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ORIGINAL ARTICLE

# Sports hernia or groin disruption injury? Chronic athletic groin pain: a retrospective study of 100 patients with long-term follow-up

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**Abstract**
*Introduction and objectives* Chronic groin pain (athletic pubalgia) is a common problem in sports such as football, hockey, cricket, baseball and athletics. Multiple co-existing pathologies are often present which commonly include posterior inguinal canal wall deficiency, conjoint tendinopathy, adductor tendinopathy, osteitis pubis and peripheral nerve entrapment. The mechanism of injury remains unclear but sports that involve either pivoting on a single leg (e.g. kicking) or a sudden change in direction at speed are most often associated with athletic pubalgia. These manoeuvres place large forces across the bony pelvis and its soft tissue supports, accounting for the usual clinical presentation of multiple symptomatic abnormalities forming one pattern of injury.
*Results* The diagnoses encountered in this series of 100 patients included rectus abdominis muscle atrophy/asymmetry (22), conjoint tendinopathy (16), sports (occult, incipient) hernia (16), groin disruption injury (16), classical hernia (11) traumatic osteitis pubis (5), and avulsion fracture of the pubic bone (4). Surgical management was generally undertaken only after failed conservative therapy of 3–6 months, but some professionals who have physiotherapy during the football season went directly to surgery at the end of the football season. A variety of operations were performed including groin reconstruction (15), open hernia repair with or without mesh (11), sports hernia repair (Gilmore) (7) laparoscopic repair (3), conjoint tendon repair (3) and adductor tenotomy (3). Sixty-six patients were available for follow at an average of 13 years after initial consultation and the combined success rate for both conservative treatment and surgery was 94 %.
*Conclusion* The authors believe that athletic pubalgia or sports hernia should be considered as a 'groin disruption injury', the result of functional instability of the pelvis. The surgical approach is aimed at strengthening the anterior pelvic soft tissues that support and stabilise the symphysis pubis.

**Keywords** Sports hernia · Conjoint tendinopathy · Adductor tendinopathy · Osteitis pubis · Athletic pubalgia · Groin disruption injury

## Introduction

Chronic groin pain is one of the least understood and poorly explained conditions in clinical medicine. There is no consensus on nomenclature, duration, diagnosis, pathophysiology or management, yet it is a common diagnostic and management challenge for the Clinician and team Physician in sports such as football, hockey, cricket, athletics, basketball, etc. "Pubalgia" is defined by Orchard

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This research complies with the laws of the commonwealth of Australia.

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et al. [1] as chronic groin pain that presents with no obvious hernia, and no clear-cut cause arising from the structures in the pubic region. This pattern of injury includes sports (occult, incipient) hernia, conjoint tendon lesions, adductor tendinopathy, osteitis pubis and peripheral nerve entrapment. We regard sports hernia as a presentation of groin pain with an impalpable inguinal bulge demonstrated by diagnostic imaging (ultrasound or CT) as opposed to a "classical" hernia in which there is a palpable defect and a protrusion which increases with abdominal pressure and which is readily reducible.

In clinical practice, chronic groin pain is usually well localised, and tends to be focused on the pubic bone with radiation superiorly to the rectus abdominis insertion and inferiorly to the adductor longus insertion. The site of pain is typically provoked by athletic activities of kicking, sprinting and changing direction, and the symptoms improve after resting. But chronic groin pain recurs if vigorous activity is resumed. Physical examination reveals tenderness and pain over the pubic crest on resisted sit-up (abdominal "crunch test"). There may be pain and tenderness at the superficial inguinal ring, but a visible and palpable lump indicating classical inguinal hernia is absent in sports hernia. Decreased range of hip joint motion may be elicited, and decreased range of internal rotation is a frequent finding. There is no consensus on the significance of either clinical or the radiological imaging findings of pubic structures in athletes with groin pain. This diverse group is the subject of this research.

We reviewed our first 10 years experience in managing chronic groin pain between 1990 and 1999 focussing on the types of pathology encountered, and the implications for diagnosis and management and have observed a fairly consistent pattern of multiple concurrent injuries in cases of chronic athletic pubalgia. These include the sports (occult, incipient) hernia, conjoint tendon lesions, adductor tendon lesions, osteitis pubis and various peripheral nerve irritations. The objective evidential base supporting the concept of sports hernia and groin disruption injury is primarily radiological utilising a variety of imaging modalities including plain X-ray, computed tomography (CT), ultrasound (US) and magnetic resonance imaging (MRI).

## Materials and methods

### Patient entry

This is an uncontrolled surgical case series and the publication of this research is approved by the Medical Advisory Board of Sydney Private Hospital. In the period between 1990 and 1999, 100 consecutive patients including professional or amateur athletes and injured workers presenting with undiagnosed chronic groin or lower abdominal pain, with either negative or equivocal physical examination findings, were assessed by various diagnostic images. The average time to presentation was not recorded. Forty-three patients have previously been reported in a study of occult groin hernia [2]. This study group also included some sports people with a clinically obvious hernia and some patients who had undergone a previous open or laparoscopic repair. Several patients had previously undergone a local anaesthetic/corticosteroid test injection into the area of pain but the actual number is not known. Many patients who were referred had prior MRI or ultrasound examinations that were either negative inconclusive or unreliable, so management decisions were based on the current physical examination and diagnostic imaging findings. Follow-up was mainly carried out by questionnaire to the patient or referrer, and/or telephone enquiry, email, social media and physical examination when requested.

The imaging investigations used were initially obtained without using any consistent examination protocol (typical outpatient referral practice). Until a reliable diagnostic pathway evolved, diagnostic tests could variously include plain radiographs, ultrasound, CT, MRI. Electromyography (EMG), contrast herniography and isotope bone scan were occasionally utilised.

#### *X-ray*

Radiographs included a standing anterior–posterior (AP) view of the pelvis and flamingo stress views of the symphysis pubis. Flamingo stress views were considered positive if $\geq$2 mm vertical displacement across the symphysis pubis could be demonstrated.

#### *Ultrasound*

Real-time ultrasound was used to (1) assess the conjoint tendons for size, integrity, echotexture and tenderness; (2) detect conjoint tendon dysfunction appreciated as protrusion of the posterior inguinal canal wall when actively straining (e.g. during a 'half sit-up'); (3) assess the symphysis pubis for irregularity and tenderness; and (4) assess the adductor longus origins for size, integrity, echotexture and tenderness.

#### *CT*

Dynamic helical non-contrast scans were obtained both resting and straining, usually with the patient supine (and occasionally prone). Straining and non-straining views were compared to determine if any abnormal movement of abdominal contents occurred through a hernial orifice.

*MRI*

Non-contrast 1.5T scans were centred on the symphysis pubis using a phased-array surface coil, multiple imaging planes, and a variable combination of (1) non-fat-suppressed T1 and/or PD-weighted, and (2) fat-suppressed fluid-sensitive sequences (STIR or fat-suppressed PD).

*Herniography*

Herniography was initially considered to be a useful test for classical hernia, but the false positive and false negative rate due to occlusion of a hernia sac by a plug of omentum or extra-peritoneal fat, and vaso-vagal reaction to the injected contrast material, led us away from this modality in favour of the non-invasive groin ultrasound. US has been shown to provide similar information to herniography using a non-invasive technique [3], [4].

Analysis

All patients were recruited prospectively, but the analysis was performed retrospectively, and the surgical findings were compared with the original diagnostic imaging and the long-term clinical outcomes.

## Results

100 patients, predominantly football players and athletes with undiagnosed groin or lower abdominal pain were studied, and the age range was 11–74 with a mean age of 33 years for males and 32 for females. There were 92 males and 8 females (male to female ratio 11:1). The clinical outcomes were assessed up to 10 years and beyond.

Presenting symptoms

The majority of patients presented with groin or lower abdominal pain, discomfort or aching; radiation to the testicular or perineal area was also a frequent complaint. Testicular pain, intermittent groin swelling, bilateral groin pain, suprapubic pain or discomfort and suspected muscle tear were less frequent presentations.

Patterns of injury (Table 1)

The most frequently encountered injuries included radiological rectus abdominis muscle atrophy/asymmetry (22), conjoint tendinopathy (16), sports hernia (16), groin disruption injury (16), classical inguinal hernia (11), traumatic osteitis pubis (3), adductor tendinopathy (3) and avulsion fracture of the pubic bone ("flake fracture") (4). Rectus abdominis syndrome (4) is a chronic pain syndrome the result of entrapment of anterior cutaneous branch of a lower intercostal nerve at the level of the rectus abdominis muscle fascial sheath which responds to local anaesthetic "trigger point" injection [5].

**Table 1** Predominant clinical and radiological findings in 100 patients presenting with chronic groin pain between 1990 and 1999

| | |
|---|---|
| Rectus abdominis muscle atrophy | 22 |
| Sports hernia (including bilateral 8) | 16 |
| Conjoint tendinopathy | 16 |
| Groin disruption injury (bilateral 2) | 16 |
| Classical hernia (bilateral 3, indirect 3, direct 2, spigelian 2, pantaloon 1) | 11 |
| Adductor tendinopathy | 5 |
| Rectus abdominis syndrome | 4 |
| Avulsion ("flake") fracture of pubic bone | 4 |
| Traumatic osteitis pubis | 3 |
| Neuralgia | 2 |
| Hip degeneration | 1 |
| Total | 100 |

**Table 2** Range of other pathologies co-existing in patients with sports hernia

| | |
|---|---|
| Rectus muscle atrophy/asymmetry | 8 |
| Traumatic osteitis pubis (± traction spur) | 6 |
| Asymptomatic contralateral Sports hernia | 5 |
| Avulsion fracture of pubic bone | 4 |
| Linea semilunaris tear | 2 |
| Lipoma of spermatic cord | 3 |
| Conjoint tendinopathy | 3 |
| Neuralgia | 1 |
| Hip degenerative change | 1 |
| Pelvic tilt | 1 |
| Total | 34 |

Other co-existing pathologies for sports hernia (Table 2)

Sports hernia occurred in 16 patients and in another 16 patients with GDI and in 1 patient each with osteoarthritis of hip joint and pelvic instability (34). Sports hernia co-existed with diagnostic imaging findings of rectus muscle wasting/asymmetry (8), traumatic osteitis pubis (6), contralateral asymptomatic sports hernia (5), avulsion fracture of the pubic bone (4) and conjoint tendinopathy (3) lipoma of spermatic cord (3) and linea semilunaris tear (2).

Management (Fig. 1)

55 patients were managed conservatively, the majority having muscle, tendon or bone injuries. Groin disruption

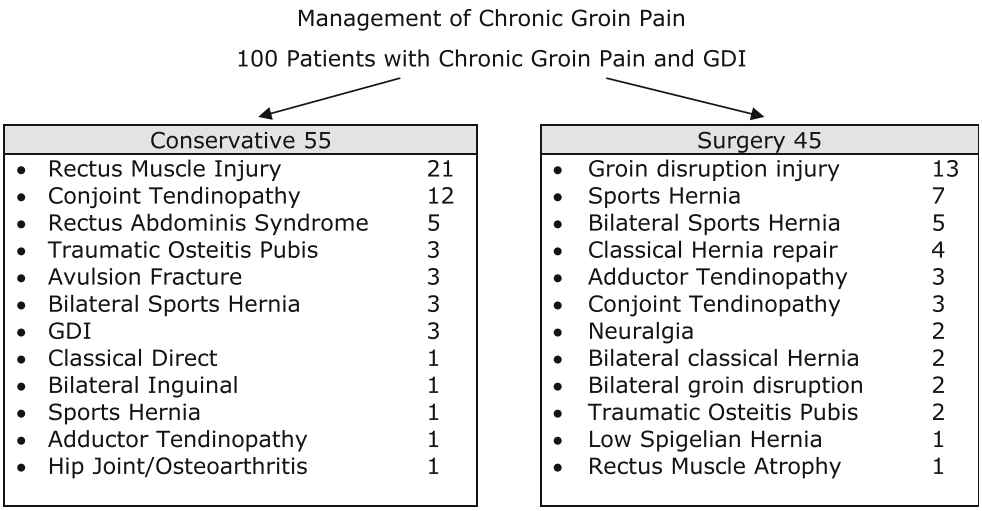


**Fig. 1** Approach to management of patients with chronic groin pain

**Table 3** Surgical procedures undertaken in 45 patients surgically managed with chronic groin pain

| | |
|---|---|
| Groin reconstruction (bilateral 2, +nerve release 4) | 15 |
| Classical hernia repair(mesh/darn 6, bilateral 4, ventral 1) | 11 |
| Sports hernia repair (bilateral 4) | 7 |
| Laparoscopic repair | 3 |
| Adductor tenotomy | 3 |
| Conjoint tendon repair | 2 |
| Neurolysis | 2 |
| Groin exploration | 1 |
| Mesh explantation | 1 |
| Total | 45 |

injury (GDI) was managed conservatively in three patients who decided not to have groin reconstruction surgery for personal reasons, but the majority were managed surgically by groin reconstruction consisting of sports hernia repair, conjoint tendon repair adductor tenotomy and peripheral nerve release [6].

### Surgical procedures (Table 3)

Forty five patients proceeded to surgery after a period of physiotherapy usually lasting 3–6 months and the remainder were managed conservatively by rest, physiotherapy, non-steroidal anti-inflammatory medications (NSAIDs), local anaesthetic injections, provided the physical signs and/or symptoms were not suggestive of operative surgical pathology (Fig. 1). Four patients with classical hernias were treated by early surgery without undergoing pre-operative physiotherapy.

The surgical procedures performed included groin reconstruction (15), classical (open) hernia repair (11), sports hernia repair (Gilmore, OJA personal communication) (7), laparoscopic repair (3), adductor tenotomy (3), conjoint tendon repair (3), neurolysis (2), groin exploration (1) and mesh explantation (1).

Those patients who satisfied the criteria for the pattern of groin disruption injury i.e. sports hernia, conjoint tendinopathy and adductor tendinopathy underwent full groin reconstruction (15), but those who suffered limited disruption underwent isolated sports hernia repair (7), adductor tenotomy (3) and conjoint tendon repair (3). Surgical groin exploration was undertaken for 4 patients who satisfied none of the criteria for groin disruption or classical hernia.

### Complications

Complications were infrequent (5 %) but included neuropraxia (1) which resolved once a staple holding the hernia mesh impinging on the ilio-hypogastric nerve was removed 7 days later, neuralgia due to scar tissue (1), and wound infection (an instance of *S. aureus* wound infection which resolved with antibiotics as an outpatient). One patient after low Spigelian hernia repair was re-admitted to hospital with unexplained pain in the region of deep inguinal ring, but settled spontaneously and was discharged 3 days later. Two patients suffered recurrent adductor tendinopathy and underwent a revision tenotomy.

## Outcome

Sixty-six patients were available for follow-up (66 %) at an average of 13 years post-operatively (range 1–22 years). Using the criterion of return to pre-injury level of sporting or work activities as the end point for both surgical and conservatively treated patients, 34 of 36 surgical patients were treated successfully. Two patients underwent re-tenotomy of the adductor longus insertion 6 months and

7 years later, respectively, due to re-growth of scar tissue and painful pseudotendon formation.

In the conservative group, 28 of 30 were managed successfully by a combination of rest, physiotherapy and local anaesthetic/corticosteroid injections, although one patient re-injured himself 9 years later (but did not require intervention). One player with untreated bilateral sports hernia played on and finished off his career some years later with ongoing discomfort, and another player managed conservatively with an avulsion injury of the pubic bone ("flake fracture") indicated that his groin was "sore" in cold weather. The combined overall successful outcome rate was 94 %.

## Discussion

Chronic athletic groin pain (athletic pubalgia) is one of the least understood and poorly explained injuries in general surgery and orthopaedics. There is no consensus on diagnosis, pathophysiology or management [7]. Yet in most football codes around the world, this is a common problem that can be career-limiting or career-ending for a player and remains a serious clinical challenge for the sports physician and treating surgeon. Within any one football team, there can be two or three players per season carrying a groin injury and potentially needing surgery. Known risk factors for athletic pubalgia include pelvic instability, adductor muscle imbalance, reduced hip joint range of motion, delayed core stability and previous groin injury.

### Imaging investigations

Frequent investigations used included 'functional' plain radiographs of the pelvis [an erect anterior–posterior (AP) view of whole pelvis supplemented with flamingo stress views of symphysis pubis], ultrasound and occasionally MRI. Plain radiography of the pelvis provides an essential overview that helps detect malalignments, limb length discrepancy (and pelvic tilt), hip pathology, stress fractures, unexpected bone lesions, osteitis pubis and pelvic instability. Vertical displacement of >2 mm at the symphysis pubis on flamingo stress views indicates frank pelvic instability, but lesser degrees of displacement do not exclude pelvic dysfunction ("micro-instability").

Dynamic assessment of the inguinal canal with real-time ultrasound is now the preferred test for sports hernia [3]. An argument can be made that MRI should replace the more traditional CT and ultrasound scan for the routine imaging work-up, as it provides excellent overall anatomical detail, and is the best method at assessing the symphysis pubis for osteitis and capsular hip disruptions, provides superior demonstration of adductor origin tears, and avoids the unnecessary exposure to hazardous ionizing radiation in young patients. However, as MRI is less effective than ultrasound at diagnosing low-grade tendinopathy and cannot reliably diagnose a sports hernia, MRI cannot be used as a substitute for ultrasound. In practice, local factors such as cost and availability will most likely determine whether ultrasound or MRI is most appropriate to the management.

### Sports hernia

Although sports hernia was a common surgical finding in this series it cannot be reliably diagnosed without an experienced and appropriately trained ultrasound operator (Sonologist). Diagnosis requires the demonstration of dynamic bulge of the posterior inguinal wall on abdominal straining (Fig. 2). Sports hernia is always clinically occult, and does not produce a visible bulge or palpable cough impulse. The ultrasonographic bulge of the posterior inguinal canal wall is a consequence of underlying conjoint tendon dysfunction. The finding of a bulge alone, without groin pain or any demonstrable conjoint tendon lesion, can be found in 20 % of asymptomatic footballers [3], and was found in 16 % of patients in this series.

A bulging inguinal wall can also be imaged in a straining patient by dynamic CT [2] but this investigation does not always provide the additional conjoint tendon findings required to confirm the diagnosis of sports hernia [8]. At surgery, the most common abnormal finding is a 2-cm posterior inguinal canal wall deficiency medial to inferior epigastric artery. A split in the conjoint tendon is only seen in about 5–10 % of patients at surgery and even fewer cases by ultrasound (Fig. 3). At surgery, there is a dehiscence between the conjoint tendon and the inguinal ligament and there may be shredding of the External oblique muscle and widening of the superficial inguinal ring (Gilmore OJA [9]).

### Associated pathologies

A thorough literature review of chronic athletic groin pain by Orchard et al. [1] found that a majority of patients have concurrent symptoms in both the inguinal and adductor regions with accompanying tenderness that is localized to the pubic tubercle and adductor longus tendon origin. Orchard's review defined "athletic pubalgia" as chronic groin pain that persistently recurs with exertion in athletes who had no clinically obvious hernia and no other identifiable non-pubic cause for pain. The typical injury pattern of sports hernia involves "multiple co-existing pathologies", that can include conjoint insertion tendinopathy, adductor origin tendinopathy and traumatic osteitis pubis. Some patients exhibit concomitant signs or symptoms of

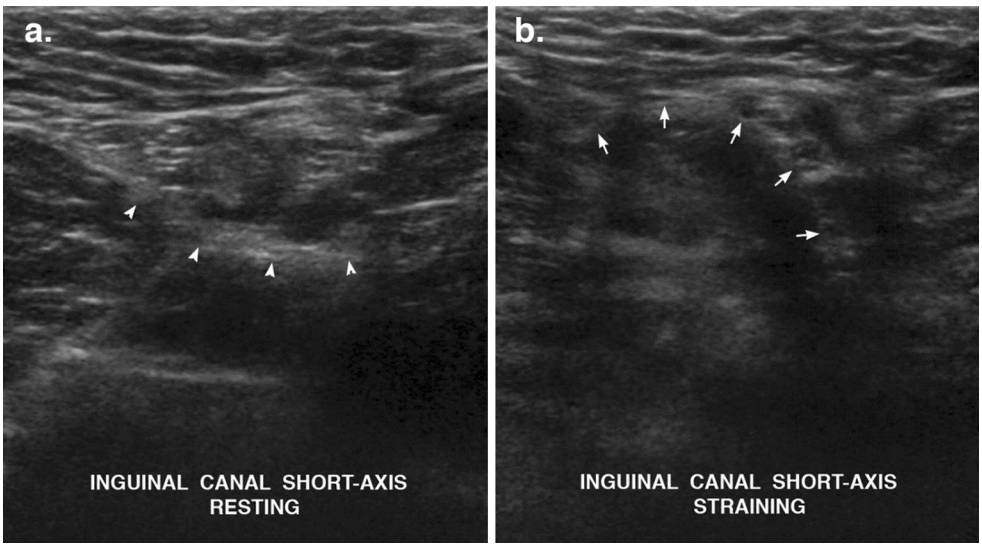


**Fig. 2** Sports hernia: Two separate cine frames from a dynamic short-axis ultrasound examination of inguinal canal show **a** the normal resting contour of posterior inguinal wall (*arrowheads*), and **b** the abnormal convex anterior bulge of incipient direct inguinal hernia (*arrows*)

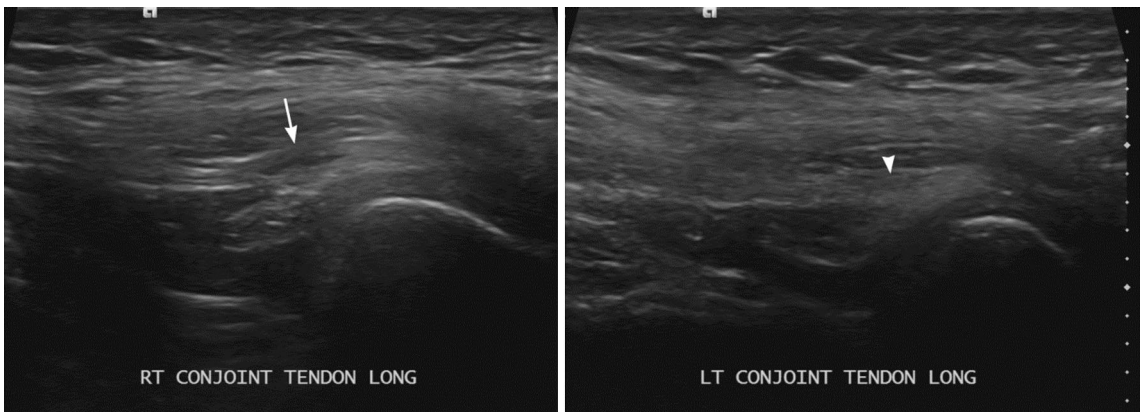


**Fig. 3** Right conjoint tendon tear: Long-axis ultrasound images show a hypoechoic line of intrasubstance tear involving the distal right conjoint tendon (*arrow*) compared with the normal left conjoint tendon (*arrowhead*)

peripheral nerve entrapment (which can variously involve obturator, ilio-inguinal, genitofemoral, and lateral femoral cutaneous nerves). Concurrent hip pathology may be present, with painful restricted range of internal rotation on physical examination and an incidence of acetabular labral tear on MRI of at least 12 % has been noted in our unpublished observations.

Rarely does a 'single diagnosis' explains the clinical features encountered in patients with chronic athletic pubalgia; instead, multiple co-existing pathologies have been reported in 27–95 % of cases [10–12]. Pelvic instability is considered to be the most likely unifying explanation. An unstable symphysis pubis might explain secondary mechanical overload of not only the pubic bone but also the adjacent conjoint tendon insertions and adductor origins implying the connection between conjoint tendinopathy and secondary dysfunction of the inguinal canal as the cause for a sports hernia. This hypothesis would further account for associated peripheral nerve 'entrapments' ('irritations') as a reaction to increased dynamic loading (or stretch) of nerves as the degree of unstable pelvic motion increases.

### *Conjoint tendinopathy*

Fredberg and Kissmeyer-Nielsen [13] have suggested that sports hernia does not constitute a credible explanation for chronic groin pain in athletes. Their arguments reject the concept of sports hernia, but in our experience posterior inguinal canal deficiency, can be imaged by at least two different modalities (US and CT scan) and is associated with the underlying pain generator of conjoint tendinopathy with or without tear and can be confirmed surgically. Abnormalities of the conjoint tendon at surgery consist of a

split in the horizontal fibres that insert onto the pubic bone, but Lovell and Malycha [14] took biopsies from the area and found no histological abnormalities. We believe that the high incidence of rectus abdominis muscle atrophy/asymmetry in this series is a reflection of conjoint tendon insertion injury.

*Adductor tendinopathy*

Adductor longus insertion tendinopathy (tendinosis, tendinitis) occurs either at the adductor longus insertion onto the body of the pubic bone or the confluence with the conjoint tendon and the pubic aponeurotic plate. In this series, adductor tendinopathy was a common co-existing diagnosis, and usually co-existed with sports hernia, conjoint tendinopathy, and traumatic osteitis pubis to complete a diagnosis of GDI. Isolated adductor tendinopathy occurred in 3 % of patients and recurred after surgery in 2. Following adductor tenotomy, a reduction in post-operative strength of the adductor longus has been described [15], but this does not result in any functional or sporting limitation in our experience. An anatomical study [16] has shown that the adductor longus tendon is longer anteriorly than posteriorly, and explains why a low adductor tenotomy can be performed releasing most of the anterior fibres of the adductor longus tendon, while keeping the majority of the musculotendinous fibres intact, thus minimising the loss of adduction strength after this surgical procedure. However, two of the complications in the surgical group involved recurrent adductor tendinopathy and the reason for this is unclear.

Avulsion fracture of the pubic bone (4 % incidence) indicates that the adductor longus tendon insertion is overstretched to the extent that it causes a flake of pubic bone to be pulled off the pubic bone, which is indicative of loss of elasticity due to chronic inflammation of the tendon.

*Traumatic osteitis pubis*

Osteitis pubis was a co-existing finding in 19 % of patients with sports hernia or GDI. Plain radiological findings may be absent in early or mild forms of this condition, but increased tracer uptake may be obtained in the delayed phase of a nuclear bone scan. When MRI is used for the diagnosis of chronic groin pain, there is a high correlation between para-symphyseal bone marrow oedema and chronic groin pain, and it has been suggested that bone pain may be the primary source of pubalgia (Verall GM, unpublished observations). A large differential diagnosis of possible co-existing pathologies with osteitis pubis includes sacro-iliac joint dysfunction, limitations in hip joint movement and Gracilis enthesopathy [17]. Reconstructive surgery usually resolves symptoms of osteitis pubis, but may take over 2 years to resolve radiologically. Corticosteroid injections have been suggested as a treatment for osteitis pubis [18] which would imply that a teno-periosteal component exists as part of the pathology of osteitis pubis, because bone stress itself would not be expected to respond well to corticosteroids.

*Peripheral nerve entrapment*

Isolated neuralgia occurred in 2 % of patients presenting with chronic groin pain. Although considerable variation exists in the distribution of peripheral nerves, ilio-inguinal nerve entrapment in a window of the External oblique aponeurosis as described by Gilmore [9], and obturator nerve entrapment as described by Bradshaw [19], are not uncommon findings and symptoms improve after these nerves have been released in our experience of four such patients (Table 3).

## Surgery

The actual source of pain of sports hernia remains uncertain and disputed. It seems probable that a minimal bulge of the posterior inguinal wall is insufficient explanation, particularly when asymptomatic bulges exist in 25 % of the adult population [20, 4]. Also, as there is still no consensus with regard to the pathogenesis of the condition, there is no clear guiding principle upon which an ideal surgical approach might be devised and tested by randomised control trial. Yet a variety of surgical procedures that essentially constitute inguinal hernia repair have been used to treat athletic pubalgia, most with moderate-to-good clinical outcomes. As a consequence, a wide range of operations varying from open to endoscopic procedures are being performed with no true science to support them [5]. Groin reconstruction involves repair of the posterior inguinal canal wall (herniorrhaphy), repair of the conjoint tendon and adductor longus tenotomy. Tenotomy achieves pain relief by de-tensioning a structure that would otherwise be painful under load. Although the other adductor muscles (adductors magnus, brevis and pectineus) preserve function and there does not appear to be any significant functional impairment, the loss of adductor strength created by tenotomy could contribute to an imbalance of forces acting across the symphysis pubis and notionally exacerbate the underlying problem of pelvic instability. Thus, despite this successful surgical procedure, the long-term advisability of adductor tenotomy remains questionable.

Patients with femoro-acetabular impingement and acetabular labral tears require collaboration with an orthopaedic hip specialist. Some of these patients will benefit from labral debridement (before any groin reconstruction is undertaken), but appropriate patient selection remains a

significant clinical challenge. Hip arthroscopy is an undertaking that is not without risk in a young patient population that already has a high background prevalence of asymptomatic labral tears. Diagnostic injections of local anaesthetic and corticosteroids into the hip joint are, therefore, mandatory before deciding to proceed with hip arthroscopy.

## Protocol of diagnosis and treatment

After becoming familiar with the problem of chronic groin pain, patients were subsequently managed with an examination checklist and a diagnostic and therapeutic algorithm (Fig. 4). If history and physical examination did not reveal a specific diagnosis, a diagnostic work-up with weight-bearing plain pelvic radiographs with flamingo views (contralateral leg raised) and groin ultrasound were performed. This was sometimes combined with an MRI of the pelvis. Any single pathological entity is treated definitively, but if multiple co-existing pathologies are detected consistent with groin disruption injury, physiotherapy is undertaken for 3–6 months. If physiotherapy is successful, permanent maintenance rehabilitation of core strength and stability and flexibility is encouraged. If physiotherapy is unsuccessful then groin reconstruction is performed. If diagnostic imaging is inconclusive, exploratory surgery is performed.

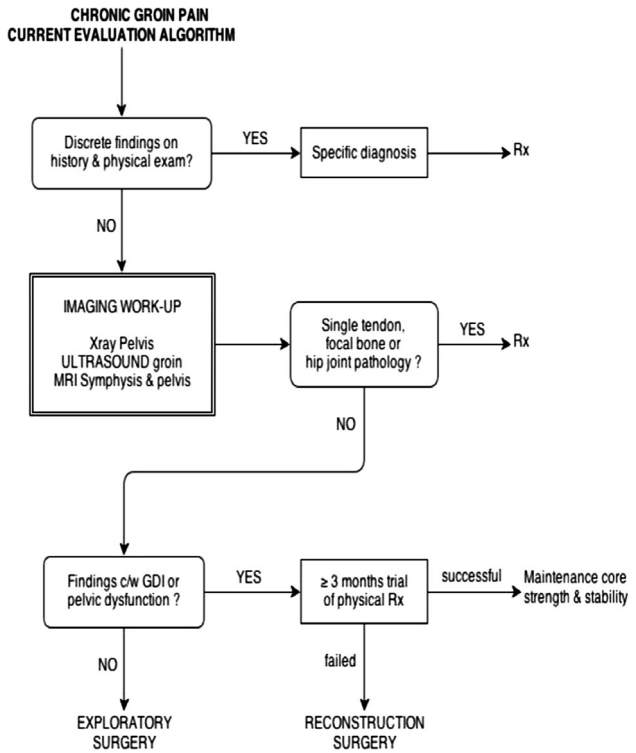


**Fig. 4** Algorithm used to manage patients with chronic groin pain

## Conclusion

Sports hernia, conjoint insertion tendinopathy, adductor origin tendinopathy, osteitis pubis and peripheral nerve entrapments are all frequent co-existing pathologies in a syndrome that might better be described as groin disruption injury (GDI) with the presumed common underlying aetiological factor being pelvic instability. Conservative management only has a role if no sports hernia is present on ultrasound and flamingo stress radiographs indicate a stable pelvis. If either sports hernia or frank pelvic instability is demonstrated, conservative management is likely to fail and the player will lose a substantial amount of game time by conservative treatment. The natural history of sports hernia is not evident from this series, but there is no objective evidence that sports hernia can be corrected by physiotherapy alone. Although not intended as a control group, the equal success of both conservative and surgical treatment in this unselected group emphasizes the need for a properly constructed randomized controlled trial of exercise medicine vs surgery.

Clinical, imaging and surgical studies provide substantial evidence that groin disruption injury exists as this pattern of pathological entities. The relative contribution of each of these entities to the symptom of pubalgia is inconclusive. It is not clear whether the sports hernia is a precursor to or a consequence of other groin or hip pathology. We recommend management that considers all the existing pathological process as one complex pattern of injury.

We recommend differentiating athletic pubalgia from non-pubic causes of chronic groin pain on history, physical examination and ultrasound, but if the pain is located in the pubic region, in the presence of a sonographically diagnosable hernia, then groin disruption injury can be diagnosed. Surgical management has a role in cases of failed conservative treatment, and a groin reconstruction is the preferred procedure.

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**Conflict of interest** None.

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