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ORIGINAL ARTICLE

Sportsman hernia: what can we do?

J. F. W. Garvey · J. W. Read · A. Turner

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Abstract
Introduction Sportsman (sports) hernia is a medially located bulge in the posterior wall of the inguinal canal that is common in football players. About 90% of cases occur in males. The injury is also found in the general population.
Clinical presentation The presenting symptom is chronic groin pain which develops during exercise, aggravated by sudden movements, accompanied by subtle physical examination findings and a medial inguinal bulge on ultrasound. Pain persists after a game, abates during a period of lay-off, but returns on the resumption of sport. Frequently, sports hernia is one component of a more extensive pattern of injury known as 'groin disruption injury' consisting of osteitis pubis, conjoint tendinopathy, adductor tendinopathy and obturator nerve entrapment.
Risk factors Certain risk factors have been identified, including reduced hip range of motion and poor muscle balance around the pelvis, limb length discrepancy and pelvic instability. The suggested aetiology of the injury is repetitive athletic loading of the symphysis pubis disc, leading to accelerated disc degeneration with consequent pelvic instability and vulnerability to micro-fracturing along the pubic osteochondral junction, periosteal stripping of the pubic ligaments and para-symphyseal tendon tears, causing tendon dysfunction.
Radiology Diagnostic imaging includes an erect pelvic radiograph (X-ray) with flamingo stress views of the symphysis pubis, real-time ultrasound and, occasionally, computed tomography (CT) scanning and magnetic resonance imaging (MRI), but seldom contrast herniography. Other imaging tests occasionally performed can include nuclear bone scan, limb leg measurement and test injections of local anaesthetic/corticosteroid.
Prevention and treatment The injury may be prevented by the detection and monitoring of players at risk and by correcting significant limb length inequality. Groin reconstruction operation consists of a Maloney darn hernia repair technique, repair of the conjoint tendon, transverse adductor tenotomy and obturator nerve release. Rehabilitation involves core stabilisation exercises and the maintenance of muscle control and strength around the pelvis.
Outcome Using this regimen of groin reconstruction and post-operative rehabilitation, a player would be anticipated to return to their pre-injury level of activity approximately 3 months after surgery.

Keywords Sports hernia · Groin disruption injury · Athletic pubalgia · Physiotherapy · Ultrasound diagnosis

J. F. W. Garvey (✉)
Groin Pain Clinic, Suite G01, 135 Macquarie Street,
Sydney, NSW 2000, Australia
e-mail: jgarvey@groinpainclinic.com.au

J. W. Read
Castlereagh Imaging, 286 Pacific Highway,
Crows Nest, NSW 2065, Australia
e-mail: johnwread@mac.com

A. Turner
Harbour Street Sports Physiotherapy,
52 Harbour Street, Mosman, NSW 2088, Australia
e-mail: a-turner@bigpond.com; aturner@optusnet.com.au

Introduction

Sports hernia is the name coined by South Australian Sports Physician Greg Lovell to describe a syndrome of *chronic* groin pain in athletes that is associated with a small direct inguinal hernia. The injury is a medially located bulge in the posterior wall of the inguinal canal which is

most common in football players, but can affect any sport that involves repetitive energetic kicking, twisting, turning or cutting movements [1].

The minimum criteria required for a diagnosis of sports hernia include: (a) a clinical setting of chronic groin pain which develops during exercise, is located over the lower lateral edge of the rectus abdominis muscle *with or without* radiation to the testis or adductor longus origin, and is often aggravated by sudden acceleration, twisting and turning, cutting and kicking, sit-ups and coughing or sneezing; (b) subtle but consistent physical examination findings; and (c) appropriate imaging features. All of these criteria must be simultaneously present, because: (1) there are numerous *other* potential causes for groin pain in athletes; and (2) *asymptomatic* direct inguinal hernias are common in the general population [2].

Frequently, sports hernia is a component of a more extensive pattern of 'groin disruption injury,' which involves several concurrent pathologies, which we believe all derive from the same basic underlying mechanism of *pelvic instability*. The interrelated components of groin disruption injury include:

- Osteitis pubis;
- Sports (occult or incipient direct) hernia;
- Conjoint tendinopathy and/or tear;
- Adductor tendinopathy and/or tear;
- Obturator nerve entrapment and/or irritation.

No general consensus has yet been reached concerning the actual existence of sports hernia, the relevant pathology or even the name that should apply to this condition. Other terms that have been used include sportsman's hernia, athletic pubalgia, Gilmore's groin [3], footballers groin injury complex and pubic inguinal pain syndrome (PIPS). The injury is also found in the general population, including injured workers.

Clinical presentation

The majority of patients are males, but about 10% of cases occur in females. The sports most often involved are soccer, rugby, Australian Rules football [4], cricket, martial arts, ice hockey and long-distance running. The presenting complaint is exercise-related groin pain. The pain is typically located over the lower lateral edge of the rectus abdominis muscle and may radiate toward the testis, suprapubic region or adductor longus origin. The onset is usually insidious, but in some cases can involve an initial sudden 'tearing' sensation. Sports hernia pain is often aggravated by sudden acceleration, twisting and turning, cutting and kicking, sit-ups, coughing or sneezing [1, 5, 6]. The pain generally persists for a day or two after a game. There may be stiffness and difficulty in getting out of bed the following day. Despite a suitable period of rest or lay-off, the pain returns immediately and with full force upon the resumption of sport.

Objective physical examination findings are typically sparse [7]. There is often localised tenderness at or just above the pubic crest on the affected side. Pain at this location is usually reported on resisted sit-up. Palpation for a positive inguinal cough impulse is usually either negative or equivocal. A subtle bulge in the skin surface contour over the affected inguinal region can occasionally be seen when the patient is observed from above while standing (J.W. Read, personal observation). Resisted hip adduction is painful and the adductor 'squeeze test' is positive in supine and/or 90° hip flexed positions. Obturator nerve entrapment is diagnosed by bluntness to pin-prick sensation in a characteristic distribution along the medial aspect of the thigh. A groin examination checklist is used for all patients.

Risk factors

Risk factors for 'sports hernia' as a specific entity cannot be clearly separated from those associated with the less narrowly defined entity of 'chronic groin pain.' Reduced range of hip motion and poor muscle balance around the pelvis are risk factors which both have well-established supporting evidence (discussed below), but we consider, from clinical experience, that significant limb length discrepancy should also be regarded as a risk factor. It can be argued that these factors may all contribute to both functional and structural pelvic instability, and it is our view that maintaining rotational control and stability of the pelvis is the most important factor in preventing both injury and re-injury.

Decreased external and internal rotation of the hip joint have been detected in pre-season soccer players [8, 9] and professional Australian Football League players [10] with pubalgia. In the latter study, the authors postulate that compression loading occurs at the symphysis during unilateral weight-bearing, with a consequent vulnerability to high-use overload. It seems logical to suggest that restricted hip joint range of motion may also secondarily increase the forces acting across the symphysis.

Previous injury as a risk factor has been established in cases of abdominal strain [11] and groin strain [11–13]. For example, ice hockey players are twice as likely to re-injure if they have sustained a groin injury in the previous year [13].

Muscle imbalance is another recognised risk factor. For example, adductor muscle strains are 17 times more likely in ice hockey players if their adductor strength is less than 80% of their abductor strength [14]. There is some debate

regarding adductor strength and length as risk factors for groin strain, along with sporting experience and age [15]. An imbalance in strength between hip stabilisers and movers has been suggested as a mechanism for adductor strains [16]. Sports hernia is associated with both decreased abdominal oblique strength and decreased isokinetic hip strength [11], but it remains unclear whether these deficiencies are causal or secondary. Cowan et al. [17] found that the feed-forward activation of the transversus abdominis was delayed in patients with long-standing groin pain, and this may have implications for motor control of the pelvis and response to pelvic ring perturbations.

Additionally, we believe that there is an association between *significant* limb length discrepancy and sports hernia. This risk factor reflects asymmetric loading of the right and left hemipelvis with consequent predisposition to structural and, subsequently, functional pelvic instability, and is supported by biomechanical studies which have shown significantly increased ground reaction force in the shorter leg when the limb length inequality is ≥5 mm [18].

Aetiology

The aetiology of sports hernia is debatable. Although isolated traumatic tears of the conjoint tendon are occasionally encountered, an association with pelvic instability is evident in the majority of cases and our working hypothesis is summarised in Fig. 1. Repetitive athletic loading of the symphyseal disc leads to accelerated disc degeneration with consequent loss of disc turgor and reduced mechanical strength, eventually resulting in acquired pelvic instability. The unstable symphysis is then vulnerable to: (a) recurrent episodes of avulsive micro-fracturing along the osteochondral junction, which, in turn, produce the clinical and radiographic manifestations of 'osteitis pubis'; and (b) periosteal stripping injuries of the pubic ligaments and increased loading of the para-symphyseal tendon attachments, giving rise to various combinations of 'tendonitis' and tendon tears. Associated chronic 'dysfunction,' or, alternatively, a sudden tear, of the conjoint tendon then results in a 'sports hernia.'

Diagnostic tests

The imaging of chronic groin pain should always commence with a standing anterior-posterior (AP) plain radiograph (X-ray) of the pelvis (Fig. 2) and flamingo ('stork') stress views of the symphysis pubis (Fig. 3). These are an important complement to the interpretation of other radiological tests and provide an essential preliminary screen for osteitis pubis, limb length discrepancy, pelvic instability, hip joint pathology, stress fractures and, rarely, other unsuspected bone lesions. Flamingo stress views are positive if ≥2 mm motion is demonstrated across the symphysis pubis, identifying anterior pelvic structural instability or 'macro-instability.' However, it should be also be appreciated that some patients will have <2 mm motion at the symphysis at a stage when functional instability is actually present, but the passive system of anterior pelvic stability remains intact; this situation may, therefore, also be thought of as pelvic 'micro-instability.'

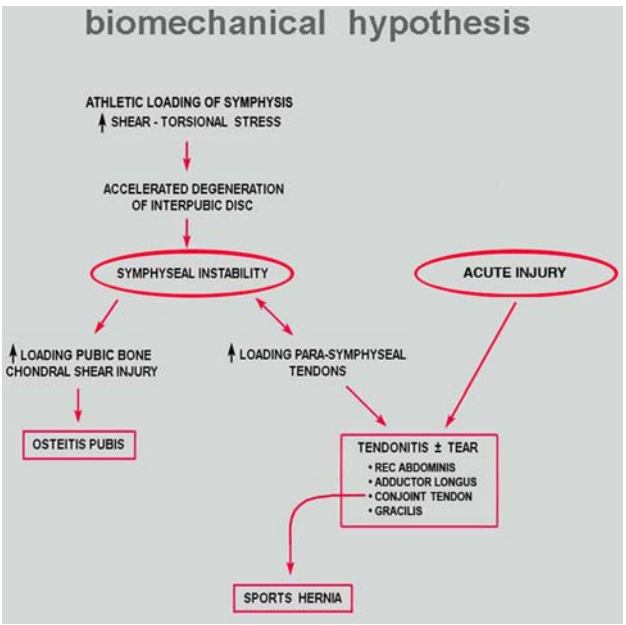

Fig. 1 Suggested pathophysiology of sports hernia

Fig. 2 Standing anterior-posterior (AP) view of pelvis in a case of pelvic instability. There is slight malalignment and moderate degenerative change at the symphysis pubis. Also note pelvic tilt indicative of significant leg length discrepancy

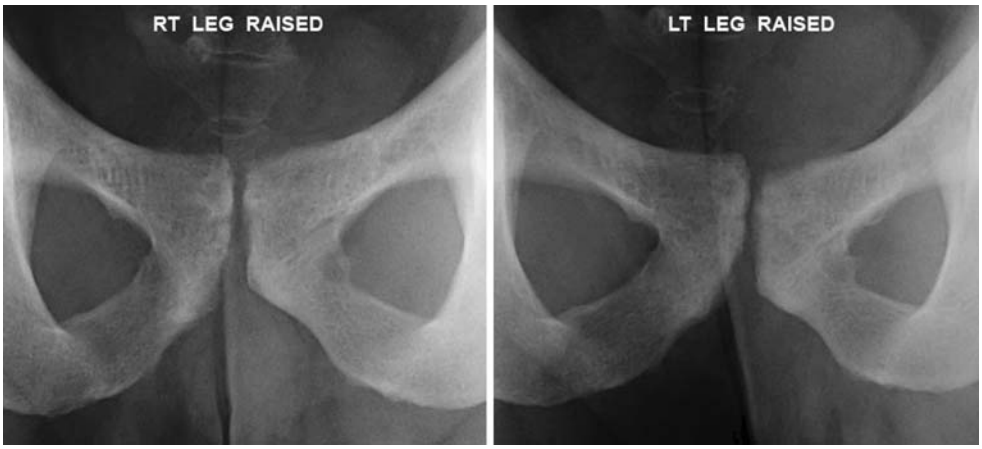

Fig. 3 Flamingo stress views of the symphysis pubis. Symphyseal displacement of 2 mm or more, as shown here, indicates pelvic macro-instability. Also note degenerative changes with cortical irregularity and a subchondral cyst superiorly on the *right*

The mild posterior inguinal wall protrusion which has been called a sports hernia is a dynamic phenomenon that, in most patients, can only be appreciated as the abdominal wall is actively strained (e.g. during a 'half sit-up'). This mild hernial bulge can be demonstrated by real-time ultrasound (Fig. 4), multi-detector computed tomography (CT) scanning performed as the patient actively strains (Fig. 5), fast single-shot magnetic resonance imaging (MRI) acquired while the patient actively strains or intra-peritoneal contrast herniography following an injection of iodinated contrast material. Of these, we prefer ultrasound because this test is non-invasive, avoids exposure to ionising radiation and provides good assessment of the conjoint tendon (which is poorly resolved and assessed by both MRI and CT). It must be appreciated that mild bulges of the posterior inguinal wall are common lesions that are often asymptomatic [19]. The diagnosis of a 'sports hernia,' therefore, cannot be made on the basis of this imaging finding alone; other concordant clinical and imaging findings must also be present. Importantly, a significant (i.e. symptomatic) hernial bulge almost always has an accompanying demonstrable conjoint tendon abnormality, usually with associated tenderness (Fig. 6). The presence of *bilateral* hernial bulges, even when the symptoms are unilateral, also increases the likelihood of a clinically relevant finding [20]. On the other hand, the absence of a hernial bulge on ultrasound may effectively exclude the diagnosis of sports hernia.

If clinical doubt remains concerning the presence of osteitis pubis, either MRI or nuclear bone scanning (Fig. 7) may be performed for clarification.

Other diagnostic tests which may be occasionally used include: (a) long-leg X-ray or CT topogram for the accurate measurement of limb length (Fig. 8); (b) test injections of corticosteroid and local anaesthetic to determine whether any abnormalities detected at the hip joint, iliopsoas bursa, conjoint tendon or symphysis pubis are clinically relevant;

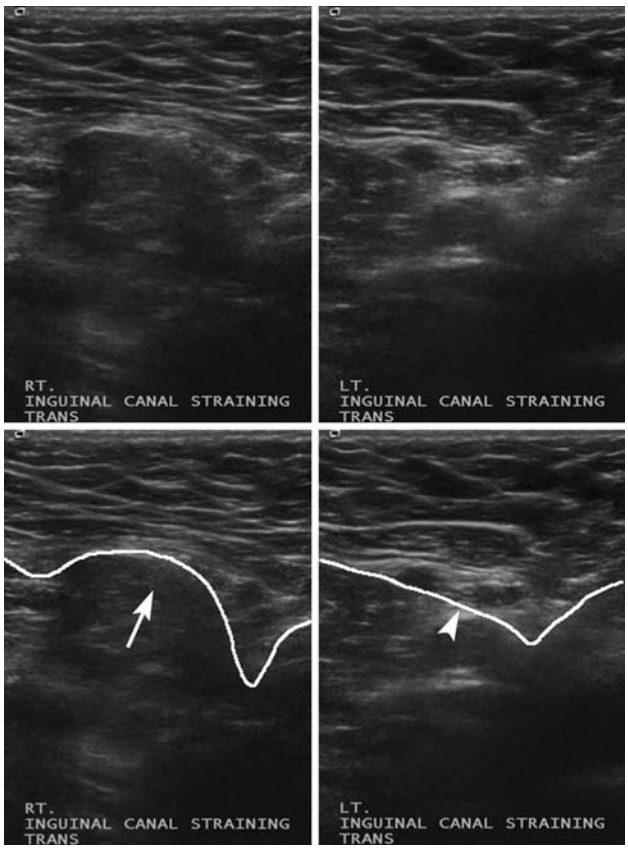

Fig. 4 Ultrasound of right-sided sports hernia. The imaging plane is transverse to the long axis of the inguinal canal, with the patient's head to the left of the image. The assessment is performed in real-time as the patient strains (e.g. during a shallow sit-up or when asked to 'tense' the abdominal muscles). The contour of each posterior inguinal wall is indicated by a superimposed *white line*. The sports hernia is appreciated as a mild anterior bulge of the posterior inguinal wall on the right side of the patient (*arrow*). The normal left posterior inguinal wall is straight (*arrowhead*). A video clip showing the real-time dynamics of sports hernia can be found on YouTube (searching under 'sports hernia') or at the author's website (http://www.sportsmedicineimaging.com)

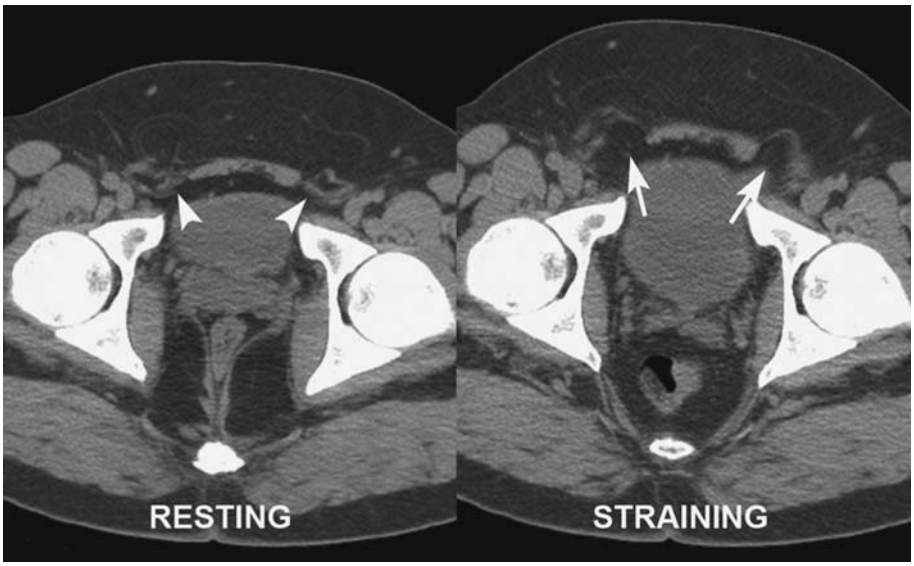

Fig. 5 Non-contrast axial computed tomography (CT) images show normal posterior inguinal wall contours at rest (*arrowheads*) but anterior bulge of both posterior inguinal walls on straining typical of bilateral incipient direct inguinal hernia (*arrows*)

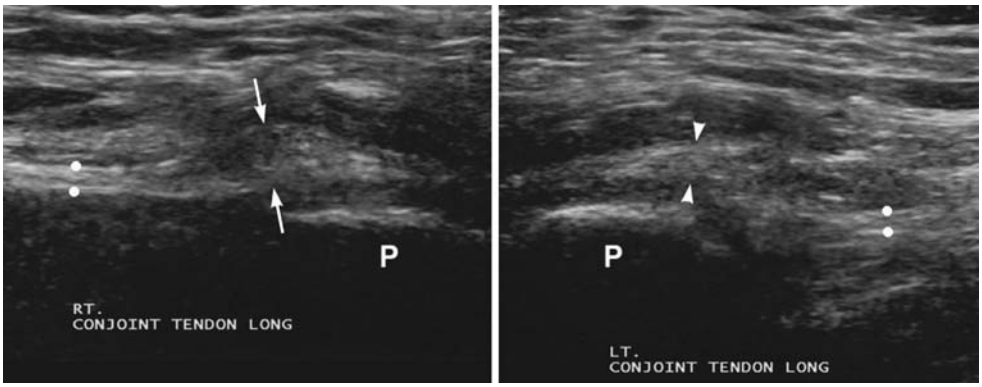

Fig. 6 Ultrasound of a patient with sports hernia and accompanying conjoint 'tendonitis' on the symptomatic right side. Comparison long-axis views of each conjoint tendon have been obtained. A short segment of tender hypoechoic conjoint tendon thickening was appreciated (*arrows*). For the sake of clarity, this is an unusually marked example. The *arrowheads* indicate normal left conjoint tendon at an equivalent level; the *white dots* indicate conjoint tendon segments laterally; *P* = pubic crest

and (c) nerve conduction studies to confirm obturator nerve entrapment.

As the differential diagnosis for chronic groin pain in athletes is wide, causes other than sports hernia must also be considered. A thorough clinical examination and appropriate imaging screen is, therefore, warranted. One relatively common cause for groin pain in athletes is *hip joint pathology* [21]. Hip problems including acetabular labral tears can arise from trauma, femoro-acetabular impingement, developmental dysplasia or other causes (e.g. previous slipped capital femoral epiphysis [SCFE] or Perthes' disease). It is important to understand that the hip can be a source of diagnostic confusion, as it is not uncommon for an athlete to have *co-existing* hip joint pathology and sports hernia/groin disruption. This association may be explained by the increased mechanical loading on the symphysis that results from reduced range of hip motion [22].

Prevention

The cornerstones of groin injury prevention are the detection of at-risk players, minimisation of known risk factors and the monitoring of individual training load. Based on the research findings discussed above, it is logical to suggest that screening should include isometric and isokinetic strength and range of motion testing of the hips. The assessment of muscle balance, motor control and flexibility may be important in preventing groin injury. The pre-season profiling of key strength, core stability and flexibility tests may be used as indicators of impending overload. The development of a strong and well-controlled single-leg stance, along with motor challenges for rotational control of the pelvis, may be important in preventing overload on structures around the pelvis. Players with a previous history of groin pain should be closely monitored. Structural

Fig. 7 Nuclear bone scan of athletic osteitis pubis. Note asymmetrically increased radiotracer uptake at the right pubic bone. Pelvic tilt is present. Image reproduced with permission: Atlas of Imaging in Sports Medicine, 2nd edition, McGraw-Hill, 1998

Fig. 8 A standing long-leg plain X-ray demonstrates lower extremity length discrepancy. The right lower limb is almost 5 mm shorter than the left

variations that are detected, such as significant limb length inequality, may require specific orthotics made with a permanent heel-raise for use in all forms of footwear.

Surgery

In view of the underlying aetiology of sports hernia, the primary aim of treatment is to restore anterior pelvic stability by strengthening the chronically disrupted and/or weakened tendon 'envelope' formed by the continuous mechanical linkage of conjoint tendon, pubic aponeurosis and adductor longus origin [23]. An anterior surgical approach rather than a laparoscopic extraperitoneal technique is, therefore, preferred.

The repair operation is known as a groin reconstruction and consists of a tension-free tissue hernia repair by the Maloney darn technique, repair of the conjoint tendon on the crest of the pubic bone with 4x #1 inverting Prolene sutures (Hyde technique) (personal communication), partial release of the adductor longus tendon from the pubic bone by transverse adductor tenotomy and release of the obturator nerve by incising the deep fascial layer between the pectineus and adductor brevis with Pott's angled scissors. Surgical pubic bone stabilisation is rarely needed because core stabilisation exercises are usually sufficient to maintain pubic alignment after the soft tissue reconstruction has been completed.

Rehabilitation

The principles of rehabilitation are essentially to:

- Minimise pre-existing risk factors and compensatory strategies;
- Implement core stabilisation exercises; and
- Maintain good motor control and strength around the pelvis, particularly in single-leg stance.

Safe progression through the various stages of the rehabilitation programme requires the monitoring of objective measures such as the adductor squeeze test and hip flexibility. Pubic symphysis shear tests have been developed to guide the initiation and progression of running [24] and have proven to be more reliable than pubic bone palpation. Clinical outcome measures are used to guide rehabilitation and exercise is encouraged to the point of pain tolerance with modification of activity according to clinical indicators.

Core exercises commence with static contraction of the deep core muscles and an initial emphasis on correct activation [17]. These exercises are progressed by adding in limb movements in stable positions and, subsequently, more

unstable positions, progressing to more functional positions and incorporating external perturbation and distraction. Particular attention is given to the development of a strong single-leg stance, progressing to added external load via band or cable. Eventually, the player is progressed into functional and then dynamic positions, utilising controlled lateral movement and then skating on a slide board. Particular emphasis is given to adductor strengthening [14, 25–27].

Functional strength training follows a pattern of bilateral squat to single-leg squat and lunge, adding direction to the lunge in the final stages. Active programmes concentrating on the restoration of optimal hip and abdominal muscle ratios, power and coordination achieve superior outcomes [11, 28] and dynamic stabilisation of the pelvic ring is the central goal [26, 29].

Muscle stretching is performed with an active component, and flexibility and joint range of motion in the hips and lumbar spine is expected to be optimal prior to return to sport. Clinical criteria control the return of the athlete to running and there should be a pain-free and strong squeeze test, minimal adductor guarding, pain-free pubic symphysis shear test into extension and pain-free brisk walking before running [29]. The player may start with a walk/run pattern every 2 days and build gradually under supervision. The player is monitored very closely, with any adverse response resulting in 2 days of rest and the programme recommenced by returning to the previous level of activity. Running is then progressed into straight-line speed, changing direction and then accelerative drills. Finally, kicking and other power activities involving direction and speed are added, followed by sports-specific drills and training. Rehabilitation takes about 3 months after surgery [30] and is divided stepwise into fortnightly segments.

Discussion

There are several excellent review articles available on sports hernia, the most recent being Morales-Conde [31], and the following points are agreed:

- Chronic athletic groin pain is a major diagnostic and therapeutic challenge.
- A precise diagnosis is always preferable before operation.
- Operation should only be undertaken if conservative therapy fails.
- Operative treatment can return the player to his/her sport within three months.
- Surgery achieves pain-free return to full activities in the majority of cases.
- Physical rehabilitation after surgery is imperative and a 3-month post-operative protocol in a 2-week staged format is generally required.
- Conservative treatment of sports hernia does not often succeed.
- A multi-disciplinary approach to diagnosis and treatment is needed.

However, there are some points that are not agreed upon. We would argue that:

- Sports hernia is not a clinical diagnosis *of exclusion* but, rather, a specific injury that can be reliably diagnosed using a combination of history, physical examination and imaging investigation.
- Contrast herniography is both unnecessary for the detection of clinically occult hernias and is inappropriately invasive in view of the ready availability of other non-invasive methods, such as ultrasound, CT and MRI.

Controversy exists as to whether sports hernia is a true hernia or whether it is simply a ‘weakness’ of the posterior inguinal canal wall. In our view, this entity of mild or incipient bulge through the posterior inguinal wall satisfies the definition of a true hernia; that is, “the protrusion of a viscus, or part of a viscus, beyond the confines of its containing cavity” [32].

Further controversy exists as to the cause of pain in sports hernia. Although various theories have been proposed, the most plausible being pubic bone stress reaction, our belief after 15 years of experience with correlative real-time ultrasound is that the hernia itself may be less significant than the underlying conjoint tendon pathology, which can almost always be documented by ultrasound (Fig. 6) and is the more likely source of symptoms. This observation would also account for the common physical finding in sports hernia of localised tenderness in the same region.

One English surgeon with an experience of over 1,700 cases believes that there is a ‘classical’ group of sports hernia patients with posterior inguinal wall defects who get better after surgical reconstruction and an ‘atypical’ (i.e. difficult to treat) group who have other pathologies, including acetabular labral tears of the hip (M. Scott, personal communication). We believe that the ‘atypical’ group can be further subdivided into two broad categories: (a) athletes who actually have other causes for groin pain, such as acetabular labral tears, but, nevertheless, also exhibit co-incidental symptomatic *or* asymptomatic posterior inguinal wall bulges; and (b) athletes who actually have a severe ‘groin disruption injury’ with gross underlying pelvic instability that is refractory to standard surgery and physical therapy alone.

‘Pelvic stability’ is a complex entity which is defined as the ability of the pelvis to effectively transfer loads through

the joints [33]. Stability may be viewed as the interdependent outcome of a neural control system, an active myofascial system and a passive osteoarticular-ligamentous system [34]. Thus, stability has both 'functional' (referring to the active and neural systems) and 'structural' (referring to the passive system) aspects. Pelvic instability is defined as failure of this system.

Finally, what can we do about sports hernia?

1. Recognise that the condition exists;
2. Find an experienced and interested radiologist who is capable of performing or willing to learn the imaging technique most appropriate for local resources;
3. Treat functional pelvic instability with the help of an experienced specialised sports physiotherapist and limb length discrepancy with the help of a sports podiatrist;
4. Employ an appropriate surgical technique that works for your patients;
5. Take great care to operate only on established cases with objectively documented imaging findings and persisting groin pain, despite 3–6 months of physiotherapy with a specialised groin physiotherapist.

Summary

Sports hernia is a real entity that usually indicates a more severe underlying condition known as groin disruption injury. The underlying aetiology is believed to be pelvic instability. Diagnosis is dependent upon concordance between the patient history, physical examination and imaging findings (especially plain X-ray and ultrasound). None of these parameters are reliable in isolation and sound clinical judgement is required to bring the overall picture into perspective. A period of conservative physical therapy is mandatory and reconstructive surgery is indicated only if 3–6 months of specialist groin pain physiotherapy has failed. After surgery, an on-going minimum 3-month programme of post-operative core-strengthening physiotherapy is implemented to maintain pelvic stability and restore function.

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