CASE REPORT

Repair of a Proximal Hamstring Rupture in a 14-Year-Old Patient: A Case Report

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Abstract Proximal hamstring tendon ruptures are rare in children and adolescents. The typical pediatric hamstring injury pattern involves an apophyseal avulsion fracture. We present the case of a 14-year-old male with a widely displaced ischial avulsion fracture and a bony fragment that was too small to allow for bony fixation. The patient presented with left-buttock pain and ecchymosis, as well as tenderness at the ischial tuberosity, following an injury sustained while running 2 weeks prior. Imaging demonstrated an avulsion of the proximal hamstrings with a 4-mm bony fragment, too small to allow for repair. The patient underwent primary repair using two 3-mm suture anchors. The bony fragment was not excised but incorporated into the repair. Although most proximal hamstring injuries in children and adolescents are treated non-operatively, operative treatment may confer a small but clinically important difference in rates of healing and return to play in adolescent athletes. This case demonstrates successful treatment of a proximal hamstring rupture with suture anchor fixation, which may be considered for pediatric and adolescent displaced avulsion fractures when the bony fragment is too small to allow for bony fixation.

Keywords proximal hamstring · ischial avulsion fracture · adolescent · pediatric · suture anchor repair

Introduction

Avulsion fractures in children and adolescents occur commonly through apophyses, which are growth areas adjacent to tendon attachments [8, 10]. The mechanism of injury typically involves a forceful contraction of the attaching musculotendinous unit [14]. As with other pediatric physeal fractures, adolescent avulsion fractures take place most often in the zone of hypertrophy [9]. Such injury often occurs during an adolescent's growth spurt, when apophysis cartilage cells become more active and prone to injury [3]. Ischial avulsion fractures, at the origin of the hamstrings, typically occur when the hamstrings contract, with knee extended and hip flexed [2]. Although the majority of ischial avulsion fractures are treated non-operatively, operative treatment may confer a small but clinically important difference in rates of healing and return to play in adolescent athletes, particularly if the fragment is displaced more than 15 mm [6]. Typical surgical fixation includes open reduction and internal fixation with screws [7]. Excision of the bony fragment and suture anchor repair has previously been described [13], but the indication for this surgical technique has not been delineated.

The following case demonstrates a clinical variant of an ischial avulsion fracture, with an exceptionally small bony fragment, and describes a modern suture anchor approach, suggesting the indications for surgical treatment of ischial avulsions in adolescents.

Case Report

A 14-year-old male presented for evaluation 2 weeks after injuring his left leg while running on his high school's track team. He felt a pop and immediate pain in the back of his leg and was unable to bear weight.

The patient was 5'10" and weighed 130 lbs. There was tenderness to palpation over his left ischial tuberosity and along the proximal hamstring tendon, notable soft tissue

Work performed at Rothman Institute at Thomas Jefferson University Hospital

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swelling and ecchymosis along the left buttocks and posterior thigh, and a palpable defect at the hamstring insertion on the ischial tuberosity. The patient had full hip range of motion, limited by pain with extremes of hip flexion. Evaluation of his left knee was normal, with no tenderness to palpation and stable ligamentous testing. The neurovascular exam showed full motor strength, with the exception of hamstring strength of 3+/5, limited by pain. Sensation was normal, including in the distribution of the posterior cutaneous nerve of the thigh. Evaluation of the contralateral limb was normal.

Radiographs of the left hip showed no obvious osseous abnormalities, although skeletal immaturity was noted (Fig. 1). Magnetic resonance imaging (MRI) showed acute avulsion of the proximal hamstring tendons, with 2.7 cm of retraction at its most distal extent (Figs. 2, 3, and 4).

We discussed both operative and non-operative treatment options with the family. Surgical fixation would require suture anchors rather than screw fixation because the bone fragment was so small. Non-operative treatment could produce persistent hamstring weakness, sciatic nerve symptoms, prolonged recovery, and delayed or diminished return to sports. We discussed the benefits of anatomically repairing the tendon to the ischial tuberosity, including greater likelihood of healing, with the potential for optimized hamstring strength, shorter recovery, and slightly greater odds of returning to sports. Inherent surgical risks were discussed, as well as specific risks including persistent pain at the hamstring insertion site, pain with sitting, inability to return to prior activity level, persistent weakness, bleeding, infection, and blood clots [11].

The family elected for surgical repair. General anesthesia and the prone position were used, with the operative extremity draped into the surgical field to allow for intraoperative knee flexion. A 5-cm transverse incision was made in the

Fig. 2. Sagittal T2-weighted MRI scans demonstrating avulsion of the proximal hamstring tendons with 2.7 cm of retraction.

left gluteal fold. Superficial dissection was carried out using sharp and blunt dissection down to the gluteal fascia, with care taken to protect the posterior cutaneous nerve. The gluteal fascia was split, and immediately a hematoma was encountered. This was aspirated and irrigated.

Fig. 1. X-ray of the left hip demonstrating skeletal immaturity, no osseous abnormality.

Fig. 3. Coronal T2-weighted MRI scans demonstrating avulsion of the proximal hamstring tendons with 2.7 cm of retraction.

The hamstring tendon stump was identified, mobilized, and debrided (Fig. 5). A 4-mm piece of bone, attached to the tendon stump, was too small to be used for definitive bony fixation and was incorporated into the final suture repair. The sciatic nerve was palpated, protected, and retracted laterally. Next, the ischial tuberosity was exposed using three deep retractors. The site of the avulsion, at the apophysis, was debrided to promote healing. Two 3-mm double-

Fig. 5. Intraoperative photograph showing the proximal hamstring tendon stump after debridement and passage of the fiberwire sutures.

loaded BioComposite™ SutureTak® anchors (Arthrex, Naples, FL, USA) were placed on the lateral aspect of the ischial tuberosity to restore the anatomic footprint of the tendon. The eight limbs of fiberwire suture were passed through the proximal hamstring stump in a Krackow fashion. Following irrigation, the tendon was reduced under direct visualization to the ischial tuberosity, and the sutures were tied to secure the fixation (Fig. 6). The wound

Fig. 4. Axial T2-weighted MRI scans demonstrating avulsion of the proximal hamstring tendons with 2.7 cm of retraction.

Fig. 6. Intraoperative photograph showing the reduced proximal hamstring tendon stump to the ischial tuberosity.

was copiously irrigated, and the fascial and superficial layers were closed.

After skin closure and dressing application but before reversal of anesthesia, the patient was placed into a custom hip abduction brace to prevent hip flexion. Prolonged periods of sitting and positions of hip flexion combined with knee extension were avoided. Enteric-coated aspirin for deep venous thrombosis prophylaxis was prescribed, as was an oral pain regimen. He was discharged on the same day from an outpatient surgery center after a neurovascular check showed normal sciatic nerve function and limb perfusion.

The patient was given strict non-weight-bearing precautions on his operative extremity for 2 weeks and then progressed with physical therapy to 10% weight bearing. Trunk and excessive hip flexion were limited, with emphasis placed on avoiding lengthened hamstring positions (hip flexion, knee extension). He was progressed to full weight bearing at 4 weeks and began straight leg raises to a maximum of 30° of hip flexion at 4 weeks. Starting at 6 weeks, he progressed to straight leg raises to a maximum of 70° of hip flexion. Hamstring and quadriceps strengthening were initiated at week 8, jogging at week 12, and sport-specific drills at week 16. The latter continued until the patient demonstrated more than 85% performance of the involved side compared to the non-involved side in single-leg hop for distance and isokinetic testing. This criterion, along with absence of symptoms with testing, was used to determine appropriate return-to-play timing.

At 2-year follow-up, the patient had returned to full activities, including track. He reported no pain, had full left hip range of motion, and showed no hamstring weakness on manual muscle testing of his operative leg.

Discussion

This case report describes an adolescent athlete who sustained an ischial avulsion fracture, with a bony component too small for bony fixation. Suture anchor repair was performed, with the small bony fragment left in situ, without excision. In Wood's classification of proximal hamstring avulsion patterns, this injury was a type 1, bony avulsion injury [17].

Hamstring muscles are the most commonly injured muscles in an athlete [1, 4]. The proximal hamstring complex consists of three tendons—the long head of the biceps femoris, the semimembranosus, and the semitendinosus—that attach to the lateral aspect of the ischial tuberosity. They extend the hip, flex the knee, and rotate the tibia medially, especially when the knee is flexed [15]. In adolescents, the typical injury pattern involves avulsion of the ischial apophysis. In adults, bony injury is less common. When a tendinous rupture occurs, a complete rupture is defined when all three tendons are pulled off the ischial tuberosity.

A systematic review of 13 studies including 387 primarily adult patients with proximal hamstrings avulsions found that after surgical repair 76 to 100% returned to sports, 55 to

100% returned to their pre-injury level of play, and 88 to 100% were satisfied with their treatment. Postoperative hamstring strength ranged from 78 to 101%, and endurance and flexibility after surgery were reported as comparable to the uninjured side [16]. In the active adult patient, surgery is often advocated for a complete rupture or a partial rupture involving two tendons with more than 2 cm of tendon retraction [5].

In a meta-analysis of 14 studies including 596 adolescents with pelvic avulsion fractures treated operatively or non-operatively [6], 30% were ischial tuberosity avulsion fractures. The authors reported 88% overall success in the operative group compared to 79% in the non-operative group, with a rate of return to sports of 92 and 80%, respectively. The authors note poor quality of the included studies and advocate consideration of operative fixation of adolescent avulsion fractures in high-demand patients and with fragment displacement greater than 15 mm [6].

However, the single largest study contributing to that meta-analysis included 228 pediatric apophyseal avulsion fractures, 11% of which were ischial avulsion fractures [12]. Only two patients were treated surgically. The authors concluded that 97% of patients with avulsion fractures can be treated successfully with a non-operative approach. There were five non-unions, and four of these were ischial avulsion fractures. Although non-union could be potentially debilitating in an athlete, apophyseal avulsion non-unions are not necessarily symptomatic. There are no high-quality comparative studies on the treatment of adolescent ischial avulsion fractures, and optimal treatment remains a topic of debate.

Surgical treatment of ischial avulsion fractures typically involves screw fixation. However, bony fragment excision and suture anchor repair has previously been described [13]. It is theorized that hamstring power may be reduced with fragment excision, but no studies exist to support this concern. Comparison of bone fixation with screws and tendon suture anchor fixation has not been evaluated. We feel that suture anchor fixation was necessary in the current case, with minimal bone available for bony fixation. The bony fragment was incorporated into the final repair. Routine excision of large bony fragments is not recommended at this time.

The following approach for treatment of adolescents with ischial avulsion fractures is recommended: for minimally displaced avulsions, an initial non-operative approach is reasonable for most patients. Surgical fixation can be reserved for symptomatic non-unions and for avulsions displaced more than 15 mm and at variable lesser degrees of displacement for high-level athletes. In patients with ischial avulsions with minimal bone avulsed, suture anchor repair could be considered if displaced more than 15 mm and at variable lesser degrees of displacement for high-level athletes. Future prospective comparative studies focusing on functional outcomes may help to better delineate the role of suture anchor fixation versus standard avulsion fragment screw fixation, as well as the displacement threshold for surgical intervention.

Compliance with Ethical Standards

Conflict of Interest: Patrick S. Buckley, MD, declares that he has no conflicts of interest. Christopher C. Dodson, MD, reports being a paid consultant to Arthrex, Inc., during the conduct of the study.

Human/Animal Rights: All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2013.

Informed Consent: Informed consent was obtained from all patients for being included in this case study.

Required Author Forms Disclosure forms provided by the authors are available with the online version of this article.

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