Hernia (2010) 14:5–15
DOI 10.1007/s10029-009-0613-z

ORIGINAL ARTICLE

Sportsmen hernia: what do we know?

S. Morales-Conde · M. Socas · A. Barranco

Received: 4 December 2009 / Accepted: 13 December 2009 / Published online: 8 January 2010

Abstract Athletes and other physically active people often suffer prolonged inguinal pain, which can become a serious debilitating condition and may place an athlete's career at risk. A sportsmen hernia is a controversial cause of this chronic groin pain, as it is difficult to be defined. From an anatomical point of view, the definition and the name of this entity should be reviewed. In the majority of athletic manoeuvres, a tremendous amount of torque or twisting occurs in the mid-portion of the body and the front, or anterior portion, of the pelvis accounts for the majority of the force. The main muscles inserting at or near the pubis are the rectus abdominis muscle, which combines with the transversus abdominis. Across from these muscles, and directly opposing their forces, is the abductor longus. These opposing forces cause a disruption of the muscle/tendon at their insertion site on the pubis, so the problem could be related to the fact that the forces are excessive and imbalanced, and a weak area at the groin could be increased due to the forces produced by the muscles. The forces produced by these muscles may be imbalanced and could produce a disruption of the muscle/tendon at their insertion site on the pubis or/and a weak area may be increased due to the forces produced by the muscles, and just this last possibility could be defined as "sportsmen hernia." In conclusion, this global entity could be considered to be an imbalance of the muscles (abductor and abdominal) at the pubis, that leads to an increase of the weakness of the posterior wall of the groin and produces a tendon enthesitis, once a true origin is not detected, that may lead to a degenerative arthropathy of the pubic symphysis in the advanced stages. Based on this, this entity could be re-named as "syndrome of muscle imbalance of the groin" and the sportsmen hernia could be considered as an entity included in this syndrome. It is recommended that a multidisciplinary approach is given to this entity, since the present literature does not supply the proper diagnostic studies and the correct treatment which should be performed in these patients.

Keywords Sportsmen hernia · Groin pain · Posterior inguinal wall · Imbalance · TEP

S. Morales-Conde (✉) · M. Socas · A. Barranco
Advanced Laparoscopic Unit,
University Hospital "Virgen del Rocío", Sevilla, Spain
e-mail: smoralesc@gmail.com

Introduction

Groin pain is defined as tendon enthesitis of the adductor longus muscle and/or abdominal muscles that may lead to degenerative arthropathy of the pubic symphysis in an advanced stage. The pubic region is a point where kinematic forces cross. The balance between the adductor and abdominal muscles is of great importance, as well as the elasticity of pubic symphysis, which enables movement of up to 2 mm and rotation of up to 3°. The weakness of the abdominal muscle wall, known as the sportsman's hernia, is the most common cause of painful groin [1].

Sportsmen often suffer prolonged inguinal pain, which can become a serious debilitating condition and may place an athlete's career at risk. As it has been said in most cases, the pain originates from a musculoskeletal problem [2]. However, for some patients, it has been suggested that the aetiology is a weakness of the inguinal canal.

Sportsman's hernia is a controversial cause of chronic groin pain in athletes [3] and other physically active people. This chronic groin pain in athletes forms a major diagnostic and therapeutic challenge, and there is no evidence-based consensus available to guide decision-making and most

studies are Level IV [4]. This pathology presents, in most of the cases, as chronic groin pain that flares with activity and disappears during periods of inactivity [5]. The definition of "sportsman's hernia" is very variable. This term has been used to describe a weakness or disruption of the musculotendinous part of the posterior inguinal wall, which causes persistent groin pain in athletes [6]. Other definitions are an imminent, but not demonstrable, inguinal hernia [7]; a syndrome caused by a distension of the posterior inguinal wall, effectively an early direct inguinal hernia [8]; a patient presenting with symptoms similar to hernia, but not having a hernia at the time of surgical exploration [9]; a tear in the transversalis fascia that was not evident by preoperative physical examination [10].

Although there are several reports of sportsman's hernia in women [8], it is almost exclusively found in men [3]. Groin pain was also found to be associated with increasing age in some studies [11]. It is also important to point out that this entity is a challenging problem among not only athletes but also the general population [12].

Approximately 2.5% of all sport-related injuries are in the pelvic area [13]. Sports injuries to the hip and groin region, including sportsman's hernia, occur most commonly in athletes participating in sports involving side-to-side cutting, quick accelerations and decelerations, and sudden directional changes [14]. Most commonly seen in soccer [3, 7, 14–22] and ice hockey players [3, 7, 9, 23], sportsman's hernia can be encountered in a variety of sports and in a variety of age groups, such as Australian footballers [24, 25], runners [19], basketball players [19], baseball players [19] and rugby players [21, 26], but in some series, the majority are recreational athletes [19].

Definition

From an anatomical point of view, the definition and the name of this entity should be reviewed. Confusion related to "sportsmen hernia" often arises from the complex anatomy and biomechanics of the symphysis region, from the large number of potential sources of groin pain and from the similarity of symptoms in athletes with different sites of injuries. There are different anatomic areas to be considered when we talk about this entity, including ligaments, tendons, nerves, muscles and bones.

In the majority of athletic manoeuvres, a tremendous amount of torque or twisting occurs in the mid-portion of the body and the front, or anterior portion, of the pelvis accounts for the majority of the force. The main muscles inserting at or near the pubis are the rectus abdominis muscle, which combines with the transversus abdominis. Across from these muscles, and directly opposing their forces, is the abductor longus. These opposing forces cause a disruption of the muscle/tendon at their insertion site on the pubis, so the problem could be related to the fact that forces are excessive and imbalanced, and a weak area at the groin could be increased due to the forces produced by the muscles.

As has been said, the forces produced by these muscles may be imbalanced and could produce a disruption of the muscle/tendon at their insertion site on the pubis or/and a weak area may be increased due to the forces produced by the muscles, and just this last possibility could be defined as sportsmen hernia.

In conclusion, this global entity could be considered as an imbalance of the muscles (abductor and abdominal) at the pubis, that leads to an increase of the weakness of the posterior wall of the groin and produces a tendon enthesitis, once a true origin is not detected, since, for example, a hernia is a hernia or a nerve entrapment is a nerve entrapment etc., that may lead to a degenerative arthropathy of the pubic symphysis in the advances stages. Based on this, this entity could be re-named as "syndrome of muscle imbalance of the groin" and the sportsmen hernia could be considered as an entity included in this syndrome.

Etiopathology of groin pain

Most common groin injuries are soft-tissue injuries, such as muscular strains, tendinitis or contusions. But more difficult areas to pinpoint are such entities as osteitis pubis, nerve entrapment, the so-called "sports hernia," avulsion fractures, intra-articular hip disorder [10], lumbosacral spine pathology [27] or even the detection of prostatitis.

The most common reasons for groin pain could be:

- A referral of pain from internal organs;
- Due to lesions of the symphysis of the pubis, and this lesion may be the result of the straining of tendons, ligaments and fascias, and this may predispose for an inguinal hernia as well [15]. These avulsion fractures of the apophyses occur through the relatively weaker growth plate in adolescents; most of these will heal with a graduated physical therapy programme and do not need surgery [28], but, also, this osteitis pubis is characterised by sclerosis and bony changes about the pubic symphysis [28];
- Due to stress fractures of the bones of the pelvis, particularly after a sudden increase in the intensity of training; most of these stress fractures will heal with rest, but femoral neck stress fractures can potentially lead to more serious problems and require closer evaluation and, sometimes, surgical treatment [28];
- Due to nerve compression to the nerves supplying the groin, that, in cases which do not respond to desensitisation measures, neurolysis can relieve the pain [28];

- Due to adductor strains, which are common problems in kicking sports, such as soccer;
- Or occult hernia, so called "sports hernia."

As has been analysed, nerve entrapment could also be involved in chronic inguinal pain, on the ventral surface of the scrotum and the proximal ventro-medial surface of the thigh. However, since few reports discuss the detailed course of the nerves in association with the pain, Akita et al. [29] have examined the cutaneous branches in the inguinal region in 54 halves of 27 adult male cadavers. From their results, in addition to the cutaneous branches from the ilioinguinal nerve (in 49 of 54: 90.7%), cutaneous branches originating from the genital branches of the genito-femoral nerve were found in the inguinal region in 19 of 54 halves (35.2%). In seven cases (in 7 of 54: 13.0%), the genital branch and the ilioinguinal nerve united in the inguinal canal. In six cases, the genital branch pierced the inguinal ligament to enter the inguinal canal, and in three cases, the genital branch pierced the border between the ligament and the aponeurosis of the obliquus externus muscle to be distributed to the inguinal region. Therefore, the courses of the genital branches vary considerably, and may have a very important role in chronic groin pain produced by groin hernia. In addition, entrapment by the ligament may be a reasonable candidate for the cause of chronic groin pain.

On the other hand, the previous so-called sportsman's hernias are unique because the injury is not identifiable on physical examination or imaging [5]. The basic pathology of a sportsman's hernia varies from one author to another, considering the presence of an occult hernia, a tear in the transversalis fascia [5, 10] or muscle strains [9].

Diagnosis

The diagnosis of chronic groin pain is difficult, but early diagnosis is very important, since morbidity will be reduced. These groin injuries are some of the most challenging injuries in the field of sports medicine, and the literature provides no consensus on the definitions of or the diagnostic criteria for groin pain in athletes [13]. The combination of complex anatomy [30], variability of presentation and the non-specific nature of the signs and symptoms make the diagnostic process problematic.

Therefore, the management of groin injuries can be challenging, and diagnosis can be difficult because of the degree of overlap of symptoms between the different problems [28]. This clinical setting demands the recruitment of a team with experience of different aspects of groin pain. Ekberg et al. [31] have established a multidisciplinary investigation in order to reveal the underlying cause. These examinations included general surgeons for the detection of inguinal hernia and neuralgia, orthopaedic surgeons for the detection of adductor tenoperiostitis and symphysitis, urologists for the detection of prostatitis, radiologists for performing different imaging tests and nuclear medicine for isotope studies. In this study, in 19 out of 21 patients, there was a positive diagnosis for two or more of the diseases (ten patients had two diseases, six patients had three diseases, three patients had four diseases), and two patients had only signs of symphysitis. These results show the complexity of long-standing groin pain in athletes. For all of these reasons, the so-called sportsman's hernia is largely a clinical diagnosis of exclusion [3].

This condition must be distinguished from the more common osteitis pubis and musculotendinous injuries [6], but the first step is to determine the differential diagnosis of hip and groin pain with respect to the high frequency of referred pain from the lumbar spine, lower abdomen and pelvis [32], which is very difficult in some cases. A systematic approach to the hip and groin area is important in order to identify the origin of pain. Both the history and quality of symptoms and the physical examination are the basics of the diagnostic algorithm, completed, in some cases, using the diagnostic work-up with roentgenograms and, possibly, an injection with a local anaesthetic to the suspected origin of pain [32]. There are clinical signs in the diagnosis of nerve pathologies, such as obturator neuropathies; these patients usually show clinical symptoms and signs of post-exercise groin, lower abdominal or medial tight pain and adductor muscles weakness and paresthesia in the cutaneous distribution of medial thigh. Except clinical signs in the diagnosis of obturator neuropathy, diagnostic local anaesthetic block and electromyography have been used [33].

History of chronic groin pain that is non-responsive to treatment should raise suspicions of sportsman's hernia, but physical examination findings are subtle and most diagnostic tests do not definitively confirm the diagnosis [3]. Prior to surgery, patients could be assessed by history, clinical examination, pelvic X-ray, bone scanning with technetium, ultrasound of the inguinal region [15], computed tomography (CT) and magnetic resonance imaging (MRI).

Physical examination

Physical examination is the first step in the diagnosis of groin pain, although symptoms are often vague and diffuse [13]. When active, sportsmen start to feel a dull pain in the groin region. The clinical assessment of groin pain in athletes is difficult, with the lack of specific clinical tests being partly responsible. The examinations could include the evaluation of adductor muscle-related pain and strength, iliopsoas muscle-related pain, strength and flexibility, abdominal muscle-related pain, and strength and pain at the

symphysis joint, but the only test without acceptable inter-observer reliability was the strength test for the iliopsoas muscle [34].

Basically, three pain provocation tests are described in the diagnosis of chronic groin pain [35], namely, the single adductor, squeeze and bilateral adductor tests. The adductor test is of great importance for physical examination; the patient should be lying supine with his hips abducted and flexed at 80° [1]. The test is positive if the patient, while attempting to pull his/her legs against pressing in the opposite direction, feels a sharp pain in the groin. Gradual physical therapy combined with pharmacotherapy should be effective in most cases and should be part of the diagnosis process. This process includes non-steroidal anti-inflammatory drugs (NSAIDs) and muscle relaxants. A physical therapy programme usually involves the stretching and strengthening of adductor muscles, abdominal wall muscles, iliopsoas muscle, quadriceps and hamstrings. In the case that physical therapy and pharmacotherapy fail, different tests should be performed.

Ultrasound

Ultrasound is a useful adjunct in evaluating the groin for hernia. The overall accuracy in finding a hernia of any kind by ultrasound is 92% and, on the other hand, this imaging test identifies the pathology in a groin without a palpable bulge at an accuracy of 75% [36]. Dynamic ultrasound examination is able to detect inguinal canal posterior wall deficiency in young males with no clinical signs of hernia with chronic groin pain. This examination has been proposed [37] to be performed with the patient in the supine and erect positions, in a relaxed state, as well as during coughing and during the Valsalva manoeuvre.

Orchard et al. [11] have shown a correlation between bilateral deficiency of the posterior wall and groin pain, although the temporal relationship between the clinical and ultrasound findings is not established by this study. Depasquale et al. [38] also show that ultrasound is a useful tool for identifying hernias, and, therefore, aids surgical management, since 39% (94 patients) of the patients examined presenting groin pain were positive for hernias, finding only four false-positive cases out of the 62 who underwent surgery, giving a positive predictive value of 94% in the operated patients. Ultrasound seems to show promise as a diagnostic tool in athletes with chronic groin pain who are considered as possible candidates for hernia repair.

CT and MRI

Other authors have proposed the use of other diagnostic techniques, but the costs of computed tomography (CT) and magnetic resonance imaging (MRI) are such that their routine use for the assessment of patients with groin pain cannot be justified [6]. The use of CT scans could help to identify posterior inguinal wall deficiencies and hernias in some cases [39] but they may, however, be employed in difficult cases to help define the anatomical extent of a groin injury [6].

MRI provided an accurate depiction of pubic bone alterations and of adjacent myotendinous structures [24, 40], and is also very useful to determine the presence of inguinal hernias [40], since it allows the direct visualisation of the hernial sac within the inguinal canal. Athletes with groin pain and tenderness of the pubic symphysis and/or superior pubic ramus have clinical features consistent with the diagnosis of osteitis pubis. The increased signal intensity seen on MRI is due to pubic bone marrow oedema. An association exists between the clinical features of osteitis pubis and the MRI finding of pubic bone marrow oedema and degenerative features, such as subchondral cyst formation, fluid signal within the pubic symphysis disc and irregularity of the pubic symphysis; other findings are myotendinous post-traumatic changes, such us haematomas of the psoas muscle and injuries of the abductor muscles of the thigh, or isolated dysmetria of the rectus abdominis muscles, with possible involvement of the sacroiliac joint [40].

Verrall et al. [41] have recently published a histologic analysis of bone biopsy specimens taken from the parasymphyseal pubic bone region with MRI T2-weighted increased signal intensity of athletes diagnosed by clinical and MRI criteria as having chronic groin injury. This study demonstrates new woven bone formation that may contribute significantly to athletic groin pain, which can be identified by MRI. A stress injury to the pubic bone is the most likely explanation for these MRI findings and may be the cause of the clinical entity osteitis pubis.

Osteitis pubis, intended as reactive intra-spongious oedema of the pubic bones, is the most frequent cause of groin pain in athletes. In the early diagnostic phases, both plain films and CT may be negative or not specific. On the other hand, MRI has always proved to be a valuable diagnostic technique in detecting the osteitic change as an area of low signal intensity on T1-weighted images and of high and homogeneous signal intensity on T2-weighted scans without fat suppression [40]. Dysmetria of the straight muscles of the abdomen, which may be associated, is always well depicted by MRI on axial planes. Both post-traumatic and dysmetric changes of the muscular structures adjacent to the pubis are well documented by ultrasound and MRI. The latter, however, thanks to its multiplanar capabilities, allows better spatial assessment of the alteration, especially if located at the peri-insertional level. Possible associated diseases such as the involvement of the sacroiliac joints are also shown well by MRI.

In conclusion, only MRI can permit an accurate and early diagnosis of the different sport-related pubic conditions, being also a valuable tool in monitoring the alterations with reference to their response to treatment, which may also help return the athletes back to their normal activities. But we also have to consider that abnormal MRI findings are also common in asymptomatic athletes, which decreases the value of MRI in surgical decision-making [42].

Nuclear medicine

Technetium-99 m bone scan could show, in patients with chronic pain, an increased uptake at the symptomatic pubic tubercle and also an increased uptake at other sites in the groin [39].

Herniography

On the other hand, in patients with chronic groin pain, herniography or peritoneography is a seldom-used, yet widely available, technique that can detect an occult inguinal hernia that is not detectable clinically. This technique is usually performed using a midline or paraumbilical approach, and radiographs are obtained with patients in prone and prone oblique positions with the head elevated 20° to 25°, both with and without provocative manoeuvres [43]. Heise et al. [43] have shown how 36 (45%) patients out of 80 who underwent a herniography were diagnosed radiographically to have inguinal hernias that were not detectable clinically, and 27 of these patients subsequently underwent inguinal exploration, with a hernia being confirmed in 24 (89%). Mäkelä et al. [44] have also shown how 38 (36%) out of 106 patients with obscure groin pain were diagnosed of inguinal hernias with this technique, with only one false-positive and two false-negative hernias. On the other hand, Smedberg et al. [45] performed a herniography in 101 painful groin sides in 78 athletes, finding a hernia in 84.2% of the symptomatic groin sides and in 49.1% of the asymptomatic groin sides. Kesek and Ekberg [46] have performed a study using herniography to find out the prevalence of symptomatic non-palpable groin hernias in women under 40 years old with undiagnosed chronic groin pain, considering this technique as a useful tool to detect occult hernia in women, which were present in 24% of the 116 women included in this study.

All of these results show that herniography may help in situations of obscure chronic groin and pelvic pain [6], but when herniography is used consistently in the diagnostic process of these patients, it could be observed how, in some series, 49% of cases of hernias are also demonstrated on the opposite, asymptomatic groin side [45, 47]. But the important issue is that herniography is highly reliable for detecting these clinically occult inguinal hernias and has a low complication rate, being related, in most of the cases, to the needle colon puncture, all of them usually managed conservatively [48]. Its usefulness has been shown in prospective consecutive series for the detection of occult hernias in patients with chronic inguinal pain [43]. As a conclusion, we can establish that herniography is a safe and useful diagnostic test in the setting of persistent inguinal pain and a negative clinical examination.

Conclusions

van den Berg et al. [49] have tried to determine the diagnostic accuracy of physical examination, ultrasound and dynamic MRI in patients with inguinal hernia. In this study, 82 groins, in 41 patients with clinically evident herniations, were evaluated using a standard ultrasound and MRI protocol, the latter including T1- and T2-weighted sequences, as well as two dynamic sequences. These ultrasound examinations and MRI scans were reviewed without knowledge of clinical findings and, in all cases, correlation with findings at laparoscopic surgery was made, in which 55 inguinal herniations were found. Physical examination revealed only 42 herniations, with one false-positive finding, whereas ultrasound made the diagnosis of a hernia in 56 cases (five false-positive and four false-negative findings) and MRI diagnosed 53 herniations (one false-positive and three false-negative findings). Thus, the sensitivity and specificity figures were 74.5 and 96.3% for physical examination, 92.7 and 81.5% for ultrasound, and 94.5 and 96.3% for MRI. The conclusion of this study showed that, in patients with clinically uncertain herniations, MRI is a valid diagnostic tool with a high positive predictive value.

A recent study published by Jansen et al. [50] evaluated the validity of diagnostic tests used to identify the pathologies explaining long-standing groin pain in athletes. The results show that the abductor provocation tests are moderately valid for osteitis pubis, a pelvic belt might provide some insight into the role of the pubic symphysis during adduction provocation and palpation can be used for the provocation of adductors and symphysis. On the other hand, roentgen, bone scan and herniography show poor validity, while bilateral abdominal abnormalities on ultrasound appear to be a valid marker for these pathologies. MRI can visualise oedema and other abnormalities, although the relation to groin pain is not unambiguous. The conclusion of this study shows that MRI and ultrasound should be the primary diagnostic tools after clinical examination.

The final analysis shows that plain radiography, ultrasonography and possibly scintigraphy should be the usual first-line investigations to supplement clinical assessment

[6], but MRI appears to have excellent diagnostic potential for these patients [4], being recommended as a multidisciplinary approach to groin pain in athletes. In conclusion, the final diagnosis often reflects the speciality of the doctor and the present literature does not supply proper studies that should be performed in these patients.

Treatment

Based on previous definitions in case this imbalance of the groin causes a disruption of the muscle/tendon at their insertion site on the pubis, treatment should be based on rest, anti-inflammatory medication and a proper training programme, followed by a re-evaluation. But in case that a weak area has been found at the groin due to the forces produced by the muscles, patients should undergo a surgical repair of the groin reinforcing the posterior wall with a mesh, since if a conjoined tendon is adequately supported by a mesh, abductor discomfort almost uniformly resolves with postoperative rehabilitation, being rarely the case that the abductor requires an operative release, a tenotomy or a perforation on the pubis.

Conservative treatment

Many cases of groin pain due to problems related to the musculoskeletal system are a self-limiting disease that can take several months to resolve. Corticosteroid injection can sometimes hasten the rehabilitation process [28]. Most of these will respond to a graduated stretching and strengthening programme, but can sometimes take a long time to completely heal. When this entity is related to adductor-related groin pain, a prospective randomised trial performed by Hölmich et al. [51] has demonstrated that an active training programme is superior to physiotherapy treatment without active training. In this sense, an active training programme aimed at improving the strength and coordination of the muscles acting on the pelvis, in particular the adductor muscles, is very effective in the treatment of athletes with long-standing adductor-related groin pain. All of these issues show that a manual therapy treatment might be a promising treatment for this entity [52, 53].

On the other hand, Schilders et al. [54] has shown the efficiency of a single entheseal pubic cleft injection. This treatment can be expected to afford at least one year of relief of adductor-related groin pain in a competitive athlete with normal findings on an MRI scan; however, it should be employed only as a diagnostic test or short-term treatment for a competitive athlete with evidence of enthesopathy on MRI.

Reinforcement of the posterior wall deficiency

The management of the so-called sportsmen hernias is different, and that is the reason for the importance of a proper diagnosis. Conservative treatment of this entity does not often result in the resolution of symptoms [3]. In some series, the athletes have received different conservative treatments without success [8] and the surgical procedures performed in these cases have offered a definitive resolution to this problem [8]. However, several surgical approaches are available for the repair of inguinal hernias, but without knowing the true natural history of this disorder, and the problem is that it is difficult to know when it is appropriate to have a hernia repaired [55]. It is recommended to operate only if conservative therapy, with prolonged rest, fails [2].

But a precise diagnose is always preferable before performing a hernia repair in a patient with chronic groin pain. Steele et al. [39] show no significant difference in outcome between subjects who had an abnormal ultrasound scan on the symptomatic side and those who had a normal scan. There was a significant difference in outcome between patients who had a bone scan with increased uptake at the symptomatic pubic tubercle and those who did not ($P < 0.04$). This study supports other researches which show that good results can be obtained with surgery when posterior inguinal wall deficiency is the sole diagnosis. Ultrasound scan does not appear to aid in predicting surgical outcome, while the role of isotope bone scanning still requires further study. In fact, Kesek et al. [16] has published advanced changes in the relief of clinical symptoms in 21 (65.6%) patients out of 32 who showed bone changes at the pubic symphysis.

Surgical intervention of chronic groin pain by performing a hernia repair results in the pain-free return to full activities in the majority of cases [3]. There is no consensus view supporting any particular surgical procedure for sportsman's hernia [6]. Various types of operations, based on the variable theories regarding the pathophysiological process, have been developed for the treatment of this syndrome (Table 1). Some surgeons focus on the external elements of the inguinal canal and repair the external oblique fascia or enforce the groin with the rectus abdominis. Other surgeons perform an inguinal hernia repair procedure, either with sutures or synthetic mesh, performed by an open approach or laparoscopically. Some researchers believe that the problem is in the lower abdominal muscles or is caused by nerve entrapment, and treat it accordingly. Other authors recommend a Bassini's hernial repair in combination with a percutaneous adductor longus tenotomy [17]. There are no controlled comparative data on the results of the various surgical approaches, and there is no evidence that surgical treatment is more beneficial than conservative treatment.

Table 1 Surgical technique and the results of return to normal activity

	Number	Return to normal activity (%)	Surgical technique
Susmallian et al. [15]	35	97.1	TEP with mesh
Paajanen et al. [7]	41	95	TEP with mesh
Hackney [8]	15	87	Open repair to the posterior inguinal wall
Malycha and Lovell [55]	50	93	Open surgical repair of the hernia
van Veen et al. [56]	55	100	TEP with mesh
Simonet et al. [9]	10	100	Open inguinal repair (seven with mesh)
Kluin et al. [58]	14	93	TAPP and TEP
Steele et al. [39]	47	77	Open inguinal repair
Srinivasan and Schuricht [57]	15	87	TEP
Taylor et al. [67]	9	89	Open inguinal repair
Polglase et al. [24]	64	93.8	Bassini repair and Tanner slide or by plication of the transversalis fascia followed by a nylon darn
Lacroix et al. [23]	11	100	Repair of the external oblique tear, ablation of the ilioinguinal nerve
Azurin et al. [68]	8	100	TEP inguinal repair
Genitsaris et al. [66]	131	97	TAPP
Van Der Donckt et al. [17]	41	91.3	Bassini's hernial repair and percutaneous adductor longus tenotomy
Ahumada et al. [19]	12	100	Open inguinal repair (nine reinforced with mesh)
Kumar et al. [72]	35	96	Open repair of external oblique tear (when present) and Prolene darn or Lichtenstein mesh repair of the posterior inguinal canal
Akermark and Johansson [64]	16	62.5	Tenotomies of the adductor longus tendon
Edelman and Selesnick [10]	10	90	TEP with Surgisis
Bohnsack et al. [70]	30	94	Hip arthroscopy
Topol et al. [21]	24	92	Simple dextrose prolotherapy
Ziprin et al. [62]	25	92	One open hernia repair; for the rest, defects were found in the external oblique aponeurosis through which neurovascular bundles containing terminal branches of the iliohypogastric nerve passed. Tears were repaired after division of the bundles
Ingoldby [26]	28	96	50% open mesh repair 50% laparoscopic mesh repair
Simonet et al. [9]	10	100	Open repair either directly or with a synthetic mesh reinforcement (seven cases)
Mann et al. [63]	73	88	Laparoscopic inguinal release procedure with mesh reinforcement
Hussain et al. [12]	43	69	TAPP repair
Bradshaw et al. [71]	17	94	TAPP repair
Lloyd et al. [65]	48	82	Laparoscopic inguinal ligament tenotomy and mesh reinforcement
Canonico et al. [60]	16	100	Lichtenstein repair with fibrin glue
van Veen et al. [56]	55	100	TEP repair

But, basically, a number of reports have been published describing different repairs of the posterior inguinal wall deficiency as the main approach for sportsman's hernias (Table 1). Appropriate repair of the posterior wall results in therapeutic benefit in selected cases. Among the different surgical procedures that have been proposed to solve this pathology, open and laparoscopic mesh reinforcement of the inguinal area with a polypropylene mesh is one of the most common options, with the endoscopic preperitoneal approach being the technique most often used in the last year [7, 15, 56, 57], although other authors consider an open hernia repair using mesh, performed as an outpatient procedure with local anaesthesia and sedation, as the optimal treatment [5]. Ingoldby [26] has performed a

comparative non-randomised study comparing the open and the laparoscopic approach, showing that the endoscopic repair permits an early return to activity.

During the operation, the inguinal canal should be thoroughly explored in order to find the different entities that could be detected during the surgery (Table 2), such as a true inguinal hernia, a wide internal ring and peritoneal dimple [15], a hernia femoralis [58], a preperitoneal lipoma [58], hernia obturatoria [58], a pre-vascular hernia [59], an obvious musculotendinous tear [7], a muscle asymmetry [7] or a significant bulge in the posterior wall [55], but even if no clear pathology is identified, reinforcement of the wall

Table 2 Pathology found during surgery

	n	Pathology found during surgery	No clear pathology
Susmallian et al. [15]	35	True inguinal hernia in 4 (11.4%)	3 (8.6%)
		Wide internal ring and peritoneal dimple in 28 (80%)	
Paajanen et al. [7]	41	Obvious musculotendinous tear in 10 (24%)	24 (58%)
		Muscle asymmetry in 7 (17%)	
Malycha and Lovell [55]	50	Significant bulge in the posterior in 40 (80%)	10 (20%)
van Veen et al. [56]	55	Inguinal hernia in 100%	0
Simonet et al. [9]	10	Tears in the floor of the inguinal ring in 100%	0
Kluin et al. [58]	18	Inguinal hernia in 9 (50%)	1 (5.5%)
		Hernia femoralis in 4 (22.2%)	
		Preperitoneal lipoma in 3 (16.6%)	
		Hernia obturatoria in 1 (5.5%)	
Kesek et al. [16]	51	Inguinal hernia in 12 (23.5%)	32 (62.7%)
		Obturator hernia in 1 (1.9%)	
Taylor et al. [67]	9	Inguinal hernias in 8 (88.8%)	0
		Partial avulsion of the internal oblique fibres from their insertion at the public tubercle in 1 (11.2%)	
Polglase et al. [24]	72	Substantially deranged posterior wall of the inguinal canal in 85%	0
		Apparent splitting of the conjoint tendon in 26%	
		Indirect inguinal hernias in 8%	
Lacroix et al. [23]	11	Varying degrees of tearing of the external oblique aponeurosis and external oblique muscle associated with ilioinguinal nerve entrapment in 100%	0
Azurin et al. [68]	9	Small inguinal hernias in 100%	0
		(7 patients have bilateral hernias when they were explore intraoperatively)	
Genitsaris et al. [66]	262	A deficiency of the posterior inguinal wall in 100%	0
Ahumada et al. [19]	12	Most common intraoperative findings were non-specific attenuation of the inguinal floor and cord lipomas	–
Kumar et al. [72]	35	Tear in the external oblique aponeurosis with or without a significant posterior bulge in 20 (57.1%)	0
		Significant posterior bulge in 10 (28.6%)	
		Tear in the conjoint tendon with dilated superficial ring in 3 (8.6%)	
		Small direct hernial sac in 1 (2.9%)	
		Lipoma of the spermatic cord in 1 (2.9%)	
Bohnsack et al. [70]	30	Lesion of the acetabular labrum in 17 (57%)—cartilage degeneration grade II in 11 (37%)	2 (6%)
Ziprin et al. [62]	31	Occult inguinal hernia in 1 (3.2%)	0
		Patent processus vaginalis in 1 (3.2%)	
		Defects found in the external oblique aponeurosis, through which neurovascular bundles containing terminal branches of the iliohypogastric nerve passed in 29 (93.6%)	
Bradshaw et al. [71]	17	Posterior wall deficiency	0

using a mesh offers good clinical results for athletes with idiopathic groin pain [56], although other authors recommend not to use the mesh in these cases [2]. Basically, the most common finding in athletes with chronic groin pain was a deficiency of the posterior wall of the inguinal canal [24].

There are also, nowadays, some controversies on how to fix the mesh in open or endoscopic approaches. Canonico et al. [60] have evaluated the efficacy of mesh fixation with human fibrin glue in open, tension-free inguinal repair, in the treatment of sportsmen hernias, in place of conventional sutures. The results of this study were excellent in all cases, with no reported intra- or postoperative complications, which confirms the efficacy of suture-less tension-free hernia repair with human fibrin glue for the treatment of sportsmen suffering from chronic groin pain.

But there are some aspects that should be analysed when we determine whether to operate on these patients, since some series show that further clinical investigation of the non-cured, operated athletes gave an alternative and treatable diagnosis in more than 80% of cases [47].

Other surgical options

We also have to consider that the surgical treatment of chronic symphysis syndrome is successful and can salvage the career of athletes. Surgery of these cases is performed by spreading the lateral border of the sheath of the rectus abdominis muscle, together with an epimysial adductor release, or by the reconstruction of the rectus abdominis muscle [61].

On the other hand, in cases in which a neuropathy is diagnosed, surgical neurolysis could provide, in most of the cases, a definitive cure of pain [33]. There are some groups of patients [62] who have chronic groin pain related to nerve entrapment in the external oblique aponeurosis. In these cases, defects have been found in the external oblique aponeurosis, through which neurovascular bundles containing terminal branches of the iliohypogastric nerve passed, and these tears must be repaired after division of the bundles. But the release of the nerves may also be performed by laparoscopy [63], being described together with a mesh reinforcement.

Other authors, such as Topol et al. [21], have proposed simple dextrose prolotherapy in athletes with chronic groin pain from the osteitis pubis and/or adductor tendinopathy. Monthly injection of 12.5% dextrose and 0.5% lidocaine is performed in the thigh adductor origins, suprapubic abdominal insertions and symphysis pubis, depending on the palpation tenderness. Injections were given until the complete resolution of pain or the lack of improvement for two consecutive treatments.

Other groups [10] have proposed a hip arthroscopy for patients with chronic groin pain. Different entities have been found in these cases: lesions of the acetabular labrum, being performed as a partial resection, and a cartilage degeneration grade II in the Outerbridge classification.

For some authors [64], when conservative treatment fails, tenotomy of the adductor longus tendon gives good long-term functional results in the treatment of chronic groin pain that is localised at the origin of the adductor longus muscle. Decreased muscle strength is observed in some studies and does not seem to influence participation in sports. On the other hand, other authors have proposed a tenotomy of the inguinal ligament together with mesh reinforcement, performed by laparoscopy, showing excellent results, with 92% of patients returning to normal sporting activities after their surgery [65].

Final considerations on surgical treatment

It is concluded that athletes with chronic groin pain who are unable to compete in active sport should be considered for routine inguinal hernia repair if no other pathology is evident after clinical examination and investigation [55]. Endoscopic preperitoneal herniorrhaphy is an effective treatment for obscure groin pain when the pain is associated with an inguinal hernia or a deficiency of the posterior wall, and allows for a short recovery time back to full athletic activity. The laparoscopic approach also allows the examination and repair of both inguinal posterior walls in the same approach, which will offer a shorter convalescent period and better results as compared to open myorrhaphy [66].

These techniques, open or laparoscopic hernia repair, offer good results with no complications [7] and, in most of the series, an operative treatment can return the patient to his/her sport within 3 months [58, 67].

References

1. Janković S, Delimar D, Hudetz D (2001) The groin pain syndrome. Arh Hig Rada Toksikol 52(4):421–428
2. Kaplan O, Arbel R (2005) Sportsman's hernia—a plea for conservative therapeutical approach. Harefuah 144(5):351–356, 381
3. Moeller JL (2007) Sportsman's hernia. Curr Sports Med Rep 6(2):111–114
4. Swan KG Jr, Wolcott M (2007) The athletic hernia: a systematic review. Clin Orthop Relat Res 455:78–87
5. Joesting DR (2002) Diagnosis and treatment of sportsman's hernia. Curr Sports Med Rep 1(2):121–124
6. Fon LJ, Spence RA (2000) Sportsman's hernia. Br J Surg 87(5):545–552
7. Paajanen H, Syvähuoko I, Airo I (2004) Totally extraperitoneal endoscopic (TEP) treatment of sportsman's hernia. Surg Laparosc Endosc Percutan Tech 14(4):215–218

8. Hackney RG (1993) The sports hernia: a cause of chronic groin pain. Br J Sports Med 27(1):58–62
9. Simonet WT, Saylor HL 3rd, Sim L (1995) Abdominal wall muscle tears in hockey players. Int J Sports Med 16(2):126–128
10. Edelman DS, Selesnick H (2006) "Sports" hernia: treatment with biologic mesh (Surgisis): a preliminary study. Surg Endosc 20(6):971–973
11. Orchard JW, Read JW, Neophyton J, Garlick D (1998) Groin pain associated with ultrasound finding of inguinal canal posterior wall deficiency in Australian Rules footballers. Br J Sports Med 32(2):134–139
12. Hussain A, Mahmood H, Singhal T, Balakrishnan S, Nicholls J, Grandy-Smith S, El-Hasani S (2008) Laparoscopic surgery for chronic groin pain in the general population: a prospective study. J Laparoendosc Adv Surg Tech A 18(6):809–813
13. Kidron A (2001) Groin pain in sport. Harefuah 140(11):1095–1099, 1115
14. Holzheimer RG (2005) Inguinal hernia: classification, diagnosis and treatment—classic, traumatic and Sportsman's hernia. Eur J Med Res 10(3):121–134
15. Susmallian S, Ezri T, Elis M, Warters R, Charuzi I, Muggia-Sullam M (2004) Laparoscopic repair of "sportsman's hernia" in soccer players as treatment of chronic inguinal pain. Med Sci Monit 10(2):CR52–CR54
16. Kesek P, Ekberg O, Westlin N (2002) Herniographic findings in athletes with unclear groin pain. Acta Radiol 43(6):603–608
17. Van Der Donckt K, Steenbrugge F, Van Den Abbeele K, Verdonk R, Verhelst M (2003) Bassini's hernial repair and adductor longus tenotomy in the treatment of chronic groin pain in athletes. Acta Orthop Belg 69(1):35–41
18. Siwiński D (2005) Neuropathy of the obturator nerve as a source of pain in soccer players. Chir Narzadow Ruchu Ortop Pol 70(3):201–204
19. Ahumada LA, Ashruf S, Espinosa-de-los-Monteros A, Long JN, de la Torre JI, Garth WP, Vasconez LO (2005) Athletic pubalgia: definition and surgical treatment. Ann Plast Surg 55(4):393–396
20. Bahar A, Soudry M (2000) Surgery for groin and lower abdominal pain in soccer players. Harefuah 139(1–2):29–32, 78
21. Topol GA, Reeves KD, Hassanein KM (2005) Efficacy of dextrose prolotherapy in elite male kicking-sport athletes with chronic groin pain. Arch Phys Med Rehabil 86(4):697–702
22. Gilmore J (1998) Groin pain in the soccer athlete: fact, fiction, and treatment. Clin Sports Med 17(4):787–793
23. Lacroix VJ, Kinnear DG, Mulder DS, Brown RA (1998) Lower abdominal pain syndrome in national hockey league players: a report of 11 cases. Clin J Sport Med 8(1):5–9
24. Polglase AL, Frydman GM, Farmer KC (1991) Inguinal surgery for debilitating chronic groin pain in athletes. Med J Aust 155(10):674–677
25. Verrall GM, Slavotinek JP, Fon GT (2001) Incidence of pubic bone marrow oedema in Australian rules football players: relation to groin pain. Br J Sports Med 35(1):28–33
26. Ingoldby CJ (1997) Laparoscopic and conventional repair of groin disruption in sportsmen. Br J Surg 84(2):213–215
27. Deysine M, Deysine GR, Reed WP Jr (2002) Groin pain in the absence of hernia: a new syndrome. Hernia 6(2):64–67
28. Lynch SA, Renström PA (1999) Groin injuries in sport: treatment strategies. Sports Med 28(2):137–144
29. Akita K, Niga S, Yamato Y, Muneta T, Sato T (1999) Anatomic basis of chronic groin pain with special reference to sports hernia. Surg Radiol Anat 21(1):1–5
30. Falvey EC, Franklyn-Miller A, McCrory PR (2009) The groin triangle: a patho-anatomical approach to the diagnosis of chronic groin pain in athletes. Br J Sports Med 43(3):213–220
31. Ekberg O, Persson NH, Abrahamsson PA, Westlin NE, Lilja B (1988) Longstanding groin pain in athletes. A multidisciplinary approach. Sports Med 6(1):56–61
32. Holmich P, Dienst M (2006) Differential diagnosis of hip and groin pain. Symptoms and technique for physical examination. Orthopade 35(1):8, 10–15
33. LeBlanc KE, LeBlanc KA (2003) Groin pain in athletes. Hernia 7(2):68–71
34. Hölmich P, Hölmich LR, Bjerg AM (2004) Clinical examination of athletes with groin pain: an intraobserver and interobserver reliability study. Br J Sports Med 38(4):446–451
35. Verrall GM, Slavotinek JP, Barnes PG, Fon GT (2005) Description of pain provocation tests used for the diagnosis of sports-related chronic groin pain: relationship of tests to defined clinical (pain and tenderness) and MRI (pubic bone marrow oedema) criteria. Scand J Med Sci Sports 15(1):36–42
36. Lilly MC, Arregui ME (2002) Ultrasound of the inguinal floor for evaluation of hernias. Surg Endosc 16(4):659–662
37. Lorenzini C, Sofia L, Pergolizzi FP, Trovato M (2008) The value of diagnostic ultrasound for detecting occult inguinal hernia in patients with groin pain. Chir Ital 60(6):813–817
38. Depasquale R, Landes C, Doyle G (2009) Audit of ultrasound and decision to operate in groin pain of unknown aetiology with ultrasound technique explained. Clin Radiol 64(6):608–614
39. Steele P, Annear P, Grove JR (2004) Surgery for posterior inguinal wall deficiency in athletes. J Sci Med Sport 7(4):415–421
40. Barile A, Erriquez D, Cacchio A, De Paulis F, Di Cesare E, Masciocchi C (2000) Groin pain in athletes: role of magnetic resonance. Radiol Med (Torino) 100(4):216–222
41. Verrall GM, Henry L, Fazzalari NL, Slavotinek JP, Oakeshott RD (2008) Bone biopsy of the parasymphyseal pubic bone region in athletes with chronic groin injury demonstrates new woven bone formation consistent with a diagnosis of pubic bone stress injury. Am J Sports Med 36(12):2425–2431
42. Paajanen H, Hermunen H, Karonen J (2008) Pubic magnetic resonance imaging findings in surgically and conservatively treated athletes with osteitis pubis compared to asymptomatic athletes during heavy training. Am J Sports Med 36(1):117–121
43. Heise CP, Sproat IA, Starling JR (2002) Peritoneography (herniography) for detecting occult inguinal hernia in patients with inguinodynia. Ann Surg 235(1):140–144
44. Mäkelä JT, Kiviniemi H, Palm J, Myllylä V (1996) The value of herniography in the diagnosis of unexplained groin pain. Ann Chir Gynaecol 85(4):300–304
45. Smedberg SG, Broome AE, Gullmo A, Roos H (1985) Herniography in athletes with groin pain. Am J Surg 149(3):378–382
46. Kesek P, Ekberg O (1999) Herniography in women under 40 years old with chronic groin pain. Eur J Surg 165(6):573–578
47. Fredberg U, Kissmeyer-Nielsen P (1996) The sportsman's hernia—fact or fiction? Scand J Med Sci Sports 6(4):201–204
48. Yilmazlar T, Kizil A, Zorluoglu A, Ozgüç H (1996) The value of herniography in football players with obscure groin pain. Acta Chir Belg 96(3):115–118
49. van den Berg JC, de Valois JC, Go PM, Rosenbusch G (1999) Detection of groin hernia with physical examination, ultrasound, and MRI compared with laparoscopic findings. Invest Radiol 34(12):739–743
50. Jansen JA, Mens JM, Backx FJ, Stam HJ (2008) Diagnostics in athletes with long-standing groin pain. Scand J Med Sci Sports 18(6):679–690
51. Hölmich P, Uhrskou P, Ulnits L, Kanstrup IL, Nielsen MB, Bjerg AM, Krogsgaard K (1999) Effectiveness of active physical training as treatment for long-standing adductor-related groin pain in athletes: randomised trial. Lancet 353(9151):439–443
52. Weir A, Veger SA, Van de Sande HB, Bakker EW, de Jonge S, Tol JL (2009) A manual therapy technique for chronic adductor-related

groin pain in athletes: a case series. Scand J Med Sci Sports 19(5):616–620
53. Kachingwe AF, Grech S (2008) Proposed algorithm for the management of athletes with athletic pubalgia (sports hernia): a case series. J Orthop Sports Phys Ther 38(12):768–781
54. Schilders E, Bismil Q, Robinson P, O'Connor PJ, Gibbon WW, Talbot JC (2007) Adductor-related groin pain in competitive athletes. Role of adductor enthesis, magnetic resonance imaging, and entheseal pubic cleft injections. J Bone Joint Surg Am 89(10):2173–2178
55. Malycha P, Lovell G (1992) Inguinal surgery in athletes with chronic groin pain: the 'sportsman's' hernia. Aust N Z J Surg 62(2):123–125
56. van Veen RN, de Baat P, Heijboer MP, Kazemier G, Punt BJ, Dwarkasing RS, Bonjer HJ, van Eijck CH (2007) Successful endoscopic treatment of chronic groin pain in athletes. Surg Endosc 21(2):189–193
57. Srinivasan A, Schuricht A (2002) Long-term follow-up of laparoscopic preperitoneal hernia repair in professional athletes. J Laparoendosc Adv Surg Tech A 12(2):101–106
58. Kluin J, den Hoed PT, van Linschoten R, IJzerman JC, van Steensel CJ (2004) Endoscopic evaluation and treatment of groin pain in the athlete. Am J Sports Med 32(4):944–949
59. Aldridge AJ, Packham IM, Nash AG (2001) Pre-vascular hernia: a rare cause of chronic obscure groin pain after inguinal hernia repair. Hernia 5(1):53–55
60. Canonico S, Benevento R, Della Corte A, Fattopace A, Canonico R (2007) Sutureless tension-free hernia repair with human fibrin glue (tissucol) in soccer players with chronic inguinal pain: initial experience. Int J Sports Med 28(10):873–876
61. Biedert RM, Warnke K, Meyer S (2003) Symphysis syndrome in athletes: surgical treatment for chronic lower abdominal, groin, and adductor pain in athletes. Clin J Sport Med 13(5):278–284
62. Ziprin P, Williams P, Foster ME (1999) External oblique aponeurosis nerve entrapment as a cause of groin pain in the athlete. Br J Surg 86(4):566–568
63. Mann CD, Sutton CD, Garcea G, Lloyd DM (2009) The inguinal release procedure for groin pain: initial experience in 73 sportsmen/women. Br J Sports Med 43(8):579–583
64. Akermark C, Johansson C (1992) Tenotomy of the adductor longus tendon in the treatment of chronic groin pain in athletes. Am J Sports Med 20(6):640–643
65. Lloyd DM, Sutton CD, Altafa A, Fareed K, Bloxham L, Spencer L, Garcea G (2008) Laparoscopic inguinal ligament tenotomy and mesh reinforcement of the anterior abdominal wall: a new approach for the management of chronic groin pain. Surg Laparosc Endosc Percutan Tech 18(4):363–368
66. Genitsaris M, Goulimaris I, Sikas N (2004) Laparoscopic repair of groin pain in athletes. Am J Sports Med 32(5):1238–1242
67. Taylor DC, Meyers WC, Moylan JA, Lohnes J, Bassett FH, Garrett WE Jr (1991) Abdominal musculature abnormalities as a cause of groin pain in athletes. Inguinal hernias and pubalgia. Am J Sports Med 19(3):239–242
68. Azurin DJ, Go LS, Schuricht A, McShane J, Bartolozzi A (1997) Endoscopic preperitoneal herniorrhaphy in professional athletes with groin pain. J Laparoendosc Adv Surg Tech A 7(1):7–12
69. Morelli V, Weaver V (2005) Groin injuries and groin pain in athletes: part 1. Prim Care 32(1):163–183
70. Bohnsack M, Lekkos K, Börner CE, Wirth CJ, Rühmann O (2006) Results of hip arthroscopy in sports related groin pain. Sportverletz Sportschaden 20(2):86–90
71. Bradshaw CJ, Bundy M, Falvey E (2008) The diagnosis of longstanding groin pain: a prospective clinical cohort study. Br J Sports Med 42(10):851–854
72. Kumar A, Doran J, Batt ME, Nguyen-Van-Tam JS, Beckingham IJ (2002) Results of inguinal canal repair in athletes with sports hernia. J R Coll Surg Edinb 47(3):561–565