in younger patients)

Because of these overlapping medical conditions and because the anatomy of the region is so complex, a team approach is optimal. In the authors' National Institute for Groin Injuries, primary care sports physicians coordinate input from a team of urologists, neurologists, radiologists, interventional radiologists, orthopedists, general surgeons, gynecologists, physical therapists, and gastroenterologists.

* Corresponding author.
E-mail address: morellivincent@yahoo.com (V. Morelli).

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The primary care physician, in addition to performing a focused history and physical examination, should have an understanding of the diagnostic imaging available and a working knowledge of the sensitivities and specificities of each test. After generating a complete differential diagnosis, appropriate referral when needed, and formulation of a treatment plan, the coordinating physician must diligently maintain oversight of the athlete's response to initial conservative management. This is paramount not only because of the difficulty of diagnosis, but also because 27% to 90% of patients presenting with groin pain have more than one coexisting injury [3,4]. As the authors illustrate, these coexisting injuries are thought to arise due to the close proximity of anatomical elements in the region, predisposing one insult to naturally involve adjacent structures. Alternatively, an initial injury may alter the delicate biomechanics of the hip and groin, leading to secondary overuse injuries. Whatever the reason, it is common for one injury to be properly diagnosed and be improving with treatment, while at the same time a concomitant injury may have gone entirely undiagnosed and untreated, leaving both the athlete and physician frustrated if proper monitoring and re-evaluation are not done. In Part 1 of this two-part series, ligament/muscle strains, nerve entrapment syndromes, and posterior abdominal wall abnormalities are reviewed as common causes of groin pain.

Relevant groin anatomy

A detailed knowledge of the hip and groin anatomy is important during the physical examination and in the subsequent generation of a complete differential diagnosis. Figures throughout this article illustrate some of the relevant anatomy. The important thing to realize is how closely the anatomic structures lie in proximity to one another, and how symptoms arising from one structure may seem to be originating from adjacent anatomy.

The origins of some of the muscles that are subject injury in the groin region may be seen in Fig. 1. The main ligaments of the region are shown in Fig. 2.

The anterior iliofemoral ligament extends from the anterior inferior iliac spine (AIIS) to the intertrocanteric line of the femur, and prevents excessive hyperextension of the hip. The posterior ischiofemoral ligament stabilizes the joint posteriorly and superiorly. The pubofemoral ligament prevents excessive abduction.

The ligamentum teres not only carries some of the blood supply to the femoral head (see section on ligamentum teres injuries), but also is thought to play a role in hip stabilization [5]. Patients who suffer tears of this ligament often present with deep groin pain and a feeling of instability [6].

The blood supply to the femoral head is supplied mainly by branches from the medial and lateral circumflex femoral arteries. A branch of the

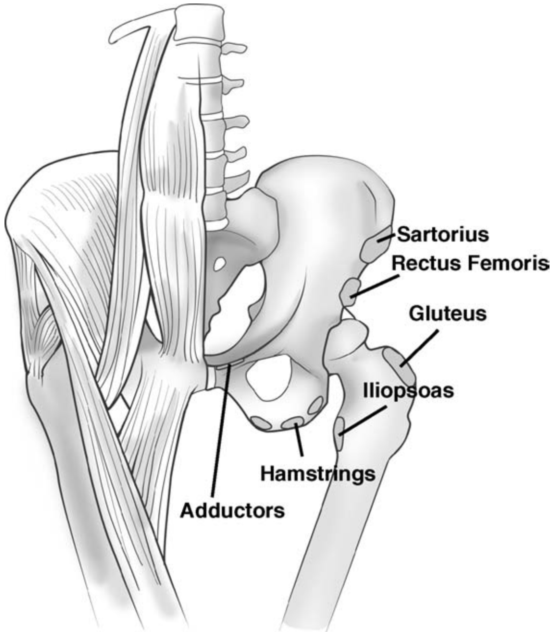

Fig. 1. Attachment of the muscles in the groin region.

obturator artery, passing through the ligamentum teres, plays a lesser role, providing a significant blood supply in only 30% of adults [7]. As adults age, this artery becomes less and less relevant, eventually supplying only a small area of the femoral head near the insertion of the ligament [8]; however, even this small area of dependency must be kept in mind, because injuries to the ligamentum teres may result in blood flow compromise, subsequent insult to the adjacent femoral articular cartilage, and painful symptoms (see below).

The nerve supply to the area is as follows: the hip joint is supplied by the femoral nerve (which also innervates the iliofemoral ligament and the superior capsule), the obturator nerve (also supplying the pubofemoral ligament), the superior gluteal nerve (which supplies the superior and lateral part of the joint capsule and also the gluteus medius and minimus), and by the nerve to the quadratus lumborum, which supplies the posterior capsule and the ischiofemoral ligament [8].

A more detailed look at the obturator nerve is deserved, because it is increasingly being reported as a source of chronic groin pain in athletes [9]. The authors do so in the below section on nerve entrapments, where we also discuss the femoral nerve, the lateral femoral cutaneus nerve, the ilioingunal/genitofemoral nerve, and the iliohypogastric nerve.

It must also be remembered that spinal nerves L2, L3, and L4 may become impinged (by bony spurs, disc herniation masses, and so on) as they leave the neural foramina and can refer pain to the groin and anterior thigh.

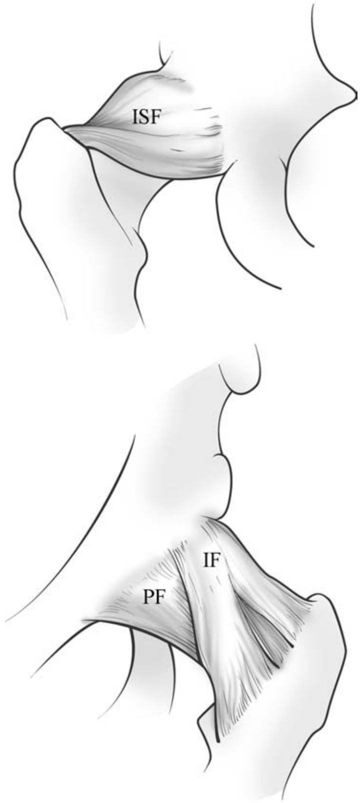

Fig. 2. The main ligaments of the groin region.

Inguinal nodes that drain the skin of the lower limb, lower abdominal wall, scrotum, labia, vagina, and anal canal may also be a cause of groin pain. These may become enlarged in a number of infectious conditions, and should not be overlooked on physical examination.

Ligament/muscle strains

Adductor strains

The most common groin injury in athletes is the adductor strain. Among soccer players, incidence rates ranging between 10% and 18% have been reported [10–12].

Risk factors

Decreased abductor range of motion and decreased adductor strength have both been proved to be associated with an increased incidence of adductor strains [13,14]. In addition, biomechanical abnormalities of the lower limb (eg, excessive pronation, leg-length discrepancy, and the like), imbalance of the surrounding hip musculature, and muscular fatigue have also been postulated to increase the risk of adductor strain [15]. Although there have been no controlled clinical studies proving these latter elements to be causative, prevention programs focused on ameliorating some of these abnormalities have been shown to be effective in professional hockey players [16].

Physical examination

Adductor strains are usually easily diagnosed on physical examination, with pain on palpation of the involved muscle and pain on adduction against resistance. It must be remembered, however, that entrapment of the obturator nerve, osteitis pubis, and hip pathology may present similarly, and may lead the physician astray if the physical examination is not meticulously done. Most strains occur at the musculotendinous junction of the adductor longus or gracilis. Complete avulsions of these tendons occur much less frequently.

Imaging

If the diagnosis is in question, ultrasound is somewhat useful for diagnosing muscle and tendon tears, but not muscle strains. MRI can be used to confirm muscle strain or tears, and partial and complete tendon tears. MRI may also yield prognostic information about muscle tears. Tears of greater than 50% of the cross-sectional area, tissue fluid collection, and deep muscle tears may indicate more severe injury and a more prolonged recovery [17]. The location of the tear also has important therapeutic and prognostic implications. An acute tear at the musculotendinous junction, which has a relatively robust blood supply, allows a relatively aggressive approach to rehabilitative treatment. In contrast, an acute partial tear at the less vascular tendinous insertion necessitates a period of rest before pain-free physical therapy becomes possible.

Treatment

Although few controlled studies of the treatment of acute adductor strains exist, most clinical experience dictates that acute treatment should include relative rest, ice, and possibly short term use of nonsteroidal anti-inflammatory drugs (NSAIDs) to help prevent further injury and inflammation. Following this, physical therapy should be directed at restoring range of motion and prevention of atrophy. Finally, the athlete should focus on regaining strength, flexibility, and endurance. When the athlete has recaptured at least 70% of strength and pain-free full range of motion, a return to sport can take place [18]. The above rehabilitation process may take 4 to 8 weeks following an acute strain.

In chronic adductor strains, the above general plan of physical therapy may take up to 6 months to achieve desired results [15]. One well-done randomized trial has shown active muscular training to be more effective than passive physical therapy in returning chronic groin patients to sport. This study of 68 athletes who had chronic adductor strains compared passive physical therapy (ie, friction massage, stretching, transcutaneous electrical nerve stimulation, laser treatment) with active exercise as a means of rehabilitation, and found that 23 patients in the active group and only 4 in the passive group were able to return to their sport after 8 to 12 weeks [15]. The efficacy of NSAIDs in chronic adductor strains has not been documented in the literature.

The sports physician must also remember (especially in recurrent acute strains and chronic strains) that biomechanical abnormalities of the lower limb should be sought and corrected as a part of any treatment protocol. Also, because the adductors play a significant role in the stabilization of the hip [19], injury to these muscles may disrupt normal hip mechanics and lead to an increased risk of adjacent injury. Lynch and Renstrom [18] have postulated that a premature return to sport may lead to added or continued injury and chronic pain.

Two situations may warrant referral to a surgeon. In the first, athletes who have chronic adductor longus strains that fail to respond to at least 6 months of conservative treatment may benefit from surgical tenotomy. This procedure may be considered only after other injuries (ie, obturator nerve entrapment, osteitis pubis) are ruled out, and the diagnosis is certain. The patient must then be informed that surgical results are less than optimal, and that only 63% of athletes have been reported to return to sport at their previous level after tenotomy [20] (a later study of 42 athletes who had chronic groin pain [21] found that a combination of hernia repair plus adductor longus tenotomy afforded 90% of athletes to return to sport at their previous level of competition.). In the second situation, rare complete tears of the tendinous insertion from the bone may also require surgical repair.

Prevention

In 2002, National Hockey League (NHL) statistics demonstrated that adductor strains occurred twenty times more frequently during training camp as opposed to the regular season, implying that deconditioning might contribute to these injuries, and that strengthening programs may be preventative. Such strengthening of the musculature of the hip, pelvis, and lower extremities has long been thought to be an important part of adductor injury prevention programs [19], and recently these programs have been documented to be effective in preventing groin injuries in soccer and hockey players [16,22]. In one such study, Tyler et al [16] presented the results of their adductor strain prevention program in NHL hockey players. Their strengthening/prevention programs focused on ameliorating adductor weakness (with a goal of keeping adductor strength at least 80% of abductor strength), and found that adductor strengthening significantly reduced injury.

Iliopsoas strain/tendonitis and iliopsoas bursitis

Strain/tendonitis of the iliopsoas muscle usually occurs at the musculotendinous junction during resisted hip flexion or hyperextension. Iliopsoas bursitis can occur alone or in conjunction with strain. The two conditions commonly occur concomitantly, and are essentially identical in their clinical presentations [23].

The largest bursa in the body, the iliopsoas bursa (which communicates with the hip joint in 15% of people) can be a source of significant groin pain. Bursitis results from overuse and friction as the iliopsoas tendon rides over the iliopectineal eminence of the pubis (Fig. 3).

This condition occurs in activities requiring extensive use of the hip flexors, including soccer, ballet, uphill running, hurdling, and jumping. Iliopsoas bursitis is characterized by deep groin pain that sometimes radiates to the anterior hip or thigh, and is often accompanied by a snapping sensation. If severe enough, the athlete may exhibit a limp [24].

Due to poor localization and reproducibility of the pain, the average time from onset of symptoms to diagnosis is 32 to 41 months [23].

Physical examination

Despite the above-stated usual delay in diagnosis, a properly directed physical examination should reveal the pathology. Tenderness may be felt over the musculotendinous junction of the iliopsoas on deep palpation over

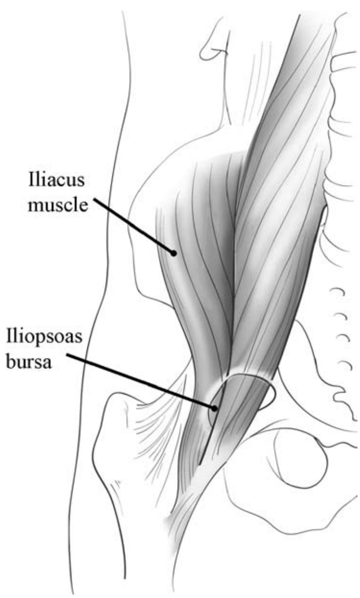

Fig. 3. Iliopsoas bursa.

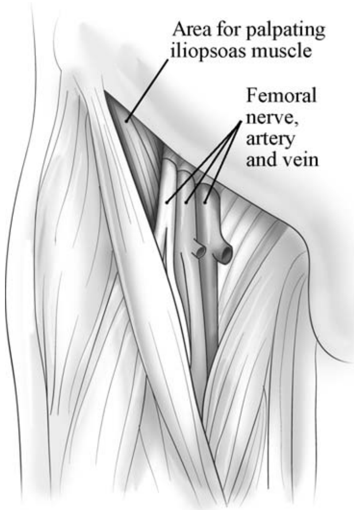

Fig. 4. Palpable iliopsoas.

the femoral triangle (adjacent to the femoral artery) (Fig. 4) [23]. Pain may also be reproduced when the flexed, abducted, externally rotated hip is extended and brought back into a neutral position (extension test). During this maneuver, the iliopsoas is stretched as the hip is extended and symptoms are reproduced. Another helpful diagnostic test is to have the supine athlete raise his or her heels off the table to about 15°. In this position, the only active hip flexor is the iliopsoas, and provocative testing as such will elicit pain [25]. Again, tenderness may be felt during this maneuver by palpating the psoas muscle below the lateral inguinal ligament at the femoral triangle [26].

Diagnostic imaging

MRI has been shown to be the most sensitive and specific method of imaging [27]. Ultrasound has been found to be useful in aiding diagnostic and therapeutic injections of the iliopsoas bursa.

Treatment

Conservative treatment of both strain and bursitis is appropriate, and consists of rest, followed by stretching of the hip flexors and rotators, then strengthening of these groups, and finally a gradual return to sport. As in any overuse injury, biomechanical abnormalities that may contribute to the injury must be sought and corrected. In persistent cases, corticosteroid injections may be helpful. Such injections may have increased success with ultrasound image guidance, as noted above. Corticosteroid injection has been shown to provide relief for 2 to 8 months in all patients in one study (N = 8) [28].

Surgical management may be considered if symptoms persist despite appropriate conservative measures. Surgery consists of either tendon release or tendon lengthening to relieve persistent friction and persistent symptoms of painful snapping hip syndrome (see below) [29]. In one study [30], tendon release has been reported to completely relieve symptoms in 12 out of 16 patients, and to improve symptoms in the remaining 4. Weakness of hip flexion was noted in 3 patients.

High hamstring strain/ischial tuberosity avulsion in adults

High hamstring strains (partial avulsion of the muscle from its origin on the ischial tuberosity), occur most commonly in dancers, hurdlers, runners, water skiers, and other athletes who place excessive stress on the stretched hamstrings [34]. Muscle fatigue may increase risk of injury [35]. It must be remembered that the ischial tuberosity may not fused until the third decade [36], and that some of these injuries may actually represent an aphositis rather than a true strain [37].

Patients usually present with posterior thigh pain, and can have radiation to the groin as well. The diagnosis is easily made when the examiner notes pain on palpation directly over the muscle insertion on the ischial tuberosity; however, it must be remembered that the adductor magnus also originates from the ischial tuberosity, and that injuries to this muscle must also be considered in the differential diagnosis (see Fig. 1).

Differentiating complete from partial ruptures may be difficult, and may require the use of MRI. As we will see, this differentiation is important to properly treat the athlete. It must be remembered that even in acute midsubstance hamstring strains, MRI has been found to have an 18% false-negative rate [35]. To the authors' knowledge, the accuracy of MRI in diagnosing and grading hamstring "origin" injuries is not documented in the literature.

Treatment usually entails a prolonged course of conservative management, although occasionally surgical intervention may be required if complete avulsions are accompanied by displaced (>2 cm) bony fragment. One series of 21 patients who had apophyseal avulsion and 14 who had apophysitis [37] found that two thirds of those who had apophyseal avulsion, and all of those who had apophysitis, responded well to conservative treatment. One third of patients who had avulsions required surgery to ameliorate painful symptoms and allow return to sport. Several authors, however, recommend early surgical repair for all complete avulsions, and feel that this affords the best functional outcome [34,37].

There is some evidence that hamstring strengthening programs will prevent hamstring strains in elite soccer players, though how these programs apply specifically to high hamstring strains is unclear [38].

Sartorius strains

These injuries occur usually with the hip extended and knee flexed when the sartorius undergoes a sudden contraction. Because the anterior superior iliac spine (ASIS) ossification center fuses relatively late (around 21–25 years of age), diagnosis of both strain and apophysitis must be entertained in these age groups [39]. Diagnosis is usually made easily on physical examination, by palpable tenderness over the ASIS and pain with provocative muscle testing. Treatment is conservative and should follow standard physical therapy regimens for muscle strain.

Rectus femoris strains

Because this is the only member of the quadriceps muscle group that spans two joints, it is subject to more stress and subsequently more injuries. Muscular injuries often result from the explosive hip flexion experienced in kicking or sprinting. Clinically, there is swelling and tenderness over the anterior thigh, or at the AIIS if the injury occurs at the tendon-bone interface. In these cases, although the AIIS is not directly palpable, provocative testing of the rectus will elicit pain. Conservative treatment is effective for most acute partial ruptures; however a small subset of these patients go on to have chronic pain and disability. These athletes may have scar tissue formation within the substance of the muscle, which may be noted as an asymmetry or mass on physical examination and may be confirmed by MRI. After a failed trial of conservative therapy, these patients have been reported to do well with surgical excision of the scar tissue [40]. Complete tears have been reported to require surgical repair [41].

Avulsion fractures/apophysitis about the hip and pelvis in the pediatric age group

Whereas strains are common in adult athletes, apophysitis and apophyseal fractures are more common in the pediatric age group. In the skeletal immature athlete, the physis is the weakest link in the muscle/tendon/bone connection. Although it is difficult to state the true incidence of apophysitis because many pediatric athletes who have this condition will not seek medical attention, 14% to 40% of pediatric athletes involved in strenuous activity sustain avulsion fractures. Ninety percent of these occur in boys between the ages of 14 to 17 [42–44].

Avulsion fractures/aphositis may occur at any of the ossification centers of the pelvis, but most commonly occur at the origin of the hamstrings on the ischial tuberosity, rectus femoris at the AIIS, sartorius at the ASIS, and adductors at the pubic symphysis. These conditions also occur less commonly at the insertion of the iliopsoas on the lesser trochanter of the femur, at the iliac crest at the attachment of the abdominal musculature, and at the superior pubic symphysis at the attachment of the rectus abdominus (see Fig. 1). One study of 203 avulsion fractures found 53% to occur at the origin of the hamstrings at the ischial tuberosity, 22% at the AIIS, and 19% at the ASIS. The two most commonly offending sports were soccer, accounting for 34% of injuries, and gymnastics, accounting for 27% [45].

Other smaller series have noted, in addition to the commonly affected iliotibial band (ITB), AIIS, and ASIS, a small incidence (11%) of iliopsoas avulsion from the lesser trochanter, and of abdominal musculature avulsion from the iliac crest [46].

These injuries can be diagnosed by proper physical examination, individually testing the involved muscles, and palpating, when possible, the sites of tendon bone interface.

Plain films are usually normal in apophysitis and are notoriously poor in diagnosing apophyseal avulsion fractures, especially if the fracture is nondisplaced or the apophysis is not ossified [47,48]. Ultrasound has been reported to be both sensitive and specific in diagnosing these injuries, and has the advantage of being quicker and cheaper than MRI [47,49]. Magnetic resonance scanning offers definitive or confirmatory imaging [50].

All cases of aphositis and most avulsion fractures may be treated without operative intervention. In the case of complete avulsion/avulsion fractures, conservative treatment consists first of relieving tension on the injured muscle until pain has subsided. This may entail a few days of bed rest with knees and hips flexed (in the case of sartorius, rectus, and iliopsoas avulsions), activity restriction, crutch ambulation, ice, and anti-inflammatories. The second stage of therapy should begin once pain has subsided, and should consist of gentle range-of-motion exercises, followed by progressive strengthening. Once 50% strength has been achieved, limited activity can be resumed, and once full strength has been restored, full return to sport may be allowed. Return to sport can usually be anticipated in 4 to 12 weeks [41].

The one exception to conservative management for avulsion fractures may be hamstring avulsions from the ischial tuberosity when the avulsion fracture fragment is displaced greater than 2 cm. Such cases have been reported to do better if managed surgically [51].

Nerve entrapment syndromes

At least six different nerve entrapments may present with pain in the groin area. Compression of the obturator, the femoral, the iliohypogastric, the genitofemoral, the ilioinguinal, and the lateral femoral cutaneous all must be considered.

Obturator nerve

The obturator nerve arises from the anterior branches of L2, L3, and L4, and travels down the medial border of the psoas muscle in the pelvis. It transverses through the obturator canal and enters the thigh through the obturator foremen. Its branches innervate the adductor magnus, longus, and brevis muscles. The sports physician must remember, however, that the adductor magnus and longus also receive partial supply from the sciatic and femoral nerves, explaining why obturator entrapment may cause only subtle weakness on physical examination, and possibly making the adductor brevis more suited for specific electromyography (EMG) diagnosis of obturator entrapment. The nerve has been reported to usually become entrapped in the obturator foramen (not in the bony obturator canal), or by thickened fascia surrounding the adductor muscles (usually adductor brevis) [52]. This anatomy highlights the difficulty in distinguishing between adductor strain and obturator nerve entrapment.

The nerve also innervates the hip joint, the knee joint, and the skin on the medial thigh. This also explains why hip pathology can refer pain to the knee and vice versa. Although this entrapment is uncommonly seen at the authors' Institute for Groin Injuries, it has been noted by some sports clinics to be increasing in frequency [53]. The classic presentation is a deep ache near the adductor origin of the pubic bone that is exacerbated by exercise. The pain may subside with rest, but often resumes with activity, and may radiate down the medial thigh toward the knee. Spasm, weakness, and paresthesias in the area may also occur [52].

Physical examination

Subtle adductor weakness may occur. Pain may also be reproduced by a pectineal stretch, in which the standing patient passively externally rotates and abducts the hip, or by the patient actively internally rotating the hip against resistance. Both tests may elicit pain as the entrapped nerve is stretched [9]. The sensitivity and specificity of these tests is undocumented in the literature.

Imaging

EMG can be helpful if done by a neurologist experienced in evaluating this area. The test is a reliable method for detecting entrapment in patients who have had symptoms present greater than 2 weeks (nerve conduction studies and EMGs usually will not become diagnostic until some degree of demyelination has occurred). If early studies are negative and clinical suspicion remains, repeat EMGs are usually done at 4 to 6 weeks [54]. Fluoroscopically guided anesthetic injection of the obturator foramen, inducing an obturator nerve block, provides further support for this diagnosis if it relieves the athlete's pain and reproduces the adductor weakness [52].

Treatment

Most chronic cases respond poorly to conservative management and warrant surgical intervention if the diagnosis is confirmed by EMG [52]. Presumably, by the time chronic changes are present, fascial thickening/entrapment has become fixed. It is not known whether or not conservative management (eg, physical therapy, massage, stretching, ultrasound) in early cases with intermittent symptoms would be helpful in preventing irreversible entrapment. Surgical neurolysis (dividing the constricting fascia from the nerve) has been described by Bradshaw and colleagues [53] and was found to be successful in all 32 patients in their study group. The average length of time symptoms had been present before surgery was 12 months, and all patients returned to prior level of competition by 6 weeks postsurgery. EMG findings in all patients also returned to normal within 12 months.

The femoral nerve

The femoral nerve arises from the ventral rami of L2, L3, and L4, innervates the psoas (along with L2 and L3 spinal nerves) along its course in the pelvis, passes out of the pelvis under the inguinal ligament, and then divides into two branches. The anterior branch provides motor innervation to the sartorius and sends sensory branches to the anterior thigh. The posterior branch provides motor branches to the quadriceps muscle and supplies sensation to the anterior medial knee and leg. Because the nerve divides into many branches shortly after passing under the inguinal ligament, it has been postulated that most severe femoral nerve compressions occur before this division, at or near the inguinal ligament [55].

Injury to the femoral nerve has been reported as a postoperative complication following hip arthroplasty, abdominal hysterectomy, prolonged labor, urologic procedures, and hernioraphy, and as a result of spontaneous retroperitoneal hematoma formation in anticoagulated patients. Of particular interest to the authors is that it has also been reported following blunt trauma and from overstretching or compression in dancers and gymnasts [56–58].

Patients may present with quadriceps weakness or giving way, thigh atrophy, or numbness in the anterior thigh and medial calf. When present, pain may be felt in the inguinal region, anterior thigh, or medial calf [55].

Diagnosis may be confirmed by nerve conduction studies and EMG of the quadriceps muscle. Pelvic or abdominal CT or MRI may be needed to detect compressing masses or retroperitoneal hematomas, whereas imaging of the lumbosacral (LS) spine may be required to rule out a lumbar source for radiculopathy.

Conservative treatment will usually relieve symptoms in athletes whose symptoms are caused by stretch or compression. Temporarily refraining from the inciting activity and physical therapy may be all that are needed if the injury is attended to in a timely fashion.

Ilioinguinal/genitofemoral/iliohypogastric nerves

Anatomy

There is considerable anatomic variation in the origin and course of these nerves, as well as overlap of their cutaneous distributions (Fig. 5) [59].

The first lumbar nerve (L1) exits the spinal canal as a common trunk for the ilioinguinal and iliohypogastric nerves. The trunk splits into the ilioinguinal, which traverses through the inguinal canal, becoming fairly superficial near the superficial inguinal ring, and continues to supply the root of penis (or labia majora), anterior scrotum, and medial thigh. The second branch, the iliohypogastric, branches into the anterior cutaneous branch, which carries cutaneous sensation from the lower abdominal/groin region medial to the ASIS, and the lateral cutaneous branch, which receives sensation from the lateral thigh and gluteal region.

In addition to the sensory components mentioned above, both the ilioinguinal and iliohypogastric provide motor innervations to the lower abdominal musculature.

The genitofemoral nerve generally receives at least some input from L2 or L3 as well as L1. Its cutaneous distribution is to the skin of the anterior scrotum/labia majora and upper medial thigh.

History and physical

Entrapment and injury of all of these nerves has been reported. Injury to the iliohypogastric has been reported following laparoscopic gynecologic

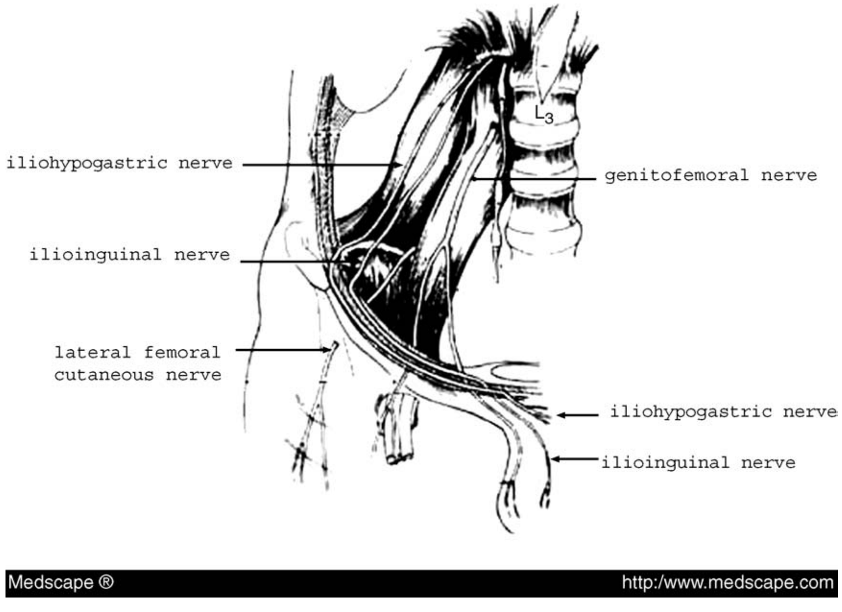

Fig. 5. Illioinguinal/genitofemoral/iliohypogstric nerves adobe groin figure.

surgery [60], inguinal herniorraphy, or other abdominal surgery [61,62]. These nerves have also been reported to become injured or entrapped following blunt trauma, scarring, or hypertrophy of the abdominal musculature with overtraining [63,64]. Entrapment of the ilioinguinal, iliohypogastric, and genitofemoral nerves may results in groin pain or lower abdominal pain that may radiate to the genitals.

On physical examination, tenderness is often noted 2 to 3 cm inferior and medial to the anterior superior iliac spine. Hip extension usually produces increased pain or hypoesthesia in the nerve's distribution. At times, a Tinel's sign may be elicited by tapping over the ilioinguinal nerve. Distinction between ilioinguinal, iliohypogastric, and genitofemoral nerve involvement may be aided by the use of local nerve blocks for iliohypogastric and ilioinguinal pathology, and by paravertebral L1 and L2 nerve-root blocks for genitofemoral pathology. Alleviation of symptoms suggests the blocked nerve as the source of pain. Nerve blocks are usually done if surgical treatment is contemplated, because failure to precisely diagnose may lead to unnecessary or misguided surgical exploration. Again, this must be done by personnel experienced in these procedures.

Treatment

Once diagnosis is made, conservative management, including changes in training regimens, ice, NSAIDS, and local corticosteroid injections, is appropriate [65].

In rare treatment resistant cases, surgical referral for neurolysis or neurectomy is warranted and generally offers good results [66].

Lateral femoral cutaneus nerve

Compression of the lateral femoral cutaneous nerve can occur as it passes under or through the inguinal ligament (see Fig. 5). It has been noted in women who sit for prolonged periods with the involved leg underneath the body, in squatting rifle team members, in patients who have leg-length discrepancies [67], and in athletes who sustain acute trauma to the area [68].

Patients present with pain or characteristic paresthesias over the lateral thigh. Treatment is composed of refraining from the offending activity and conservative therapy. In one study, 91% of 277 patients did well with nonoperative treatment. The remainder required surgery (either neurolysis or transection), which was successful 96% of the time [69].

Posterior abdominal wall abnormalities

Posterior abdominal wall abnormalities causing groin pain include sports hernias and groin disruptions. Although the two terms are often (incorrectly) used interchangeably, subtle distinctions do exist.

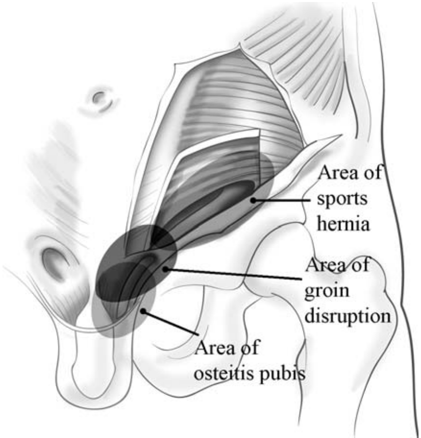

Fig. 6. Sports hernia.

Sports hernia

A sports hernia is caused by a weakening of the posterior abdominal wall, resulting in an occult direct or indirect hernia. The cause of this injury is largely speculative, but most likely multifactorial. Theories cite overuse, muscle imbalance, increased shearing forces across the hemi pelvis, or possibly a genetically weakened inguinal wall. It is not known whether or not biomechanical abnormalities contribute to the condition.

Controversy exists as to the prevalence of this condition. Some investigators believe sports hernias to be a rare cause of groin pain, whereas others believe this condition to represent the most common cause of chronic groin pain in athletes [4,31,70]. In the authors' National Institute for Groin Injuries, a tertiary center for patients presenting with groin pain, we have found an almost 30% of surgically documented sports hernias (ongoing data collection as yet unpublished).

The sports hernia presents as an insidious-onset, gradually worsening, deep groin pain that is diffuse in nature. It may radiate along the inguinal ligament, perineum, and rectus muscles. Valsalva maneuvers such as coughing and bearing down may increase pain. Radiation of pain to the testicles is present in about 30% of afflicted men [18].

On physical examination, no true hernia is palpable, because only the deep fascia is violated [32].

Clinically, it is difficult to distinguish between the sports hernia, groin disruptions, distal rectus abdominus strain, adductor strain, stress fractures, and osteitis pubis; however, the pain of sports hernia may be located more laterally and proximally than in groin disruptions (Fig. 6) and distil rectus strain. Stress fractures and osteitis pubis may be differentiated by provocative testing, as noted in Part 2 of this series.

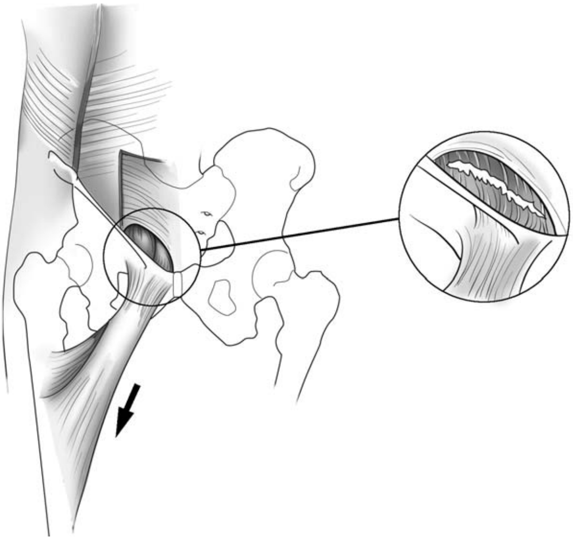

Fig. 7. Tear of the conjoined tendon.

MRI and bone scan might be helpful in ruling out other conditions (stress fractures and the like), but not in making a definitive diagnosis of sports hernia [31]. Nonoperative treatment is usually unsuccessful; however, because a definitive diagnosis is often difficult to make, a trial of several weeks of conservative treatment is warranted. If symptoms persist, the athlete should undergo surgical exploration and repair. A 90% success rate has been reported with proper surgical intervention [32].

Groin disruption

Groin disruption was first described in 1980, when three professional soccer players who had chronic groin pain of unknown origin finally underwent surgical exploration after a failed prolonged course of conservative therapy. In surgery, direct visualization of the area finally afforded a definitive diagnosis. The athletes were termed to have "groin disruptions," and after operative repair all three were able to return to competitive sport.

Factors contributing to groin disruption are similar to those contributing to sports hernias (eg, muscle imbalance with relatively strong adductors and weak lower abdominal musculature [32], increased shearing forces across the hemi pelvis, overuse, genetically weakened inguinal wall). It is not known whether or not biomechanical abnormalities of the lower extremities contribute to the condition.

The term groin disruption encompasses various distinct anatomic abnormalities of the posterior abdominal wall. Such abnormalities include tears of the transveresalis fascia, tears of the external oblique, aponeurosis/avulsion of fibers of the internal oblique at the pubic tubercle [33], abnormalities of the insertion of the rectus abdominus [31,33], tears of the conjoined tendon, or dehiscence of the conjoined and inguinal ligaments (Fig. 7).

One study of 157 athletes who underwent surgery for chronic groin pain noted 57% to have ‘‘loose-feeling inguinal floors’’; 48% had external oblique aponeurosis defects; and 23% had a thin insertion or tear of the rectus abdominus [31].

Clinically, these athletes present with groin pain on exertion, but pain with Valsalva’s maneuver; coughing, or sneezing is uncommon (10% of patients). Many patients (about 65%) also have pain with resisted adduction of the hip, making this condition difficult to distinguish from adductor strain [31]. Pain and tenderness may be elicited with pressure over the area in the supine patient supine, or with pressure applied while the patient tenses the musculature by performing a half sit-up.

As in sports hernias, imaging studies are useful to rule out other pathologies, but are not helpful in making the definitive diagnosis. After a trial of conservative treatment, definitive surgical repair is usually required. Following surgery, 87% to 95% of athletes may be expected to return to their preinjury level of competition, usually within 12 weeks [31,32].

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