

Format for ANSWERING REVIEWERS

March 25, 2015



Dear Editor,

Please find enclosed the edited manuscript in Word format (file name: 15581-review.doc).

Title: Sports hernia and femoroacetabular impingement in athletes: A systematic review

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The manuscript has been improved according to the suggestions of reviewers:

1 Format has been updated

2 Revision has been made according to the suggestions of the reviewer

- (1) The title “Multidisciplinary approach and treatment of sports hernia” does not accurately reflect the major topic and content of the study.

The title was changed in: “Sports hernia and femoroacetabular impingement in athletes: A systematic review”

- (2) Introduction: The rationale of the study is not sufficiently explained.

The introduction was then rewritten. “Groin injuries are a common occurrence in elite-level athletes, representing up to 6% of all athletic injuries[1–5]. These injuries occur as a result of running, kicking, cutting movements, or explosive turns and changes in direction, and thus impact 10%–28% of male soccer players[6–8]. One type of groin injury, called sports hernia, has been reported in 50% of athletes with groin pain lasting longer than eight weeks[9]. The most common operative finding in sports hernia is deficiency of the posterior wall of the inguinal canal[10–12], which is a consequence of underlying conjoint tendon dysfunction. Thus, demonstration of a dynamic bulge of the posterior wall on abdominal straining is a criterion for diagnosis of sports hernia. Real-time ultrasound for dynamic evaluation of the inguinal canal is currently the preferred diagnostic technique and provides good assessment of the conjoint tendon[13–15]. A bulging inguinal wall can also be imaged by dynamic computed tomography (CT)[16], though magnetic resonance imaging is more useful for detecting musculotendinous disease, osteitis pubis, and hip pathologies.

Risk factors for sports hernia include muscle imbalance[17,18] and significant limb length discrepancy (>5 mm)[19]. In addition, labral tears, as well as decreased external and internal rotation of the hip joint may be related[20], which have been detected in pre-season soccer players[21–24], Gaelic football athletes[25], professional Australian Football League players[24], and athletes with chronic groin injury or osteitis pubis[26]. Garvey et al [13] found that half of the cases of sports hernia were associated with other conditions, including rectus abdominis wasting, osteitis pubis, conjoint tendinopathy, osteoarthritis, and neuralgia. Indeed, multiple co-existing pathologies have been reported in 27%–95% of cases of sports hernia[9,27–29], including adductor tendinosis[30] and adductor pain associated with either lower abdominal or inguinal pain[13]. Feeley et al [31] described the sports hip triad (labral tear, adductor strain, and rectus strain) as a common injury pattern in the elite athlete.

Femoroacetabular impingement (FAI) is a hip pathology where the bones of the hip are abnormally shaped. FAI reportedly occurs in a very high percentage of elite-level athletes examined for chronic groin and/or hip

pain[32–34]. This suggests that the presence of FAI may be a pre disposing factor for developing groin-related sports injuries or indicate a common underlying pathogenic mechanism. To more comprehensively investigate this, a systematic review was performed. Specifically, the prevalence of the concomitant presentation of FAI and sports hernias and their treatments were assessed.

- (3) Results: In the “Patophysiology” section, most of the presented data is only a hypothesis.

Yes most of them are hypothesis but a first confirmation was found by Birmingham et al[41] that analyzed the three-dimensional motion of the pubic symphysis in six fresh-frozen human cadaveric pelvises to compare native and simulated cam lesion hips. They found that rotational motion was significantly increased by cam-type lesions due to the repetitive loading of the symphysis. Obviously further studies are needed.

- (4) The discussion is not well organized and contains far more information than is necessary to make the necessary conclusions.

The discussion were reviewed as here reported: “A wide variety of terms are used throughout the literature to describe groin pain or pubalgia, making it difficult to obtain an accurate assessment of the association between sports hernia and FAI. However, the results of this review indicate that the conditions commonly co-occur, and treatment of the underlying morphologic abnormalities can impact the sports-related symptoms.

The majority of the patients with sports hernias complain of unilateral inguinal pain or lower abdominal pain, often radiating to the pubic tubercle and the inner thigh or across the midline. Although the pain can occur after a specific event, more often the onset is insidious with exacerbation of the symptoms by activity that persists for a day or two and is temporarily relieved with rest[14,54,55]. There may be pain and tenderness at the superficial inguinal ring, but without a visible or palpable lump indicative of a classical inguinal hernia. In patients with FAI, the groin pain is accompanied with pain at the greater trochanter, deep posterior buttock, and sacroiliac joint[56]. Whereas 50% of these patients reported an insidious onset, ~26% reported acute development of symptoms in the absence of a traumatic event. In the early stage, the pain is exacerbated with prolonged sitting or walking or with athletic activity; however, the pain becomes more constant with the progression of articular damage and osteoarthritic changes.

Upon physical examination, patients with FAI demonstrate pain with combined flexion, adduction, and internal rotation of the hip during the anterior impingement test[56–58], as well as during other tests of joint rotation[59]. These patients typically show restricted internal rotation and/or flexion in the hip range of motion, and restricted abduction or external rotation is also sometimes observed. Diagnosis of FAI is confirmed from radiographic exams showing an increased angle and/or signs of overcoverage or retroversion of the acetabulum (Figure 2)[57].

The additional stress from restricted rotation can lead to weakening or tearing of the transversalis fascia and surrounding tissues over time, resulting in tendon enthesitis of the adductor longus and/or abdominal muscles and groin pain[1,60,61]. This injury affects the external oblique aponeurosis, which can cause irritation of ilioinguinal or iliohypogastric nerves, as well as the conjoint tendon and inguinal ligament, resulting in weakness (deficiency) of the lower abdominal wall and occult hernias. Athletes performing rapid acceleration and deceleration movements and repetitive, high-speed twisting and cutting motions are especially vulnerable to these injuries[1,62].

Conservative treatment of sports hernias or FAI can be effective in a variable percentage of patients[63]. However, surgical treatment results in higher success rates, as demonstrated by Pajanen et al[48]. Moreover, Polglase et al[64] conducted a randomized clinical trial and found that appropriate repair of the posterior wall of the inguinal canal is superior to nonoperative management in athletes, effectively curing 60% of patients and providing improvement to an additional 20%. In a randomized study by Ekstrand et al[65], surgical treatment significantly reduced symptoms at six months compared to conservative treatment. For patients with FAI and sports hernias, surgical treatment of both pathologies appears to be the best option[40].

The surgical techniques performed to treat sports hernias are classified into three categories: open sutured repair, open mesh repair, and laparoscopic mesh repair by either transabdominal preperitoneal or extraperitoneal approaches. Sutured repairs are the most commonly performed operations for athletic pubalgia[66–69], with successful return to sport activities in 68%–100% of cases[5,30,60,67,70–76] and

arecovery time ranging from two to four weeks to three months[67,71,73,75,76]. The open anterior mesh repair technique is analogous to the Lichtenstein method of inguinal repair and is designed to reconstruct the posterior inguinal floor in a tension-free fashion. The reported success rate with this method is 77%–100%[77–81], allowing for a return to full activities within 3–4 months[78,81]. Open or arthroscopic treatment has also been successful for treatment of FAI in athletic patients[82–85]. In addition, Djocinovic et al[30] used a Shouldice technique and a iliolumbar nerve neurectomy and resection of the genital branch of the genitofemoral nerve in a patient with untreated FAI.

The results of the present review indicate that newer laparoscopic techniques are as effective or better for successfully treating sports injuries and allowing patients to return to full activities more quickly. Compared to open surgeries, the recovery time was on the order of weeks, rather than months, and with a recurrence rate of 0%. The results also suggest that athletes undergoing extraperitoneal repair do well in the postoperative period, even when a macroscopic abnormality is not detected, which is in keeping with the idea that strengthening the posterior wall relieves symptoms. There were few instances of recurrence with these techniques, however, most reports did not include a long-term follow-up.

- (5) There are many errors in this manuscript, the authors should check carefully and correct them.

The article achieved Grade A: priority publishing; no language polishing required after editing (provided by AmEditor)

- (6) The authors described that the purpose of this study is to realize a literature review about the association of the so-called sports hernia and the femoroacetabular impingement (FAI) in athletes. However, that association was described only in pathophysiology, and in other parts, sports hernia and FAI were only reviewed respectively.

The section *Prevalence* and *treatment* were reviewed. A table summarizing the association between FAI and sports hernia was provided.

Prevalence

The results of the systematic review demonstrate that the prevalence of FAI and the associated restricted internal rotation varies widely among cases of athletic-related groin pain[13,32,34–38] (Table 1). Whereas Meyers et al[35] found an overlap of athletic pubalgia and hip pathology in 27% of hockey players, Larson et al[39] reported that 90% of collegiate football players with hip and groin pain participating in a National Football League combine showed radiologic signs of cam- or pincer-type FAI. FAI was also found in patients with adductor tendinopathies, and Sansone et al[37] reported that, although most (75%) patients were satisfied with the results of tenotomy, the prevalence of FAI was greater in patients who were not satisfied when assessed after a median follow-up of six years.

Treatment

Laparoscopic mesh repair for the treatment of sports hernias can be performed using either a transabdominal preperitoneal or total extraperitoneal approach. Most studies demonstrate a >90% success rate with these treatments, with return to full activities within 1–3 months[10,42–51] (Table 2).

Only one case report and one retrospective case series reported on combined treatment of FAI and sports hernia. Matsuda[52] reported a case report regarding an endoscopic pubic symphysectomy in a case with bilateral FAI and recalcitrant osteitis pubis with high patient satisfaction, decreased pain, improved function, and resolution of the classic waddling gait at the 12-month follow-up. In a retrospective study of 31 patients, Larson et al[40] found that surgical management of both pathologies leads to a greater rate of return to full sporting activities compared with sports pubalgia surgery or hip arthroscopy alone after a mean follow-up of 2.9 months (89% vs 33%). In this study, whether the surgeries were performed concurrently, hip arthroscopy was performed first to avoid excessive stress placed on the pubalgia repair during positioning and traction for arthroscopy. There were no differences for return to sports or outcomes scoring for concurrent versus separate setting of hip arthroscopy and sports hernia surgery. However, hip arthroscopy alone was sufficient to resolve sports pubalgia symptoms in four patients. It was postulated that the improved hip range of motion and function after FAI correction reduced the stress on extra-articular pelvic structures, thus alleviating the symptoms.

The presence of multiple pathologies does not dictate treatment outcome. The importance of treating both pathologies to obtain good and stable results during time is confirmed in a study of Holmich et al[53],

which found that active treatment of adductor-related groin pain can be effective even in the presence of morphologic changes to the hip joint. However, clinical outcome decreased overtime in patients with angles $> 55^\circ$. A multidisciplinary approach is recommended, such as one involving orthopedic and general surgeons, to detect the presence of both pathologies in order to provide optimal treatment (Figure 1).

Table 1 Prevalence of femoroacetabular impingement in patients with sports hernia and groin disruption

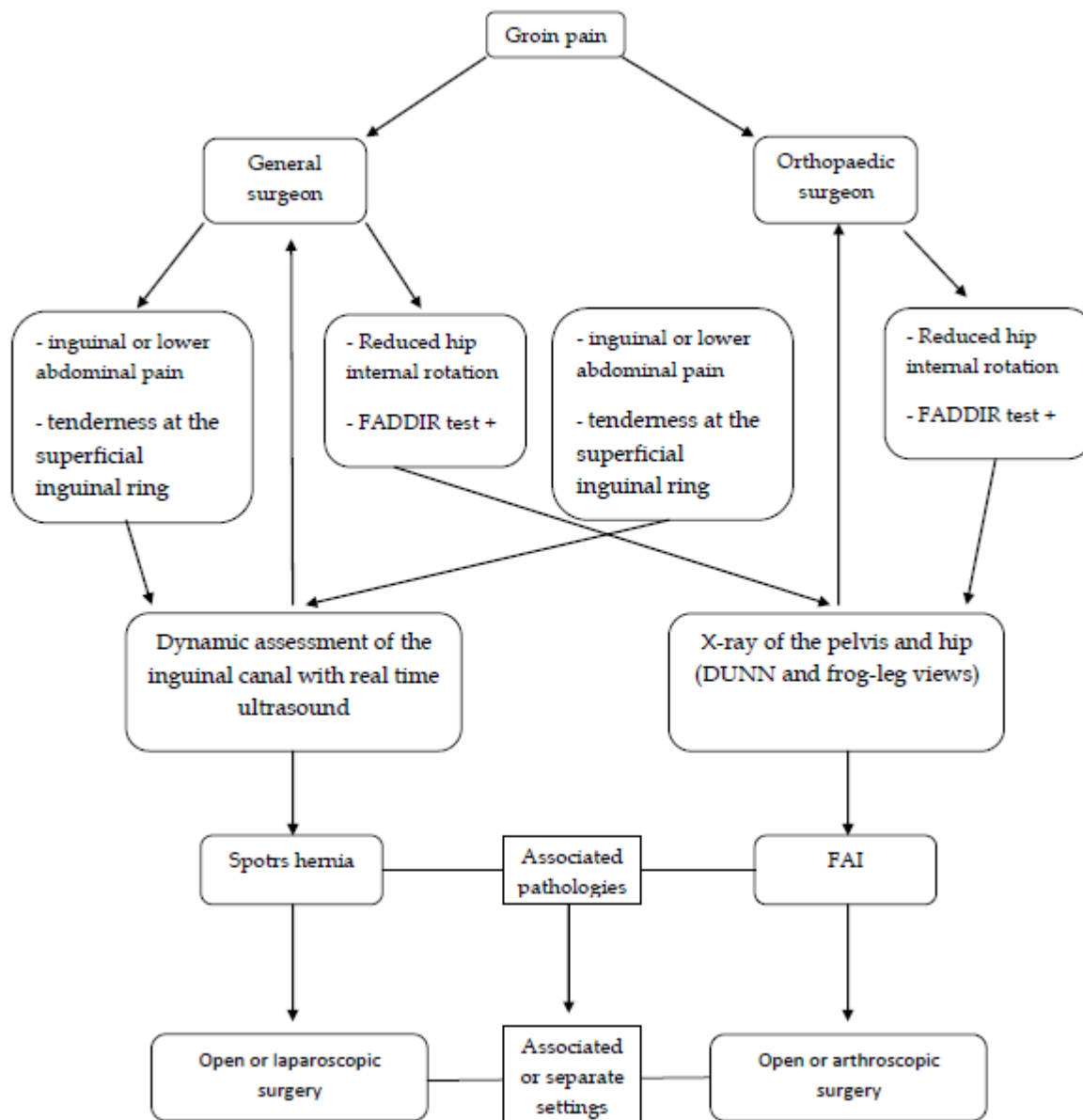
Ref.	Primary pathology	Prevalence (%)
Garvey <i>et al</i> ^[13]	Sports hernia	12*
Meyers <i>et al</i> ^[35]	Athletic pubalgia	27
Schilder <i>et al</i> ^[36]	Chronic adductor-related groin pain	34.1
Weir <i>et al</i> ^[32]	Long-standing adductor-related groin pain	94.1
Nepple <i>et al</i> ^[34]	Groin strain, sports hernia, hip flexor or hamstring strain	94.3
Sansone <i>et al</i> ^[37]	Adductor tenotomy for chronic groin pain	43.8
Economopoulos <i>et al</i> ^[38]	Athletic pubalgia	86

*Restricted internal rotation and labral tear

- (7) A multidisciplinary approach in the patient with sports hernia combined with FAI should be shown to make a correct diagnosis and treatment.

This is the diagram showing our purpose of multidisciplinary approach.

Figure 1 Diagram showing the proposed multidisciplinary approach.



(8)
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3 References and typesetting were corrected

Thank you again for publishing our manuscript in the *World Journal of Clinical Cases*.

Sincerely yours,

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