

Athletic Pubalgia (Sports Hernia)

Demetrius E.M. Litwin, MD^{a,*}, Erica B. Sneider, MD^a,
Patrick M. McEnaney, MD^b, Brian D. Busconi, MD^c

KEYWORDS

- Sports hernia • Athletic pubalgia
- Lower abdomen and groin pain • Hernia
- Inguinal canal • Laparoscopic

Athletic pubalgia or sports hernia is a syndrome of chronic lower abdomen and groin pain that may occur in both athletes and nonathletes. It is defined as weakness or tearing of the rectus abdominus insertion to the superior pubic ramus. Activity restricting lower abdomen and groin pain is a frequent occurrence in some sports, such as soccer, accounting for 10% to 13% of all injuries per year.^{1,2} However, most lower abdomen and groin injuries are self-limited and only a small percentage cause symptoms for greater than 3 weeks.² There are several causes of chronic lower abdomen and groin pain that may be related to disorders of the hip joint, injury to muscles of the thigh or abdominal wall, and even genitourinary or intraabdominal disease.^{3,4} Because the differential diagnosis of chronic lower abdomen and groin pain is so broad, only a small number of patients with chronic lower abdomen and groin pain fulfill the diagnostic criteria of athletic pubalgia (sports hernia).

Over the years, many different names have been associated with this injury, such as athletic pubalgia, sports hernia, Gilmore's groin, pubic inguinal pain syndrome, sportsmen's groin, footballers groin injury complex, hockey player's syndrome, and athletic hernia.^{3,5-9} None of the terms listed earlier is perfect, but they all seek to describe a poorly understood disease complex that is generally not well accepted by general surgeons as a real syndrome warranting surgical therapy, and for which there is a paucity of good clinical studies. However, sports hernia is becoming more widely diagnosed and more frequently operated on in part because of a greater awareness generated by the media on high-profile athletes.

The literature published to date regarding the cause, pathogenesis, diagnosis, and treatment of sports hernias is confusing. The goal of this article is to summarize the

^a Department of Surgery, UMass Memorial Medical Center, University of Massachusetts Medical School, 55 Lake Avenue North, Worcester, MA 01655, USA

^b Department of Surgery, Milford Hospital, University of Massachusetts Medical School, Worcester, MA, USA

^c Department of Orthopedics and Physical Rehabilitation, University of Massachusetts Medical School, 281 Lincoln Street, Worcester, MA 01605-2192, USA

* Corresponding author.

E-mail address: litwind@ummhc.org

current information and our present approach to this chronic lower abdomen and groin pain syndrome.

HISTORICAL CONTEXT

In 1980, Gilmore¹⁰ recognized and undertook to surgically repair groin disruption in a group of athletes who presented with a syndrome of chronic lower abdomen and groin pain. In 1992, he reported his experience in a large series of 313 athletes, most of whom were soccer players, who presented with groin pain and underwent surgery.^{10,11} This entity of groin disruption that he identified associated with groin pain in athletes was subsequently called Gilmore's groin.¹⁰ At that same time, there were other reports emanating from Europe,¹²⁻¹⁵ usually involving soccer players, also identifying a similar chronic lower abdomen and groin pain syndrome in athletes. This disorder was called pubalgia by Taylor and colleagues¹⁶ in 1991, who reported their own series of athletes with chronic pain who were unable to compete, and in which they found "abnormalities of the abdominal wall in the groin region, including palpable hernias, nonpalpable hernias, and microscopic tears or avulsions of the internal oblique muscles."¹⁶

However, whereas some investigators were describing a chronic pain syndrome related to muscular injury in athletes, there were others who felt that chronic lower abdomen and groin pain was secondary to an incipient posterior inguinal wall hernia. This condition was first described by Gullmo¹⁷ in 1980 and Ekberg and colleagues¹⁸ in 1981 in Sweden. By 1991, Polglase and colleagues¹⁹ reported the finding of a substantially deranged posterior wall of the inguinal canal in most (85%) of the 64 Australian Rules football players with chronic lower abdomen and groin pain enrolled in their study. In 1992, Malycha and Lovell²⁰ reported the detection of a bulge at the time of surgery in the posterior inguinal wall in 80% of athletes with chronic undiagnosed lower abdomen and groin pain, which they felt represented an incipient direct inguinal hernia.

Cause and Pathogenesis

One can see that 2 major schools of thought emerged regarding the cause and pathogenesis of athletic pubalgia or sports hernia. The first is characterized by the concept of muscular injury and disruption that was popularized by Gilmore.^{3,11} Athletes in Gilmore's study were found to have "1) a torn external oblique aponeurosis causing dilatation of the superficial inguinal ring; 2) a torn conjoint tendon; and 3) dehiscence between the inguinal ligament and the torn conjoint tendon."^{11,21}

The term pubalgia, coined by Taylor and colleagues,¹⁶ also encompassed the notion of muscle injury, which they described as "groin pain ... most commonly caused by musculotendinous strains of the adductors and other muscles crossing the hip joint, but ... also ... related to abdominal wall abnormalities." They went on to state "cases may be termed 'pubalgia' if physical examination does not reveal an inguinal hernia and there is an absence of other etiology for lower abdomen and groin pain."

Meyers and colleagues²² further characterized the injury leading to chronic lower abdomen and groin pain as a hyperextension injury. They asserted that the pubis serves as a pivot point into which both the rectus abdominis and the adductor longus insert, thereby causing 1 muscle to pull against the other, leading to injury, which usually occurs to the weaker abdominal wall muscles.²² This concept of a tug-of-war at the pubis is lent credence by the high prevalence of concomitant adductor symptoms.²²⁻²⁴ It has also led to one of the major strategies of surgery, which is to stabilize the anterior pelvis.^{22,25-27} In a recent paper outlining what is now his vast experience with this condition, Meyers enlarged this concept of rectifying the biomechanics

of the pubic joint to include not only tightening and broadening the abdominal muscular insertion but also loosening the attachment of muscles on the other side of the symphysis, such as the adductor longus via selective epimysiotomy.^{22,28}

The second school of thought focuses on the concept of athletic pubalgia as an occult hernia process, a prehernia condition, or an incipient hernia, with the major abnormality being a defect in the transversalis fascia, which forms the posterior wall of the inguinal canal, and not a muscle tear per se.^{19,20,26,29–31} Malycha and Lovell²⁰ described a series of 50 athletes who underwent inguinal hernia repair after examination; investigation did not reveal a cause of chronic lower abdomen and groin pain, and 40 of the athletes were found to have a bulge in the posterior inguinal wall. In addition, in these investigators' subsequent study of 15 athletes with chronic lower abdomen and groin pain in whom the conjoint tendon was biopsied, they could not find histologic evidence of injury and concluded "injury to the conjoint tendon is not the cause of chronic lower abdomen and groin pain in these athletes."³² Similarly, Polglase and colleagues¹⁹ discovered as the main finding a substantially deranged posterior wall of the inguinal canal in 61 operations of the groin in 72 athletes (85%), most of whom were Australian Rules football players with debilitating lower abdomen and groin pain. These investigators concluded, "the most common finding in athletes with chronic lower abdomen and groin pain was a deficiency of the posterior wall of the inguinal canal." Furthermore, herniography has long been advocated as a means of detecting nonpalpable hernias in football players with lower abdomen and groin pain. For example, in a study of 60 soccer players with lower abdomen and groin symptoms but no detectable hernia on clinical examination, herniography discovered occult hernias in 51 of the players.³³ In a group of Australian Rules football players with chronic lower abdomen and groin pain, but no clinical signs of hernia, Orchard and colleagues³⁴ used ultrasound as a tool to show posterior wall deficiency of the inguinal canal. They concluded that dynamic ultrasound (ie, ultrasound performed while the patient strains) was useful in detecting posterior inguinal canal deficiency, and that it was more prevalent in those players with pain. Mushaweck and Berger⁷ have recently reported the use of dynamic ultrasound as the diagnostic modality of choice for sports hernia. Using ultrasound to monitor motion of the inguinal canal and its posterior wall during a Valsalva maneuver, these investigators report "sportsmen's groin was diagnosed if a convex anterior bulge of the posterior inguinal wall was observed during stress." In addition, at surgery, the typical finding Mushaweck and Berger⁷ describe is "a circumscribed weakness found in the posterior wall, with the tissue around it being firm and intact." Joesting³⁵ too was emphatic in describing the injury in these patients as a tear of the transversalis fascia, which forms the posterior wall of the inguinal canal.

How do we reconcile these philosophic differences? Are there 2 subgroups of patients, or is it the same entity viewed from different vantage points?

Zimmerman³⁶ suggested that a tear of the conjoint tendon might be the cause of the bulge in the posterior wall of the inguinal canal seen in these patients. Although Taylor and colleagues¹⁶ postulated that muscle strain was the major cause of pain in these athletes, 7 of the 9 patients operated on had evidence of a bulge in the posterior wall, which the investigators believed represented a direct hernia. Also, even although Meyers and colleagues²² found a significant incidence of muscular injury in their series of athletic pubalgia (eg, 48% of their patients had obvious tiny defects of the external oblique aponeurosis, 17% had a thin rectus insertion, and 6% had a clear-cut tear in the region of the rectus insertion), these investigators also reported that 57% of the 157 athletes operated on "had subjectively 'loose feeling' inguinal floors

(Hesselbach's triangle)." On the other hand, Polglase and colleagues,¹⁹ who believed that the principle defect seen in athletic pubalgia was of the posterior wall of the inguinal canal, also reported "apparent splitting of the conjoined tendon" in 26% of their cases. Mushaweck and Berger,⁷ proponents of the minimal repair technique that Mushaweck has pioneered, which focuses principally on repair of the posterior wall defect that Mushaweck feels is typically present in this disorder, stress that during the repair the rectus abdominis must be, in their words, "lateralized with suture...to counteract the increased tension at the pubic bone, caused by retraction of the rectus muscle in the upward and medial direction." One could postulate that rectus abdominis injury led to the retraction that was noted during surgery.

How does one put this all together? It is likely that several factors contribute to the formation of a sports hernia. However, we believe that a large tear, or multiple small tears (microtears), must be taking place, involving 1 or several muscles in the region, which includes the external oblique aponeurosis, rectus abdominis, conjoined tendon/rectus abdominis interface, or individual muscles that form the conjoined tendon (internal oblique or transversus abdominis). Tears to any of these muscles could lead to the operative findings of attenuation, disruption, or retraction of the muscle, thereby weakening the boundaries of the posterior wall of the inguinal canal (**Figs. 1** and **2**). The repetitive stress of high-level training on the region, the demands of competition that requires explosive muscle contraction, the pulsion effect generated by increases in intraabdominal pressure during sports, and abrupt Valsalva maneuvers that occur during contact may cause failure of the transversalis fascia in the posterior wall of the inguinal canal and lead to the formation of a bulge. The bulge is most likely secondary to other biomechanical issues, specifically muscle injury and weakness. The chronic pain is likely secondary to muscle injury, not the mere presence of a bulge, which is usually minimally symptomatic in patients with conventional groin hernias irrespective of hernia size.

DIFFERENTIAL DIAGNOSIS OF GROIN PAIN IN ATHLETES

Several clinical entities that revolve around the pubic bone and hip joint can be confused with athletic pubalgia (**Box 1**). Before diagnosing a sports hernia, many of

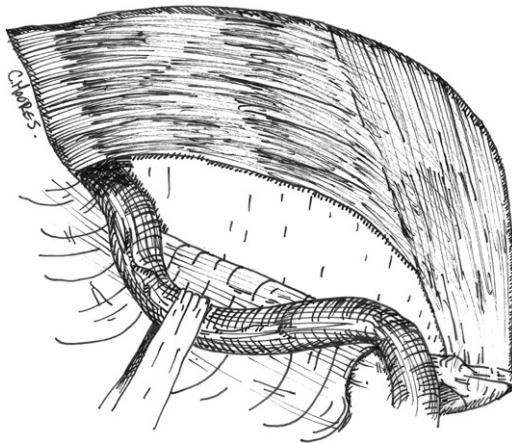


Fig. 1. The inguinal region after the external oblique is opened and reflected both superiorly and inferiorly. The spermatic cord is retracted in a caudad direction. (Artwork created by Craig Moores, Medical Student, Albany Medical College, Albany, NY.)

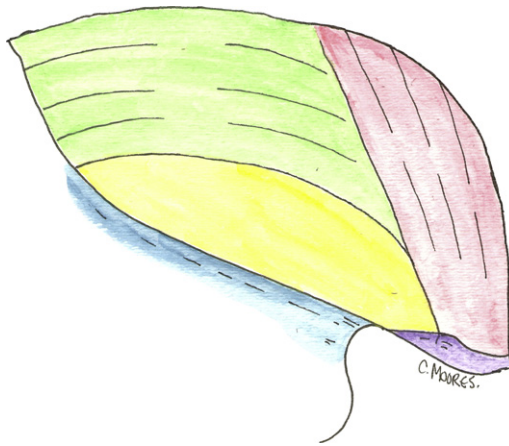


Fig. 2. The main anatomic structures are depicted. The posterior wall of the inguinal canal (yellow), also known as the Hesselbach triangle, is covered by the transversalis fascia. It is in the medial aspect of this yellow area that bulges occur in sports hernias. Muscular tears are usually found in the rectus abdominis (red) or the conjoint tendon (green), or at the interface of the 2 structures. The pubis (purple) and the shelving portion of the ilioinguinal ligament (blue) participate in the repair. (Artwork created by Craig Moores, Medical Student, Albany Medical College, Albany, NY.)

the diseases listed in **Box 1** must be considered, because many of these processes can cause symptoms that are similar to and in the same location as athletic pubalgia.^{9,23,24,37–40} However, athletic pubalgia in many cases is a clear and distinct clinical entity with typical history and physical findings, so that many of these other conditions are improbable as the cause of pain.

Disorders of the hip joint, in particular acetabular labral tears, femoroacetabular impingement, and injuries to the adductors can be difficult to distinguish from sports hernia, or may even coexist. Similarly, osteitis pubis or a conventional groin hernia may cause groin symptoms. Genitourinary issues such as epididymitis, prostatitis, or testicular tumors could be a cause of chronic groin pain in men, and a host of intraabdominal conditions in women must be considered before attributing groin pain to athletic pubalgia. This finding was particularly notable in Meyers and colleagues²² series, in which laparoscopic evaluation determined that overall 80% of the women in the series had another cause for their pain, such as endometriosis, ovarian cystic disease, PID, Crohn disease, or adhesions.

Magnetic resonance imaging (MRI) is particularly valuable to help rule out other significant musculoskeletal causes for lower abdomen and groin pain and must be obtained before accepting the final diagnosis as athletic pubalgia.^{41,42} However, athletes may have several injuries that coexist, such as an acetabular labral tears and a sports hernia.

Because of the wide range of potential disorders and the potential overlap, we have developed a multidisciplinary team approach to assess all patients with possible sports hernia. This approach includes an orthopedic sports medicine specialist and a general surgeon with a special interest in abdominal wall disorders.

IS NERVE ENTRAPMENT A CAUSE FOR PAIN?

There is increasing speculation that nerve entrapment is a reason for chronic pain, and that either nerve release or nerve division should be incorporated into the operative procedure. This observation has been described in the literature as part of both

Box 1

Differential diagnosis of groin pain in athletes

Inflammatory

- Inflammatory bowel disease
- Endometriosis
- Pelvic inflammatory disease (PID)
- Appendicitis
- Osteoarthritis
- Lymphadenopathy

Musculoskeletal

- Stress fracture
- Muscle strain
- Muscle contusion
- Tendon rupture (adductors)
- Adductor tendinitis
- Bursitis
- Avascular necrosis of the femoral head
- Acetabular labral tear
- Adductor longus dysfunction (other adductor injury)
- Osteitis pubis
- Sports hernia
- Femoroacetabular impingement
- Hockey player's syndrome
- Pubic instability
- Conjoined tendon dehiscence
- Herniated nucleus pulposus
- Inguinal or femoral hernia
- Hip flexor/iliopsoas injury (tendinosis)
- Iliac apophysis injury
- Symphyseal instability
- Hip osteoarthritis

Infectious

- Osteomyelitis
- Prostatitis
- Epididymitis
- Septic arthritis
- Urinary tract infections
- Diverticulitis

Neurologic

- Nerve entrapment (ilioinguinal, obturator)

Neoplastic

Testicular cancer

Sarcoma

Bony tumors

Congenital

Growth plate stress injury or fracture

Legg-Calvé-Perthes disease

Other

Ovarian cyst

Postpartum symphysis separation

Hydrocele/varicocele

Testicular torsion

Data from LeBlanc KE, LeBlanc KA. Groin pain in athletes. *Hernia* 2003;7:68–71; and Caudill P, Nyland J, Smith C, et al. Sports hernias: a systematic literature review. *Br J Sports Med* 2008;42:954–64.

laparoscopic and open approaches. It has been postulated that injury to the surrounding tissue can cause the nerve to become irritated or incorporated into scar tissue at some point along its course. There is little clarity as to which nerve in the groin is most likely to be involved, and several investigators have incriminated and therefore divided or released the genital branch of the genitofemoral,^{7,43} the ilioinguinal,⁴⁴ the iliohypogastric,⁴⁵ or the obturator⁴⁶ nerves in the treatment of chronic lower abdomen and groin pain during a laparoscopic or open repair for sports hernia. Because most series, with or without nerve division or release, seem to have equal results, it is improbable in the opinion of these investigators that this maneuver plays a role in the treatment of this syndrome.^{3,37} Furthermore, nerve entrapment is a common sequela of conventional groin hernia surgery and the pain syndrome in relation to that phenomenon is entirely different from athletic pubalgia.⁴⁷

WHO IS AFFECTED BY ATHLETIC PUBALGIA?

Athletic pubalgia affects both professional and nonprofessional athletes, and may result in activity-limiting pain, which can shorten a professional athlete's career⁴⁸ or jeopardize an athlete's opportunity for a college scholarship or playing time. Typically, athletes who suffer from this condition practice their sport at a high level and engage in high-intensity training. There is a growing trend toward treating recreational yet dedicated athletes who derive tremendous personal satisfaction (or quality of life) from the pursuit of their sport.^{5,49}

Chronic lower abdomen and groin pain is more common in athletes who are involved in activities in which there are running, kicking, and cutting movements, or explosive turns and changes in direction related to the sport.^{7,23,24,37,44,48} Similarly, some other activities such as pushing hard against resistance, like a lineman in football or a hockey player, when pinning a player against the boards, may be contributing factors. Prevalence data indicate that players of soccer, ice hockey, and American football tend to be most commonly affected in the United States.^{3,5,22} However, other sports commonly involved include rugby, Australian Rules football, cricket, martial arts, basketball, baseball, field hockey, tennis, swimming, and long-distance running.^{5,24,37,48,50}

Athletic pubalgia is more common in men. However, although it is less prevalent in women, there is evidence that it is becoming more frequent. Garvey and colleagues⁴⁸ estimate that currently women represent 10% of their cases, and Meyers and colleagues⁴⁹ report that women now comprise 15.2% of the patients they have seen in the last 5 years. The apparent change in this demographic characteristic is likely secondary to an increased number of women training and competing at higher competitive levels than before.^{22,37,48} Nonetheless, the prevalence of sports hernias remains lower in women and anatomic differences likely protect women from developing this disorder.²² The lower prevalence of sports hernias in women is probably explained, in part, by anatomic differences between the male and female pelvis.⁵¹ Men have stronger muscles in the lower abdomen and groin that are capable of generating greater force per unit area of insertion when compared with women. Further, the gynecoid pelvis probably provides a greater span of muscular insertion along the pubis and ilioinguinal ligament, and distributes force along a greater surface area, thereby helping to protect women from this lower abdomen and groin pain syndrome. Furthermore, studies have shown gender differences in lower extremity alignment and muscle activation with activities such as kicking a soccer ball, and this difference may predispose an athlete of 1 gender to 1 type of injury, whereas being protective of another.⁵¹ For example, one might posit that these gender differences in extremity alignment and muscle activation may predispose women to anterior cruciate ligament injury, but might protect them from lower abdomen and groin injury.⁵¹

PRESENTATION

Athletes typically present with the complaint of exercise-related lower abdomen and groin pain that may radiate to the perineum, inner thigh, and scrotum.^{3,48} The pain is typically relieved with rest but returns on resumption of physical activity.^{5,22,27,52,53} Often the athlete describes the pain as a deep and intense pain that is unilateral.^{5,54,55} Typically, patients with sports hernia describe pain that is insidious in onset but some athletes recall an inciting event that may have been the insult leading to injury.⁵ Meyers and colleagues²² found that 71.3% of 157 athletes who were operated on for sports hernia remembered and identified the distinct injury during physical exertion. The lower abdomen and groin pain is often aggravated by sudden acceleration, twisting and turning, cutting or kicking movements, sit-ups, coughing, or sneezing.^{4,5,48,56} Pain is usually present for a day or two after a game and may be associated with stiffness and difficulty getting out of bed the following morning.⁴⁸ Often after a period of rest from sport the pain returns immediately on return to activity.⁴⁸ Kachingwe and Grech⁵ distilled from their experience the cluster of 5 signs and symptoms that they felt most indicate a sports hernia: "(1) a subjective complaint of deep groin/lower abdominal pain, (2) pain that is exacerbated with sport-specific activities such as sprinting, kicking, cutting, and/or sit-ups and is relieved with rest, (3) palpable tenderness over the pubic ramus at the insertion of the rectus abdominis and/or conjoined tendon, (4) pain with resisted hip adduction at 0, 45 and/or 90 degrees of hip flexion, and (5) pain with resisted abdominal curl-up."

In our experience, the athlete with lower abdominal and groin pain usually presents for evaluation after the pain has been present for several months. Sometimes, the athlete can relate the onset of pain to an acute incident and may remember a sensation of sudden tearing, but in our practice, this is not common. When the inciting event occurs, 2 types of pain syndrome emerge: (1) the athlete is unable to participate after the first 5 minutes of exertion because of incapacitating pain, and despite conservative care is unable to rehabilitate and return to play; (2) the athlete can usually play through

the pain to finish the game, but often at less than 100% capacity, and again despite conservative care cannot rehabilitate to 100%. Certain movements typically exacerbate the pain, such as sudden acceleration, twisting, and turning. After the activity is completed, the athlete frequently has significant discomfort, may complain of a throbbing sensation in the lower abdominal groin region, and have difficulty getting out of a car or have difficulty getting out of bed in the morning. Over a day or 2, the pain cools down and the athlete returns to his/her baseline of chronic discomfort in the lower abdomen and groin that is exacerbated by certain movements.

Thereafter, the athlete often starts to play, and is able to play through the pain or discomfort, but at less than peak performance for the entire season. The athlete may end up missing practices or having lighter training sessions to allow the discomfort to improve enough so that they can compete at game time. Once the season ends, the athlete rests and anticipates that after a few months the problem resolves completely, only to discover that the issue returns when starting to train for the upcoming season. The problem not only has not improved with rest during the off-season, but the athlete feels immediately on resumption of their sport that they are back to square one.

PHYSICAL EXAMINATION FINDINGS

Physical examination findings include localized tenderness at or just above the pubic tubercle on the affected side, which can be elicited during a resisted sit-up.^{3,48} On examination, the patient with a sports hernia does not have a detectable true inguinal hernia but the following findings may be present on examination; inguinal canal tenderness, dilated superficial inguinal ring, pubic tubercle tenderness, and tenderness at the hip adductor origin.^{3,37}

When we conduct a physical examination, we examine the patient in both a standing and supine position. There is tenderness at or near the rectus insertion, lateral edge of the rectus, or the conjoined tendon/rectus abdominis interface on the affected side, or both sides, if the disease is bilateral. Typically, no cough impulse is elicited on examination, although when the patient is standing, one can occasionally palpate what seems to be a defect just below the conjoined tendon/rectus abdominis interface. If a defect is present, we can occasionally elicit a cough impulse at this location. Generally, there is not a bulge or cough impulse at the external inguinal ring, and there is no dilatation of the external ring itself.

Supine Provocative Testing

To elicit the pain of athletic pubalgia have the patient perform a supine resisted sit-up first with legs flexed (which takes out the lumbar lordosis) then with legs extended (which restores lumbar lordosis). The examiner palpates the rectus abdominus insertion on the affected pubic ramus. This procedure should reproduce the pain that has caused the patient to come to the office.

It is important to evaluate the adductor longus as a possible source of pain. Active leg adduction against resistance evaluates the adductor longus origin and can exacerbate the rectus abdominus symptoms. This positive finding may indicate that the adductor longus origin needs to be addressed either by a steroid or platelet-rich plasma injection or surgically. A diagnostic injection of local anesthetic may assist with this treatment decision.

IMAGING

The most important diagnostic tool in the evaluation of a patient with chronic lower abdomen and groin pain is the history and physical examination. Several diagnostic

tools may be used to help establish the presence of athletic pubalgia, or to rule out another disorder in the differential diagnosis of chronic lower abdomen and groin pain.

Plain radiography (radiograph) or computed tomography scanning may be helpful to rule out bony abnormalities, but MRI is essential to evaluate the entire region, including the hip joint.^{29,57} MRI may disclose another pathologic condition as the sole cause of lower abdomen and groin pain, or it may identify another condition in addition to athletic pubalgia such as strains, labral tears, osteitis pubis, iliopsoas bursitis, and occult stress fractures.^{29,37,58}

In our experience, MRI is sometimes helpful in showing injury to the muscles of the abdominal wall, and is helpful when present in corroborating the clinical opinion. Although these findings are helpful, a patient with a typical history and physical examination, and no other major injury, is a candidate for a repair, irrespective of the abdominal wall findings on MRI. MRI may have an increasingly more significant role in the diagnosis of athletic pubalgia, although historically it showed injury 10% of the time.⁵⁹ However, a recent study comparing surgical findings with those seen on MRI suggests that the MRI sensitivity may be as high as 68% in detecting injury.⁶⁰ Omar and colleagues⁶¹ have developed a standardized MRI protocol for athletic pubalgia to enhance its role as a diagnostic tool. These investigators have chronicled the findings on MRI that are associated with athletic pubalgia, which include direct visualization of tears in the rectus abdominis, adductor aponeurosis, or tenoperiosteal disruption, secondary cleft sign (indicating adductor injury), edematous or atrophic rectus abdominis near its pubic tendinous attachment or frank disruption of the rectus abdominis tendon at the symphysis or lateral head, and disruption of the adductor tendons.⁶¹

Dynamic ultrasound may play a role and is used by some groups to establish the diagnosis. The goal of dynamic ultrasound is to establish posterior inguinal wall deficiency, which can be visualized ultrasonographically. With the ultrasound probe placed over the medial aspect of the inguinal region, the athlete is asked to strain. Initial images are taken along the plane of the inguinal canal and then the images are repeated 90° to this. The test is considered positive if there is abnormal ballooning of the posterior inguinal wall.⁴² At our center, we do not use ultrasound for the diagnosis of sports hernia. Although ultrasound may show a bulge in the posterior wall of the inguinal canal, it is operator dependent, and bulges may be common and found in any age group.^{3,8,29,57}

Herniography is performed by fluoroscopy with an intraperitoneal injection of contrast followed by the patient performing a Valsalva maneuver before imaging.²⁹ This study is invasive, has a high complication rate, and should play no role in the diagnosis of athletic pubalgia.³³

NONSURGICAL TREATMENT

Groin pain related to abdominal wall injury is a frequent occurrence. In many instances the injury goes on to heal and is self-limited. In some cases, chronicity occurs, and this subgroup of patients requires surgery. However, despite typical signs and symptoms, a trial of conservative therapy should be the first treatment plan, and surgery should be reserved for failures of conservative measures. For this reason, it is unusual to perform surgery earlier than 3 months from the onset of symptoms.

For the in-season athlete a 4-week trial of rest, selective steroid or platelet-rich plasma injections to the rectus abdominus insertion or the adductor longus origin, or a short steroid burst with taper are treatment options. Allow closed-chain lower extremity workouts during the rest period. At the completion of the rest period

a functional return to sport assessment can be performed to see if the athlete is capable of returning to the season. If the pain persists, we leave it up to the athlete to choose whether to return to the season or not. Playing through pain is not believed to worsen the tear or the surgical results of repair.

SURGICAL TREATMENT

Athletes usually opt for surgery after completion of an athletic season. By the time we see them they have usually run the gamut of therapy, including periodic rest, physiotherapy, steroid injections, and nonsteroidal antiinflammatory drugs, with only temporary improvement and return of symptoms on return to sport. Typically, after 1 or 2 seasons of pain and disability, often increasing in intensity as the season progresses, and recurring despite the off-season, the athlete is left with few options. In our practice we have found that athletes tend to seek consultation many months after the onset of symptoms, and it is important to capitalize on the off-season so that surgery and recovery can occur without interfering with the following regular season.

Several operations have been described for the treatment of athletic pubalgia but they all fall into 3 main categories (**Box 2**). These operations include laparoscopic and open procedures. They are all variations of established operations for conventional groin hernias.

Laparoscopic operations can be performed in 1 of 2 ways that differ only in the way that they approach the preperitoneal space in the groin. In the transabdominal preperitoneal (TAPP) approach, the peritoneal cavity is entered, a flap of peritoneum is raised in the inguinal region, and a piece of mesh is placed in this preperitoneal space to cover the myopectineal orifice in the inguinal region. In the totally extraperitoneal (TEP) approach, the peritoneal cavity is not entered at all, and the dissection is started and maintained entirely in the preperitoneal space and that plane is continuously developed into the groin so that mesh can be appropriately placed in the inguinal region. The TAPP and TEP procedure are absolute analogues of one another in terms of where the mesh is placed.

Both are now well established and have similar results in outcomes such as postoperative pain, return to regular activity, and hernia recurrence when used in the treatment of conventional groin hernias.⁶² Both operations place mesh (usually a 10-cm × 15-cm rectangle of woven polypropylene) in a preperitoneal position to cover the entire myopectineal orifice and thereby occlude any defect that may be present in the direct, indirect, or femoral space.^{63,64} Current debate centers on the density, specifically the

Box 2

Operations performed for repair of sports hernia

- 1) Laparoscopic mesh placement
 - Transabdominal preperitoneal (TAPP) hernia repair
 - Totally extraperitoneal (TEP) hernia repair

2) Open sutured repair

3) Open mesh repair

Variations on theme:

Combination open sutured repair with mesh on-lay

Any operation with added nerve release/division

Any operation with added muscle release

weight and porosity of the mesh (heavy, medium, or light, related to pore size, weave, and reported as g/mL), because these characteristics may influence scarring, flexibility in situ, whether the mesh is palpable, the presence of chronic pain, and hernia recurrence. It is generally believed that heavier mesh induces more scarring.⁶⁵

Open operations fit into 1 of 2 categories: sutured repairs (**Fig. 3**) and on-lay mesh repairs. These open mesh repairs represent variations of the Lichtenstein technique,⁶⁶ generally use polypropylene mesh, and have become the most popular operation for conventional groin hernia repair in the United States.⁶⁷ In general, the operation is easy to perform, but there is debate in conventional groin hernia surgery regarding the type of mesh one should use because heavier mesh may cause a more intense inflammatory response, and therefore more scar-tissue formation and more pain. Heavyweight mesh is less pliable, and can be palpable when used as a muscle on-lay. Therefore, there has been a shift to using lighter mesh for conventional groin hernia surgery.⁶⁸

Sutured repairs are probably the most commonly performed operations for athletic pubalgia.^{3,7,22,28,37,61} Sutured repairs are becoming less common for conventional groin hernias, because they create tension when obliterating the hernia defect and therefore cause more pain, require more analgesia, and have a longer recovery than one sees with mesh-based tension-free repairs.^{69,70} However, in athletic pubalgia, sutured repairs satisfy the need of the surgeon to create stability of the anterior pelvis, which is often accomplished by broadening the rectus abdominis insertion, which creates some degree of tension. In addition, most sutured repairs reinforce the posterior inguinal wall, which many investigators report as attenuated. In the treatment of sports hernias, surgeons have performed several conventional open operations, usually with adaptation. These operations include variants of the Shouldice, Bassini, McVay, and Maloney darn repairs, and the range of procedures has been summarized in recent review articles.^{3,37} Two recent publications of large series at high-volume centers for this disorder both used an open sutured technique.^{7,22,28}

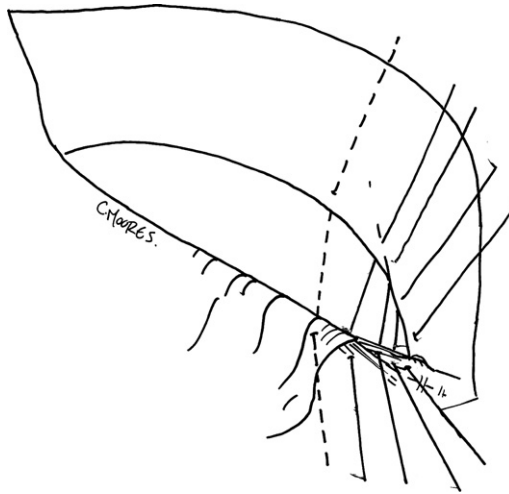


Fig. 3. The repair focuses on reattachment of the rectus primarily, and reinforcement of the posterior wall of the inguinal canal secondarily. The first 2 or 3 sutures bring the rectus abdominis muscle and the edge of rectus down to the pubis, pubic tubercle, and medial aspect of the Cooper ligament. The next 2 or 3 sutures bring the conjoint tendon down to the shelving portion of the ilioinguinal ligament to complete the repair. (Artwork created by Craig Moores, Medical Student, Albany Medical College, Albany, NY.)

We too prefer an open sutured technique that is best described as a McVay/Bassini variant. Some investigators report a combination of open sutured repair covered by on-lay mesh,³ and there is increasing speculation that nerve division/release is an important step in some patients.

Summary of Outcomes

In Nam and Brody's review article published in 2008, 12 series of open repair and 7 series of laparoscopic repair were collected from 1991 until 2007.³ In the laparoscopic series, TAPP or TEP was performed, and the reported success of return to full activity varied from 87% to 100%. Of the 12 open operations, all were variations of conventional hernia surgery, including Bassini, Shouldice, McVay, Lichtenstein, or darn repairs, and usually described as modified. Patient satisfaction levels with surgery also ranged from 77% to 100%. Jansen and colleagues⁷¹ also reviewed long-standing groin pain in athletes and reported that although good to excellent results were reported in most studies, the level of evidence was low (level 4 evidence, ie, case series). Therefore, no meaningful comparison of operative approaches can be made, and these investigators concluded that there is a compelling need for the rigor of comparative trials.

It is unusual that such disparate surgical approaches would all yield suitable clinical outcomes. Yet, despite the limitations of the data, it seems that success rates are high across the board. This finding may be related to the possibility that surgeons are operating on a wide variety of different lower abdomen and groin issues, many of which get better over time, particularly if an enforced reduction of activity occurs because of the pain and disability from a surgical procedure. However, there may be unifying principles of treatment that are satisfied to some extent by all of these operations. These principles include (1) reinforcement of the posterior wall, and (2) fixation of the rectus abdominis or rectus/conjoined tendon interface. All sutured repairs in some way reinforce the posterior wall, and generally reinforce or broaden the rectus insertion. For example, Mushawek focuses her repair on the posterior wall, in essence imbricating the transversalis fascia, but finishing her second running suture by capturing the rectus abdominis to lateralize it, in essence broadening its insertion. On the other hand, Meyers focuses his repair on the "surgical reattachment of the inferolateral edge of the rectus abdominis muscle with its fascial investment to the pubis and adjacent anterior ligaments. The operation is similar but not identical to a Bassini hernia repair." So in addition to fixation of the rectus abdominis, there is also extension of the repair in Bassini fashion to tighten (repair) the posterior wall.

Mesh repairs may accomplish the same task, whether placed open or laparoscopically. They all clearly reinforce the posterior wall, and they may broaden the fixation of the rectus abdominis inadvertently by inducing fibrosis and scarring of the rectus abdominis to the mesh, which fixates the muscle.

Adjunctive techniques have been performed to add additional benefit to the laparoscopic operation, such as inguinal ligament tenotomy at its insertion,⁷² and ilioinguinal nerve release by performing iliopubic tract division at its origin.^{43,73} However, when these maneuvers are performed, standard mesh repairs are still performed, and therefore it is impossible to determine if these adjunctive measures add benefit.

OUR OPERATIVE APPROACH

We prefer to perform an operation that is a McVay/Bassini variant. In our experience, the important elements of surgery are fixation of the rectus abdominis to the pubis as well as stabilization of the conjoined tendon/rectus abdominis interface. Unlike

conventional hernia repair, more attention is devoted to the pillar of the rectus muscle by broadening its insertion. The same attention is devoted to the posterior wall of the inguinal canal as one might do in conventional groin hernia surgery, although with less need to extend this to the internal ring.

A short groin incision is made along skin crease lines just above the external ring. This incision is carried down through subcutaneous tissues until the external oblique aponeurosis is reached. It is opened in the direction of its fibers into the external ring, with care to preserve the nerves. The external oblique is separated from underlying structures and the spermatic cord is encircled and retracted inferiorly to expose the posterior wall of the inguinal canal. The important landmarks are the following: lateral edge of rectus, pubic tubercle, conjoined tendon, shelving portion of ilioinguinal ligament, and posterior wall of the inguinal canal. At this point the findings are variable. There is often attenuation and bulging of the posterior wall (however, we do not operate on normal groins, and there is no good comparison group to establish normalcy). There is less frequently disruption of the rectus abdominis or conjoined tendon or both. This condition has usually healed at the time of surgery, but one can see gaps in the muscle or fascial discontinuity. There may be partial detachment of the rectus at its insertion.

Sometimes the groin seems normal. Despite this range of findings, the results are good after repair if the patient has the typical lower abdomen and groin pain syndrome associated with athletic pubalgia. At the beginning of the repair, the pubis/pubic tubercle is roughened with electrocautery to create an inflammatory surface for tendon reinsertion. The lateral edge of rectus is brought down to the periosteum of the tubercle with 1 or 2 stitches using Orthocord (Depuy Orthopaedics, Warsaw, IN, USA), and then the edge of rectus is brought down to the Cooper ligament with 1 stitch, followed by 1 interrupted suture approximating the conjoined tendon/rectus abdominis interface with the shelving portion of the ilioinguinal ligament. At this point, 1 or 2 reinforcing stitches extend laterally, pulling conjoined tendon to shelving portion. It is unusual to use more than 5 sutures. The repair does not obliterate the entire posterior wall and does not extend to the internal ring. All nerves are preserved. The cord is then dropped back into position, and the external oblique aponeurosis closed, as well as the skin and subcutaneous tissues. If the adductor longus is involved it can either be injected with steroid or platelet-rich plasma at the time of surgery or a functional lengthening can be performed by releasing half of the fibers at its origin.

If patients have the typical symptom complex of athletic pubalgia, but have a clear-cut conventional groin hernia, then we perform a laparoscopic TAPP procedure, which is superior to sutured repair for conventional groin hernias.^{61,62} Our TAPP technique has been described.⁶⁴ Similarly, if we have already opened the groin, and find a clear-cut groin hernia in a patient with the typical athletic pubalgia symptom complex, then our approach is to broaden the rectus insertion with 1 or 2 sutures, but still perform an open mesh repair. Mesh on-lay repairs for conventional hernias have a lower recurrence rate when compared with sutured repairs. However, we believe additional rectus fixation is required to treat athletic pubalgia symptoms.

POSTOPERATIVE REHABILITATION

The operation is performed as an outpatient surgical procedure. We use local anesthesia preemptively in the incision and perform ilioinguinal nerve blocks, give 1 mg Dilaudid subcutaneously in the postanesthesia care unit, and oxycodone as needed for postoperative pain control. We allow weight bearing as tolerated with relative rest for the first 10 days. The wound is then evaluated. For the next 2 weeks gentle

hip range of motion and closed-chain lower extremity exercises are permitted. At about week 4 light abdominal core exercises are added, and at about week 5 sport-specific activity is advanced as tolerated. Full return to sport is at about 6 weeks.

SUMMARY

Athletic pubalgia is a distinct syndrome of lower abdomen and groin pain that is found predominantly in high-performance athletes. These individuals tend to have recurring pain, more pronounced with certain activities, and which affects athletic performance. Athletic pubalgia is probably a syndrome caused by muscle injury, because muscle disruption, detachment, or attenuation is frequently found, and muscle injury likely leads to failure of the transversalis fascia, with the resultant formation of a bulge in the posterior wall of the inguinal canal. These patients often require surgical therapy after failure of nonoperative measures. A variety of surgical options have been used, and most patients improve and return to high-level competition. The principles of surgical treatment are (1) fixation of the rectus abdominis, and (2) reinforcement of the posterior wall of the inguinal canal.

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