Sports Hernia

Diagnosis and Treatment Highlighting a Minimal Repair Surgical Technique

John M. Minnich, MD, John B. Hanks, MD, Ulrike Muschaweck, MD, L. Michael Brunt, MD, and David R. Diduch, MD

Groin injuries are a common occurrence in elite-level athletes. These injuries can cause significant pain and disability, leading to prolonged periods of inactivity and consternation among athletes, coaches, athletic trainers, and physicians alike. The differential diagnosis for groin pain is vast and spans multiple disciplines, including orthopaedics, general surgery, urology, gynecology, and neurology.

Sports hernias are one cause of chronic groin pain in athletes and are distinct entities from classic hernias. They are often caused by a deficient posterior wall of the inguinal canal, but may also involve concurrent injuries, such as conjoint and adductor tendinopathies and nerve entrapment. Understanding the complex lower abdominal, pelvic, and hip anatomy and pathophysiology of sports hernias is crucial to making an accurate diagnosis and providing appropriate treatment options. Newer, less invasive surgical repair techniques show promising early results in improving pain and decreasing recovery time.

Keywords: sports hernia; athletic pubalgia; athletic hernia; sportsman’s groin; chronic groin pain; minimal repair technique

Groin injuries have been reported to account for up to 6% of all athletic injuries. Athletes performing rapid acceleration and deceleration movements and repetitive, high-speed twisting and cutting motions are especially vulnerable. High rates of groin injuries are seen in soccer, rugby, and ice hockey and to a lesser extent in football, basketball, and baseball. In fact, the incidence of groin pain in male soccer players ranges from 10% to 18% annually.

Most acute groin injuries are caused by adductor and hip flexor strains and resolve predictably. Occasionally, however, these groin injuries are caused by other disorders and can cause chronic pain and disability if treated inappropriately. To prevent this devastating outcome, athletic trainers and sports medicine providers should identify the subset of patients who are not responding to nonoperative treatment in a timely fashion, and aggressively explore other possible sources of the groin pain.

The underlying cause of chronic groin pain can usually be classified into 4 broad categories: adductor dysfunction, osteitis pubis, hip joint injury, and sports hernias. Adductor dysfunction causes tenderness localized to the adductor longus insertion. On examination, the athlete usually has pain with passive stretch of the adductors and pain on adduction against resistance. If nonoperative treatment fails, then athletes may obtain prolonged pain relief from a cortisone injection at the adductor longus enthesis. In rare cases, isolated adductor tenotomy has been shown to provide good long-term functional results for severe adductor dysfunction.

Osteitis pubis causes tenderness to palpation at the pubic symphysis and can usually be seen on imaging studies (MRI in acute cases and radiographs in chronic severe cases). Hip joint injury includes femoroacetabular impingement and injuries of the cartilage, labrum, and capsular structures.

Sports hernias have only recently been recognized as a common source of unresponsive groin pain in athletes. This injury has also been called athletic pubalgia, athletic hernia, sportsman’s hernia, sportsman’s groin, soft groin, Gilmore’s groin, and other names. The term “hernia” is a misnomer because sports hernia does not describe a classic herniation of soft tissue, and differences of opinion exist regarding the exact cause of pain and pathoanatomy. Muschaweck and Berger define sports hernia as a weakness of the posterior wall of the inguinal canal that results
in both nerve irritation (neuritis) and insertional tendon pain on bone (pubalgia). The transversalis fascia dilates at its weakest point and widens the inguinal triangle (bordered by the rectus abdominus muscle, the inguinal canal, and the inferior epigastric vessels). This in turn causes the rectus abdominus muscle to retract cranially and medially and produces increased tension on the pubis. Also, the localized bulging can compress the nearby genital branch of the genitofemoral nerve (Figure 1), especially during the stresses and straining of physical exertion. This nerve irritation produces a dull or burning pain that radiates into the inner thigh or scrotum.

Garvey et al describe sports hernias as one component of a broader group of conditions caused by pelvic instability. This “groin disruption injury” includes sports hernias, osteitis pubis, conjoined tendinopathy or tearing, adductor tendinopathy or tearing, and obturator nerve entrapment. Other authors have described additional causes of sports hernia, with generalized weakness of the pelvic floor, including an attenuated external oblique aponeurosis, torn internal oblique musculature, thin or torn rectus insertion, torn conjoined tendon, and ilioinguinal or iliohypogastric nerve entrapment.

It should be emphasized that the vast majority of athletic groin injuries resolve with nonoperative management techniques and do not evolve into a sports hernia or chronic pubalgia. Adductor strains are much more common and in some series have accounted for 10% to 43% of all injuries in elite ice hockey players. However, injuries that persist more than 3 months without significant improvement are associated with an increased likelihood of requiring surgical intervention. Ekstrand and Hilding carried out a prospective, randomized trial in soccer players with chronic groin pain of more than 3 months’ duration. Players were randomized into 4 groups: controls with no treatment, 2 different physical therapy groups, and a surgically treated group of patients who underwent inguinal floor repair ± inguinal and iliohypogastric neurectomy. Only the surgically treated group showed substantial and statistically significant improvement over the 6 months of the study.

PATHOANATOMY

The abdominal wall musculature is composed of external oblique muscle and fascia, internal oblique muscle and fascia, transversus abdominis muscle and fascia, and transversalis fascia. The cutaneous nerves include the iliohypogastric nerve (sensory to the lower abdomen), the ilioinguinal nerve (sensory to the groin), and the genital branch of the genitofemoral nerve (sensory to the scrotum and labia). Anatomic studies have shown that the course of these nerves varies considerably and may explain their variable involvement in the disease process. The internal oblique and transversus abdominis aponeuroses are closely applied and may join to form a “conjoined tendon,” which inserts onto the pubic tubercle; however, a true conjoined tendon is present in only about 5% of cases. Muschaweck describes the abdominal wall biomechanically as a matrix of tension bands that attach to the pubic bone (Figure 2). The muscle and fascia layers form a “slide bearing,” which are essential for an athlete’s mobility, including running, sprinting, jumping, and upper body rotation.

Sports hernias are linked to overuse injuries. Hip, pelvis, and trunk range of motion, including flexion, extension, rotation, and bending, are controlled by coordinated movements of the lower abdominal and pelvic girdle muscles. An imbalance between the relatively strong adductors of the thigh and the weaker lower abdominal musculature creates shear forces across the pubic symphysis. In fact, Morales-Conde et al suggest that sports hernias could be renamed as “syndrome of muscle imbalance of the groin.” Over time, the additional stress on the hemipelvis leads...
to weakening or tearing of the transversalis fascia and surrounding tissues, producing a tendon enthesitis of the adductor longus muscle and/or abdominal muscles. Less frequently, a sudden forceful movement can also initiate symptoms through a traumatic tear of the abdominal fascia and resultant sports hernia.

HISTORY AND PHYSICAL EXAMINATION

Most athletes report an insidious onset of dull, aching pain in their groin. The injury occurs almost exclusively in males. The pain is usually unilateral, sharp, or burning in nature and radiates to the proximal thigh, low back, lower abdominal muscles, perineum, or scrotum. The symptoms are typically exacerbated by activities like running, sudden accelerating movements, cutting or twisting, side-stepping, kicking, and sit-ups. Additionally, coughing, sneezing, and other Valsalva-type maneuvers often worsen the pain. The act of getting out of bed can be extremely painful, but rarely does it awaken people from sleep. The athlete is usually relatively pain-free with inactivity, but feels immediate pain with return to sport (even after an adequate trial of rest) and is unable to achieve a satisfactory level of play.

Typically, the physical examination reveals tenderness over the conjoined tendon or medial inguinal canal, the distal rectus insertion, pubic tubercle, and/or adductor origin. A skilled examiner may be able to palpate a dilatation of the superficial inguinal ring or weak inguinal floor and should exclude the presence of an inguinal or femoral hernia. The athlete will often have pain with resisted sit-ups (Figure 3) and resisted hip adduction. The adductor “squeeze test” is positive in supine and 90° flexed positions. Oftentimes, decreased internal and external rotation of the hip will be observed. In fact, restricted hip range of motion has been shown to be a risk factor for chronic groin pain in the athlete.

In addition, a comprehensive examination of the athlete should be performed to assess for other potential causes of the groin pain. The differential diagnosis is vast, and includes common orthopaedic conditions like muscle strain (adductor, rectus, iliopsoas), osteitis pubis, stress fracture, avulsion fracture, hip joint injury, nerve entrapment, and lumbar radiculopathy. Other nonorthopaedic conditions must also be considered, such as classic hernia, appendicitis, diverticulitis, irritable bowel syndrome, adhesions, urinary tract infection, prostatitis, testicular pain, varicoceles, endometriosis, ovarian cyst, and round ligament entrapment (Table 1). The clinician must also consider that athletes with groin pain may have more than one diagnosis, and the presence of one of these related diagnoses does not necessarily eliminate the possibility of sports hernia.

IMAGING

Because of the overlapping symptoms between sports hernia and other sources of chronic groin pain, it is helpful to obtain imaging studies to rule out other causes of pain. Plain radiographs can reveal congenital anomalies like femoroacetabular impingement (FAI) or developmental dysplasia of the hip (DDH), and degenerative conditions of the hip, spine, and sacroiliac joints. Radiographs can also identify osteitis pubis, which typically produces symmetric bone resorption and sclerosis and may cause symphyseal widening. Bone scans can diagnose stress fractures that are too subtle to appreciate on plain radiographs.

Magnetic resonance imaging is useful in diagnosing osteitis pubis, stress fractures, osteonecrosis of the hip, and intra-articular hip pathologic abnormalities, as well as for evaluating soft tissue abnormalities. Dedicated MRI protocols have been developed to better evaluate the varying causes of the sports hernia and assess the severity of the disease. Albers et al demonstrated that MRI can show subtle abnormalities in the musculofascial layers of the abdominal wall that correlate closely to surgical findings of sports hernia. In one study, evidence of rectus abdominis tendon injury was seen in approximately two-thirds of athletes. This may help surgeons determine whether to perform a bilateral repair and possibly decrease the rate of negative explorations. A common finding on MRI is stress-related edema within the symphysis pubis caused by the imbalance of forces and altered motion across the joint (Figure 4). Care must be taken when ordering and evaluating MRI studies in the acute setting as the acute edema may be misinterpreted as a muscle avulsion (false-positive finding).

Dynamic ultrasound is another modality that shows promise in diagnosing the sports hernia. A skilled ultrasonographer using a high-frequency transducer can detect a distinct protrusion of the transversalis fascia during a Valsalva maneuver (Figure 5). Orchard et al found
good correlation between ultrasound and surgical findings of sports hernia. Unfortunately, the study may have limited generalized applicability as it is highly operator-dependent.\textsuperscript{15,44}

Herniography is an invasive technique that has gained popularity in Europe for evaluating patients with chronic groin pain considering surgical exploration. Contrast dye is injected into the peritoneal cavity and fluoroscopic views are taken after the patient performs Valsalva-type maneuvers. The study is considered positive if there is abnormal contrast flow outside the normal contours of the peritoneum.\textsuperscript{9,47} Many authors have questioned the ability of the study to demonstrate sports hernias reliably and others have criticized the high false-positive rate.\textsuperscript{9,21,49} In addition, complication rates ranging from 3\% to 6\% may make the risks of the study unacceptably high for generalized use.\textsuperscript{9,21,49}

**NONOPERATIVE TREATMENT**

The initial treatment for a lower abdominal strain or groin injury consists of activity modification, anti-inflammatory medication, and physical therapy. Core strengthening
exercises target the abdomen, lumbar spine, and hips, and stretching focuses on the hip rotators, adductors, and hamstrings. The goal of therapy is to correct the imbalance of the hip and pelvic muscle stabilizers.  

Modalities, like therapeutic ultrasound treatments, cold tubs, and deep massage, may be helpful. After 4 to 6 weeks, the athlete gradually returns to sport-specific activities as tolerated. A small subset of patients will improve with nonoperative treatment; however, most patients who have been accurately diagnosed with sports hernias will eventually require surgical repair.  

Muschaweck argues that if the pain from a groin injury does not improve within 4 to 6 weeks of diagnosis, then the athlete is at increased risk of developing chronic inguinal pain if not aggressively treated. Others are concerned that resting an athlete until the next season can “hide” the symptoms and only delay the definitive treatment and prolong the recovery.  

Verrall et al\textsuperscript{55} reported that 89% of Australian Rules football players with sports hernias returned to play the following season after 3 months of rest and 100% returned by the second season after diagnosis. However, only 41% of the athletes were without symptoms at the commencement of the following season and only 67% by the end of that season. This study highlights the high rate of ongoing symptoms with athletes treated nonoperatively.

**OPERATIVE TREATMENT**

Surgical exploration and repair is indicated if nonoperative treatment fails and alternative diagnoses have been excluded. There is no consensus regarding the preferred surgical techniques. They are classified into 3 general categories: primary pelvic floor repair without mesh,\textsuperscript{34,41,42} open anterior mesh repair,\textsuperscript{23,26} and laparoscopic mesh repair.\textsuperscript{12} The primary pelvic floor repair can be further divided into a modified Bassini-type repair with or without adductor longus release\textsuperscript{34} and a “minimal repair” with decompression of the genital branch of the genitofemoral nerve.\textsuperscript{41,42} The primary repair described by Meyers et al\textsuperscript{34} involves suture plication of the inferolateral border of the rectus abdominis fascia to the pubis and the inguinal ligament. It is designed to tighten the attachments around the pubis including the rectus tendon insertion and thereby provide stabilization of the pubis.\textsuperscript{35} In selected patients with contracted or overdeveloped adductors, an adductor release is performed to address the underlying pelvic muscle imbalance. Meyers has also described up to 19 different syndromes that can contribute to groin pain and combines additional procedures to address the specific syndrome involved. In 2008, Meyers et al\textsuperscript{35} published their experience with sports hernias over 2 decades involving 8500 patients (85% of whom were considered athletes) and approximately 5500 operations. Overall, 95.3% of the athletes who underwent surgical repair were able to return to play within 3 months postoperatively. Many athletes were able to return sooner (especially when the surgery was performed during the season), but these data were not examined specifically. The preferred management of the adductor injuries that may occur in conjunction with a lower abdominal sports hernia—type pubalgia is to treat the underlying inguinal floor injury surgically and to manage the adductor component by therapy and rehabilitation. Although Meyers et al\textsuperscript{35} reported performing a variety of adductor and other release procedures, in their experience the indications for these procedures have not yet been precisely defined. A predominance of adductor symptoms and findings on physical examination and MRI findings that demonstrate significant adductor pathologic abnormalities are the key variables to be considered.

The new repair technique used by Muschaweck and Berger\textsuperscript{41,42} is a “minimal” repair of the transversalis fascia performed under local anesthesia. The procedure specifically targets the compression of the genital branch of the genitofemoral nerve, which Muschaweck believes is a major source of pain in sports hernias.\textsuperscript{42} Only the bulge or defect in the posterior abdominal wall is opened and the remainder of the soft tissue is not violated (Figure 7). The genital branch of the genitofemoral nerve is assessed during the procedure and resected if compressed or it appears pathologic. In a recent series, the nerve was resected in 20% of patients and histologic evaluation showed perineural fibrosis in 100% of specimens.\textsuperscript{41} A tension-free repair of the transversalis fascia is then performed and a muscular collar is created from the fascia of the internal oblique muscle to protect the nerves from mechanical irritation (Figure 7). The edge of the rectus abdominis is sutured back to the pubis with the inferior portion of the repair to restore the proper orientation of pull of the muscle. Recently, Muschaweck and Berger reported their short-term results of the minimal repair technique in 129 patients who underwent the procedure between September 2008 and May 2009.\textsuperscript{41,42} Of these patients, 78.9% reported that they were completely pain-free at a median of 14 days and that their pain scores decreased from 6 to 1 (scale of 0-10) at 4 weeks after surgery. Of the 87 professional athletes (67%) in the sample, 98.8% returned to sport within 4 weeks postoperatively and 83.7% reported a full return to “peak performance” within 4 weeks. No complications were reported. Although the follow-up period is short, the initial results of the minimal repair technique are promising and indicate that it is safe and effective.

Hanks has reported his results on a smaller series of sports hernia repairs in collegiate athletes since 1999 (unpublished data, JB Hanks, 2009). The first group of 17 athletes (from 1999-2007) were treated with the Meyers primary repair technique plus an adductor release in 16 patients (follow-up available in 16 of 17 patients). The second group of 10 athletes (2007-2009) were treated with the Muschaweck “minimal” repair technique. Although patient satisfaction and return to the same level of sport were similar for both groups, group 2 returned to sport more quickly (average 4.5 weeks compared with 16.5 weeks for group 1) and felt “back to normal” sooner (average 5 weeks compared with 20 weeks for group 1).
The open anterior mesh repairs are analogous to the Lichtenstein method of inguinal hernia repair and are designed to reconstruct the posterior inguinal floor in a tension-free fashion (Figure 8). A potential advantage of this approach, because of the absence of tension on the repair, is earlier return to full athletic activity, often within 5 to 8 weeks. Open mesh repairs are typically done under local anesthesia with sedation and may be coupled with resection of the ilioinguinal nerve. Brunt has utilized this approach in more than 100 athletes with over 90% successful return to full athletic activity (unpublished data, LM Brunt, 2009). Similarly, Brown et al reported a 97% success rate with mesh (polytetrafluoroethylene [PTFE]) repairs in 98 professional hockey players. Their group also routinely resects the ilioinguinal nerve, which they found was entrapped in the external oblique or scar tissue in a high percentage of cases.

Some groups have advocated laparoscopic repair with the potential advantages of less early postoperative pain and a faster return to sport. Successful return to athletics within 1 to 3 months has been reported in approximately 90% of athletes. van Veen et al reported findings in 55 athletes with chronic groin pain. Interestingly “incipient” hernias were identified in 36 cases (65%) and 20 athletes (36%) were thought to have true inguinal hernias. This high incidence of conventional inguinal hernia is a major departure from what has been reported in multiple series of open repairs. What is unclear is whether this reflects different selection criteria for operation or is an artifact of the visual field and insufflation from laparoscopy. Of note is that 5 athletes in this study also had an adductor tenotomy done. Reported outcomes were that 48 athletes (88%) were able to return to normal sports without pain at 6 to 8 weeks. Residual groin pain was still present.
in 5 patients at 12 weeks but ultimately resolved with rest and therapy.

A prospective randomized trial that compared laparoscopic to open repair of sports hernia has been carried out in a small series that primarily involved rugby players. The open repairs were a mix of Bassini and Lichtenstein mesh–type repairs. At 4 weeks, training was resumed in 13 of the 14 athletes repaired laparoscopically and in 9 of 14 repaired with an open approach. Each group contained 1 athlete with recurrent pain after repair. In spite of these positive reported outcomes, a higher rate of operative rein-ervention has been observed anecdotally by some groups. Therefore, the role of laparoscopic repair in this setting continues to be debated. Laparoscopy may play a valuable diagnostic role in selected athletes to exclude occult intra-abdominal or gynecologic disorders in females as a source of the pain.

POSTOPERATIVE REHABILITATION

Meyers et al tailor the rehabilitation based on the severity of injury and specific sport. The protocols allow for return to play at 3 days or 3 months postoperatively depending on the individual scenario. However, this generalized tightening of the pelvic floor results in substantial discomfort postoperatively for most patients, generally resulting in a 3-month return.

Brunt emphasizes the importance of postoperative rehabilitation to overall success of the surgery. He proposes a step-wise progression of exercises and activities, focusing on core abdominal and lower extremity strength, stability, flexibility, and balance. Any associated adductor weakness or tightness is specifically addressed.

The minimal repair technique allows a more aggressive rehabilitation protocol. Athletes are permitted to lift up to 20 kg immediately after surgery and initiate biking and running as early as 2 days after surgery. The athlete then progresses back to full activity at 10 to 14 days postoperatively. This accelerated rehabilitation protocol enables athletes to reliably return to their sport in season after undergoing surgical repair of the sports hernia.

PREVENTION

In a study of National Hockey League (NHL) players, Tyler et al reported that athletes were at risk for developing groin injuries if they had an adductor-to-abductor strength ratio of less than 80%. A preseason exercise program was developed that significantly decreased the incidence of groin injuries from 3.2 per 1000 player-game exposures to 0.71. However, only 1 of these players with a groin injury had a diagnosed sports hernia. In a prospective study using the NHL Injury Surveillance database, Emery and Meeuwisse identified a number of risk factors for ice hockey players developing groin injury that included a history of previous groin injury, number of years in the league, and a low number (<18) of sport-specific (skating) training sessions in the off-season.

Most of the prevention programs focus on reducing the risk of muscular strain injuries in the groin, not specifically sports hernias. Nonetheless, it is reasonable to extrapolate that because these protocols target the imbalance between the lower abdominal and pelvic musculature, they may help decrease the incidence of sports hernias too. Further research exploring the effectiveness of these programs for sports hernias is still necessary.

SUMMARY

The diagnosis and appropriate treatment of sports hernias requires a high index of suspicion and a multidisciplinary approach. Sports medicine providers and physicians must be familiar with the clinical presentation and diagnostic evaluation of related groin injuries. Only a small subset of athletes with sports hernias will respond to nonoperative treatment and most will require surgical repair for definitive treatment and satisfactory return to activity. Recent advances in understanding the underlying causes of sports hernias enable more effective and patient-friendly treatment options.
and pathophysiology of sports hernias has led to improved clinical outcomes and shorter recoveries. The role of imaging studies, specific surgical techniques, and preventative and postoperative rehabilitation protocols continue to evolve and will require additional research.

REFERENCES


