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Research Article

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Avulsion of the direct head of rectus femoris following arthroscopic subspine impingement resection: a case report

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ABSTRACT

Arthroscopic resection of the anterior inferior iliac spine (AIIS) for subspine impingement has become a relatively common procedure. The AIIS is the origin of the direct head of rectus femoris (dhRF). Previous studies have reported that removal of the contributing portion of the AIIS causing impingement is unlikely to weaken the attachment of the dhRF. The purpose of this article is to report a case of avulsion of the dhRF, following revision hip arthroscopy for the treatment of subspine impingement. A 23-year-old professional footballer underwent revision left hip arthroscopy for the treatment of subspine impingement. 5-mm of bone was resected inferior to the AIIS. Two-weeks post-operatively, he presented with sudden onset, severe left anterior thigh pain following a fall and hyperextension of his left hip. The patient felt a pop over the anterior aspect of his hip. He noticed immediate swelling, severe pain and stiffness. Examination revealed diffuse swelling, 4/5-power on straight-leg-raise, focal tenderness over the AIIS but no palpable gap. MRI confirmed the clinical suspicion of a dhRF avulsion. Given the minimal loss of power and the lack of significant retraction, the patient was treated conservatively. He was instructed to avoid excessive hip extension. He returned to full participation at 3-months. This article highlights a case of avulsion of the dhRF due to a hyperextension injury of the hip following arthroscopic resection of subspinal impingement, a previously unreported complication. Resection of soft and bone from the AIIS may weaken the insertion of the dhRF. Care should be taken during post-operative rehabilitation to avoid trauma and excessive forces on the dhRF tendon, which may lead to rupture. Rehabilitation should be focused on range of motion of the hip.

INTRODUCTION

Prominence of the anterior inferior iliac spine (AIIS) at the level of the acetabular rim has been recognized as a potential cause of hip impingement (AIIS subspine impingement) [1]. Accordingly, arthroscopic resection of the bony projection has been reported and has become a commonly performed procedure [2]. The AIIS is also the origin of the direct head of rectus femoris (dhRF) [3]. Previous studies have reported that such is the area of the bony footprint that avulsion of the tendon is highly unlikely following resection of a portion of the AIIS in the treatment of subpine impingement. Whereas proximal avulsions of the rectus femoris are commonly encountered in the paediatric and adolescent populations [4–6], they are rarely seen in the adult population [7].

This case study documents the first report, to the best of the authors' knowledge, of avulsion of the dhRF following the arthroscopic treatment of subspine impingement of the hip. The patient was informed that data concerning the case would be submitted for publication, and he consented.

CASE REPORT

A 23-year-old professional Australian Football League player presented with sudden onset of severe left proximal anterior thigh pain as a result of an injury sustained 2

weeks following a revision left hip arthroscopy for resection of AIIS/subspinal impingement. The mechanism of injury was hyperextension of the left hip as a result of a fall down six steps. The patient heard and felt a pop over the anterior aspect of his left hip. He noticed immediate swelling, severe pain and developed stiffness in his hip. The pain was exacerbated by flexion. On examination, he had diffuse swelling over his anterior thigh. He was able to perform a straight leg raise but with discomfort. Focal tenderness was identified over the AIIS but no gap was palpable.

Arthroscopic treatment

The operative procedure the patient underwent was a revision left hip arthroscopy. The indication for surgery was anterior hip pain exacerbated by hip flexion beyond 90° which had been refractory to conservative treatment, including intra-articular injection. The primary procedure had been performed 3 years previously at a different institution and consisted of a labral repair and femoral osteotomy—no resection of the AIIS had been performed at the index procedure. A pre-operative CT scan revealed the presence of a bony prominence at the level of the AIIS (Fig. 1) and clinical examination confirmed the presence of pain on flexion, adduction and internal rotation of the hip, suggestive of anterior impingement. Diagnostic arthroscopy of the hip revealed a well-healed labrum without evidence of a further tear, a partial tear of the ligament teres, and a bony prominence inferior to the AIIS. Resection of the capsule inferior to the AIIS was performed using a Super MultiVac 50 ArthroWand (Arthrocare Sports Medicine, Austin, TX) to expose the bony prominence, which was removed with a 5-mm burr (Fig. 2a and b). The hip was flexed under arthroscopic vision to ensure that the impingement had been eliminated. Care was taken to preserve the footprint of the dhRF. The capsule was closed with 2-FiberWire (Arthrex Inc., Naples, FL). Post-operatively, the patient was instructed to use crutches until he was comfortable walking, which were discontinued after 3 days.

Fig. 1. Three-dimensional reconstruction CT-image of the left hip. The yellow arrow demonstrates the bony prominence on the inferior aspect of the AIIS.

Diagnosis

An MRI was performed to corroborate the suspected diagnosis of an avulsion of the dhRF. The MRI revealed a complete tear of the dhRF proximal to the musculotendinous junction (Fig. 3). There was no bony avulsion of the AIIS. Notably, the muscle length was maintained, indicating that the indirect head was still attached to the rim of the acetabulum; the tendon was retracted by <2 cm. Repeat physical examination 10 days following the injury revealed a normal straight leg raise, albeit with slight tenderness and 4/5-power on hip flexion, compared with the opposite side. The patient stated that the stiffness in the hip had abated and he was no longer walking with a limp.

Treatment

Given the improvement in symptoms over a short period of time, a conservative course of treatment was adopted. Strengthening exercises were avoided for 4 weeks, with the patient concentrating on range of motion, flexibility and avoiding excessive hip extension. At 6 weeks following the injury (8 weeks post-surgery), the patient commenced strength training and running. He returned to full activity and team training at 12 weeks and at the time writing (5 months post-operatively) he remains injury-free.

DISCUSSION

AIIS/subspine hip impingement has received increased acknowledgement as a common type of symptomatic extra-articular impingement [8, 9]. A number of studies have described excellent results following arthroscopic AIIS/subspine decompression [2, 9–13]. In fact, a failure to recognize or treat this condition has been implicated in recalcitrant postoperative pain following hip arthroscopy and has been associated with the requirement for revision surgery [14]. Whereas the potential for injury to the dhRF during resection of the bony prominence on the AIIS has been highlighted, this is the first report, to the authors' knowledge, to describe avulsion of the tendon post-operatively [2].

Injuries to the rectus femoris are rare in the adult population and most commonly occur in athletes [7]. The mechanism of injury is varied. Typically, they occur in

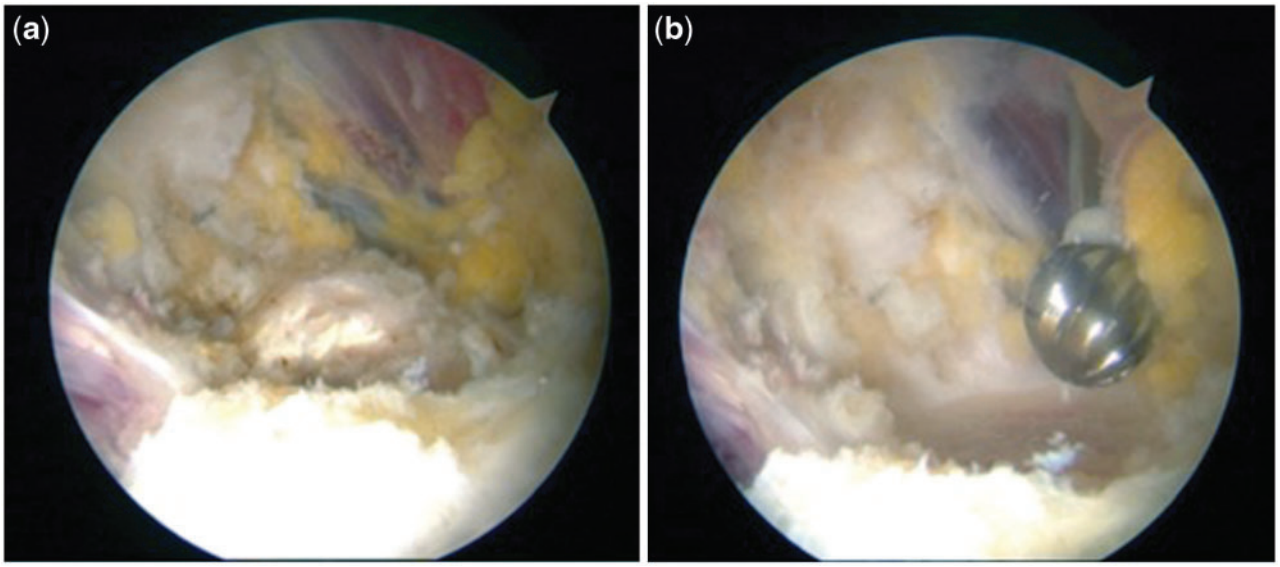

Fig. 2. (**a**) An arthroscopic image of the left hip demonstrating the bony prominence of the AIIS/Subspine impingement following removal of the soft tissue. (**b**) An arthroscopic image of the left hip following resection of the bony prominence.

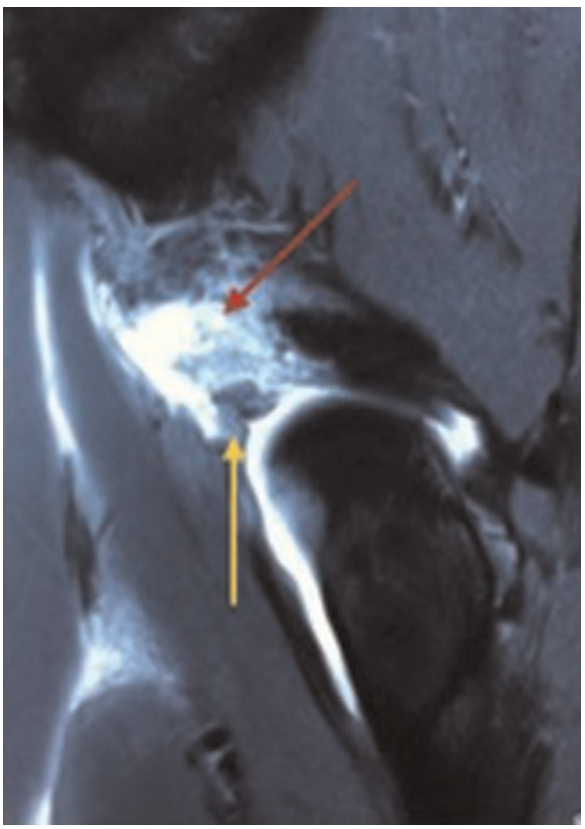

Fig. 3. Sagital T2 MRI scan of the left hip; the red arrow demonstrates significant oedema at the level of the AIIS; the yellow arrow shows the avulsed tendon of the dhRF with minimal retraction.

kicking athletes during a forceful contraction of the quadriceps from the hip-extended/knee-flexed position to the hip-flexed/knee-extended position. An abrupt arrest of the kicking motion can result in rectus femoris avulsion in kicking players; e.g. when a kick is blocked by an opponent's foot on the ball or direct contact with a body. This injury has also been reported in non-kicking athletes, where a sudden deceleration during sprinting has been proposed as a mechanism for injury [7, 15, 16]. A further mechanism of injury, as seen in this case, is hyperextension of the hip with a flexed knee. In this report, the patient slipped down some steps and in an attempt to right himself he lunged forward with his uninjured leg and hyperextended the affected hip.

An understanding of the variable morphology and anatomy of the AIIS is crucial when performing arthroscopic AIIS/subspine decompression. The rectus femoris tendon has two heads proximally, which take origin from the ilium: the direct and reflected heads. The direct head arises from the superior facet of the AIIS just above the origin of the iliofemoral ligament and iliocapsularis on the inferior facet [17]. The reflected head is attached more laterally superficial to the capsule on the periphery of the acetabulum [17]. The quantitative anatomy of the bony footprint has been defined in a number of studies [3, 8, 17]. Also, three morphological variants of the AIIS have been described based on the relationship of the AIIS with the acetabular rim. Philippon *et al.*, in their cadaveric study, demonstrated that the direct distance to the nearest point of the inner rim of the acetabulum from the inferolateral corner of the

direct head of the rectus femoris footprint was 19.2 mm (95% CI 18.0–20.4 mm). Interestingly, they also reported that the iliofemoral ligament has the widest capsular footprint and is located inferior to the AIIS. In addition, the iliocapsular muscle has a bony and capsular origin immediately inferior to the rectus femoris tendon; the inferolateral aspect of the footprint being located just 12.5 mm (95% CI 10.1–15.0 mm) from the inner rim. It should therefore be considered that to achieve access to resect bony prominence of the AIIS and requires release of a portion of the iliofemoral ligament as well as the overlying iliocapsularis. The actual dimensions of the dhRF tendon were reported by Hapa *et al.* and were recorded as having a mean proximal-distal and medial-lateral distance of 2.2 ± 0.1 cm (range 2.1–2.4 cm) and 1.6 ± 0.3 cm (range 1.2–2.3 cm), respectively. In their study, they contended that the broad origin on the AIIS was protective against direct head detachment with subspine decompression.

This case highlights a number of important points. Although the bony prominence that necessitated resection was minimal and located inferior to the footprint of the dhRF tendon, the soft tissue debrided required to access was enough to weaken the tendinous insertion. It is equally important to consider that while the inflamed tendon was subjected to a supra-physiological load, it is unlikely that the same force would have caused a similar result in the absence of recent surgery with a well-tethered tendon. Notably, this case deals with subspine impingement in the revision setting. Larson *et al.* [14] in their report of arthroscopic revision hip surgery showed that aside from residual cam-type femoral deformity, a high percentage of cases also demonstrated AIIS/subspine impingement. They concluded that, at a mean follow-up of 26 months, of all independent variables in the revision surgical population, treatment of subspine/AIIS impingement was one of the factors that were predictive of greater improvement in MHHS values from pre-operative baseline. It stands to reason, therefore, that one needs to take particular caution in the revision setting given the potential for altered anatomy and the presence of scar tissue, particularly between the capsule and the labrum and at the level of AIIS where the previous capsulotomies are often located.

The appropriate treatment for avulsion of the dhRF has not been well established. Hasselman *et al.*, in a series of 10 injuries to the musculotendinous junction of the rectus, reported that only two patients underwent surgical debridement and repair [18]. Operative and non-operative treatments have been described in the high-level adult athlete [7, 15, 16]. Gamradt *et al.* reported on a series of 11 professional American football players who were treated conservatively and returned to the same level of sporting participation. Whereas, Hsu *et al.* documented the return to play of two professional American football kickers with 1 and 3.5 cm of retraction of the dhRF, who were treated conservatively and returned to kicking during at ~6 weeks [19]. Operative treatment was reported by Irmola *et al.* [20] in five cases of rectus femoris avulsion found in four professional soccer players and one hurdler. Surgical repair was carried out between 18 and 102 (mean 53) days post-injury. The tendon was reattached with two to four suture anchors and the patients were protected with hip bracing at 45° of flexion for 1 week. Although running was initiated at 8 weeks, the players took an average of 9 months to return to sport. In addition, two of the five patients had lateral femoral cutaneous nerve palsy post-operatively. In the current case, conservative treatment was chosen due to the lack of significant retraction, the preservation of power and the proximity to his recent surgery. Whereas this post-operative injury caused something of a setback initially and gave rise to increased post-operative pain, it did not delay the return to sport in this patient, which occurred at 3 months.

CONCLUSION

This case highlights a case of avulsion of the dhRF due to a hyperextension injury of the hip following arthroscopic resection of subspinal impingement, a previously unreported complication. Although a rare occurrence, this diagnosis should be considered in the event of post-surgical injury. Resection of soft and bone from the AIIS may weaken the insertion of the dhRF. In particular, care should be taken during post-operative rehabilitation to avoid trauma and excessive forces on the dhRF tendon, which may lead to rupture. Rehabilitation should be focused on range of motion of the hip.

CONFLICT OF INTEREST STATEMENT

None declared.

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