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Case Presentation

Nonoperative Management of a Severe Proximal Rectus Femoris Musculotendinous Injury in a Recreational Athlete: A Case Report

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Abstract

This report describes a severe injury to the proximal rectus femoris (RF) muscle in a 37-year-old recreational athlete. This injury is a relatively rare occurrence in both the general and elite athletic populations. Acute and long-term imaging and functional outcomes are described. This athlete was able to return to full activity without surgical intervention. Follow-up imaging demonstrated gross healing of both complete (or near complete) muscle and tendon tears.

Level of Evidence: V

Introduction

The quadriceps muscle in the anterior thigh is composed of the rectus femoris (RF), vastus medialis, vastus intermedius, and vastus lateralis. The RF has 2 origin sites. The direct head originates from the anterior inferior iliac spine, and the indirect head originates from a groove above the rim of the acetabulum. The normal arrangement of the tendons is complex as they move distally and conjoin [1,2]. The injured state can be challenging to grade from imaging evidence because of the presence of interstitial edema, hemorrhage, tearing, retraction, avulsion, fatty infiltration, increased vascularity, scar tissue, and calcification during the destructive, inflammatory, repair, and remodeling phases of healing. This results in some controversy, with 5 radiologic muscle injury grading systems used clinically today [3]. Avulsion of the RF direct head at the site of the anterior inferior iliac spine are documented but are rare [4-7]. Even more rarely encountered is a case of musculotendinous junction tearing involving both the direct and indirect heads of the RF [4].

The majority of descriptions for this injury have been reported in adolescents and elite athletes. There is a paucity of data regarding similar injuries in mature, recreational athletes. The case presented describes an RF injury mechanism, treatment, and rehabilitation of a nonprofessional but competitive adult male.

Case Presentation

A 37-year-old right leg dominant man (height 6’2”, weight 210 lb, body mass index 27) was playing recreational kickball. He was otherwise an asymptomatic, highly competitive club soccer player with a past history significant for a right open tibia-fibular fracture, treated with intramedullary nailing, 2 years prior to this injury, and a subsequent full return to sport. Additionally, he had a left meniscus and anterior cruciate ligament injury with reconstruction, using hamstring graft, 15 years before this injury. His baseline physical condition included gym or track workouts 5-6 days a week, and a 5:55 mile time.

On the day of injury, the man was standing most of the day at work, and he felt that his legs were stiff before the evening game. He had a limited warm-up consisting of brief quadriceps, hamstring, and gastrocnemius stretching, jogging, and low-velocity strikes of the ball. At his first “at bat,” he kicked a home-run. At his second “at bat,” he attempted to kick the ball with the outside of his foot to drive the ball towards

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right-field. He made powerful contact with the kickball, and immediately felt a popping sensation. He fell after striking the ball, and witnesses (ie, the catcher and head referee) reported an audible "pop." He was unable to complete the game, and had a markedly antalgic gait with partial weight-bearing. He felt 8/10 pain in his right groin area, along with weakness, and noted a cosmetic deformity with fullness into the lower quadriceps and scalloping of the upper quadriceps region. The patient treated himself at the game with icing and compressive wraps, and he took ibuprofen 800 mg 3 times a day (which was continued for 2 weeks, for pain and swelling).

He remained ambulatory with partial weight-bearing, and presented to the authors' clinic 3 days after the injury. Physical examination revealed significant thigh edema with approximately 2 times the circumference of the noninjured left thigh (normally symmetric). There was mild ecchymosis involving the superior-anterior thigh region. The thigh was tender, and there was a palpable defect in the right proximal thigh. Hip range of motion (ROM) was near normal, but with pain and stiffness on active and passive ROM, with 4/5 resisted hip flexion strength and 4/5 knee extension strength. Resisted hip flexion strength testing was performed with the patient lying supine, with straight leg raise and with the hip/knee flexed to 90°. Hip abduction/adduction and knee flexion strength was full. He had an antalgic gait. The differential diagnoses were rectus femoris or iliopsoas muscle strain/tear/avulsion, occult femoral fracture, and femoral hernia.

Ultrasound imaging was attempted at the initial clinic visit. The examining clinician was a fellowship-trained sports medicine physician with more than 10 years of musculoskeletal ultrasonography experience. Although the injury was visible, grading of the extent of injury could not be well characterized based on ultrasound imaging [2,3].

Magnetic resonance imaging (MRI) studies were therefore ordered to further characterize the location, extent, and severity of the injury to guide clinical management. With insurance authorization and scheduling logistics, the imaging was obtained 2 weeks postinjury.

At 2 weeks postinjury, the patient presented with less pain and swelling, and an unchanged strength examination. MRI studies without contrast of the right hip and thigh revealed a severe proximal RF injury (Figure 1). The injury created a 5-cm gap at the musculotendinous junction located ~5 cm inferior to the proximal origin at the anterior inferior iliac spine. It was surrounded by an ~16-cm segment of edema within the proximal RF muscle. A moderate amount of anterior epimysial edema and hemorrhage was noted, with a 13x1-cm^2 fluid collection deep to the deep fascia of the thigh, exerting a mild mass effect on the right femoral nerve. There was no other muscle or tendon injury, and the hip joint itself was unremarkable.

Surgical intervention was considered for this competitive soccer player. After an extensive discussion and literature review, he elected to proceed with a nonsurgical course involving physical therapy. Fluid aspiration was discussed, but the collections were left to resolve spontaneously given no indications or expected clinical benefit for an aspiration. It was assumed that the majority of the patient's symptoms originated from the tear (and not necessarily from femoral nerve injury).

In the first 1-2 weeks after injury, his weight bearing progressed to full weight bearing as tolerated. The knee was not immobilized. He used ice pack applications throughout recovery. The initial course of physical therapy involved a 4-week course of stretching and restoring full ROM, in addition to manual muscle modalities and deep tissue massage to prevent/mobilize scar tissue. The stretching program emphasized anterior hip and gluteal stretching, and ROM. Strengthening was advanced at 4 weeks with an isometric strengthening program. At approximately 8 weeks, the strengthening was progressed to include ROM. At 10 weeks, the activity was advanced to include dynamic exercises including lunges, box jumps and thrusts, and progression toward a plyometrics regimen with cone and ladder drills in addition to soccer-specific cutting and dribbling drills on the field. At 12 weeks, the patient was advanced to kicking drills with progression of intensity and velocity, and a gradual return to sport (Figure 2). At 3-4 months postinjury, the patient did experience slight continued leg weakness relative to his preinjury baseline, and felt a lack of confidence in kicking the ball with his affected leg. These symptoms progressively improved so that at 1 year postinjury he was satisfied with near baseline function at full, competitive sports activities. He no longer plays kickball, but did return to competitive club soccer. He does endorse continued intermittent discomfort that localizes to the injury site following matches, intense training, and shooting drills, which improves with some rest. There are no residual cosmetic defects.

MRI follow-up at 28.5 months after injury (performed solely for research purposes) confirmed a healed proximal musculotendinous junction, with intact direct and indirect tendons of the RF and thickening consistent with chronic fibrosis (Figure 3).

Discussion

There are retrospectively documented cases of proximal rectus femoris avulsions and injuries. For example, 11 avulsions were identified by Gamradt and his colleagues in a chart review [4]. These kinds of injuries are rare, representing only 0.5% of all reported hip and pelvic injuries [8]. To our knowledge, there are significantly fewer numbers of documented cases

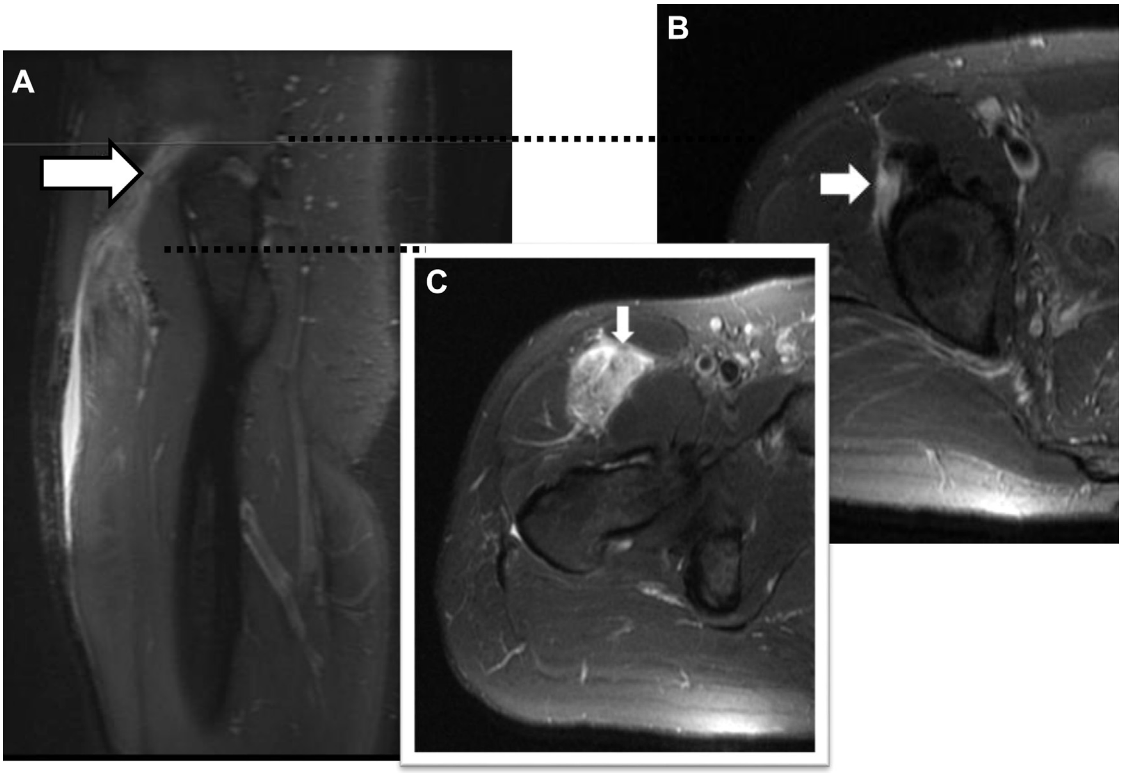

Figure 1. T2-weighted magnetic resonance images showing the rectus femoris immediately after the injury. (A) Sagittal image shows disruption of the proximal tendon of the indirect head of the rectus femoris consistent with acute injury (arrow). (B) Axial image at the level of the anterior inferior iliac spine (AIIS) shows severe injury at the proximal musculotendinous junction of the rectus femoris (dotted black line) and indirect head tendon origin (solid arrow). (C) Axial image at the level of the proximal musculotendinous junction shows high grade injury (solid arrow), characterized by discontinuous muscle and tendon fibers with surrounding edema and hemorrhage.

involving both direct and indirect head avulsions at the musculotendinous junction [4,9]. Such injury statistics could change with the increasing number of players involved socially and recreationally in other sports in addition to kickball, such as foot volley, sepak takraw, futsal, hacky sack, footbag net, footgolf, kegball, and human foosball.

Because RF avulsions are rare, there is no definitive protocol about how to treat this injury. The current literature is split on nonsurgical versus surgical options as the preferred treatment. Comparison studies show no difference in RF function between surgically and non-surgically managed athletes [4,5]. Hsu and colleagues report that the few National Football League (NFL) athletes seen with this injury are able to return to competitive play in 6 to 12 weeks, with non-surgical rehabilitation. Gamradt and colleagues describe 2 NFL players' return to play using a 3-6-week nonsurgical

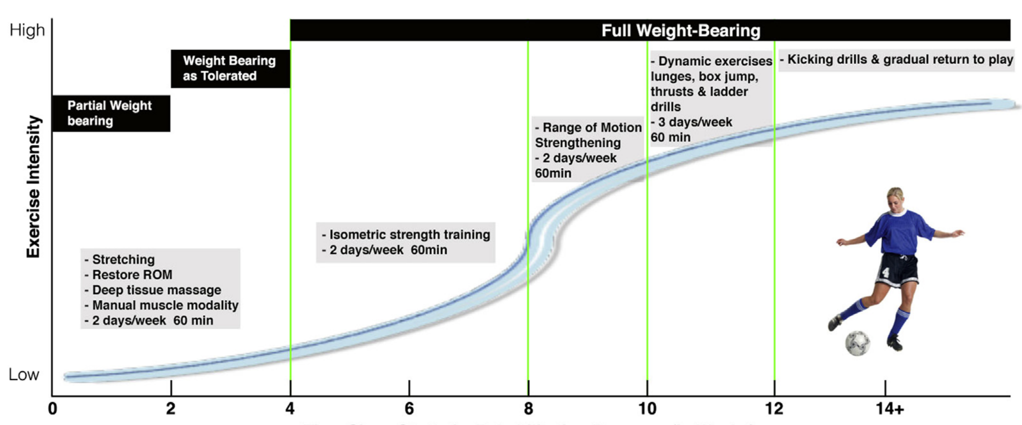

Figure 2. Postinjury rehabilitation timeline.

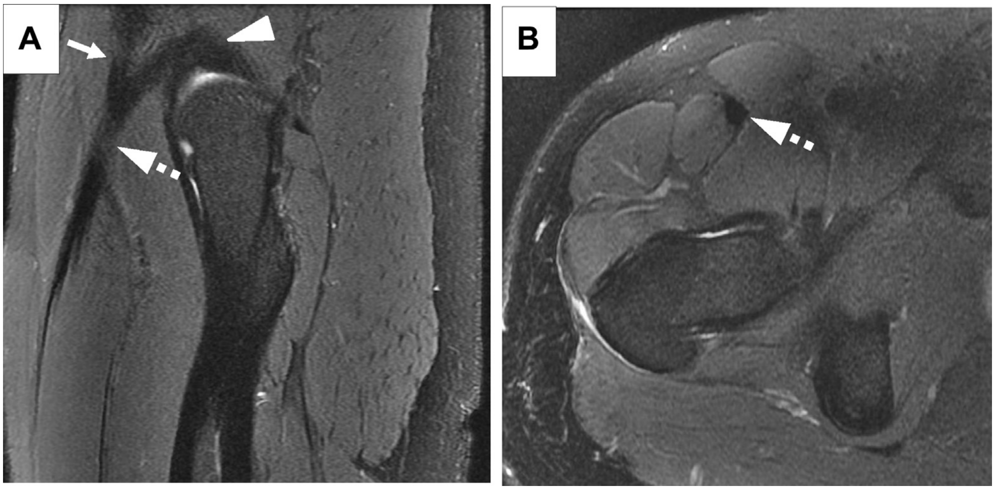

Figure 3. T2-weighted magnetic resonance images showing the rectus femoris postinjury 28.5 months. (A) Sagittal image shows complete healing of the proximal musculotendinous junction (dashed arrow), including both intact direct (small solid arrow) and indirect (arrowhead) tendons. (B) Axial image confirms an intact and healed, but thickened intramuscular tendon at the musculotendinous junction, suggesting chronic fibrosis (dashed arrow).

program. One player had an RF direct head avulsion and RF indirect head tear, the other had avulsion of both heads. These players initially had protected weight-bearing with crutches, ice, anti-inflammatories, ROM exercise, graduated return to resistance training, cardiovascular conditioning, and running. Eighteen percent of the NFL players did suffer a recurrence of symptoms however. A case report involving a similar proximal rectus femoris injury (direct head torn and indirect head avulsed) in a collegiate Division 1 soccer player described a more than 20-week nonsurgical rehabilitation program before a return to full play [9]. In this report and others in the literature, there are scant details about the nonsurgical rehabilitation program for this kind of injury.

Our mature, recreational athlete took 12 weeks of rehabilitation to return to play. This case demonstrates that the return to play time table for elite athletes and recreational athletes may be approximately similar with nonsurgical management. With surgical treatment, good return to play outcomes have also been described. However, the return to preinjury level of activity with surgery appears to occur within 4-10 months [7,10-12]. This literature indicates that surgical management may involve a longer recovery period than nonsurgical management, but it also might provide a more predictable return of strength and function [7,12]. From these case reports, it is difficult to specify what factors lead to the more prolonged recovery seen with surgical treatment without more details about surgical technique, post-operative rehabilitation guidelines and patient characteristics.

MRI provides structural information of musculotendinous pathology at a resolution far beyond the capacity of current ultrasound technology [3,12]. This permits more detailed grading of injury severity [2]. But because of MRI costs and lack of access for many physicians, one might consider ultrasound examination as an alternative for serial imaging to follow muscle and tendon injuries. In one case of a quadriceps muscle belly tear, ultrasonography was unable to detect a change in defect dimensions over time [13]. However the ultrasonographic images did show improved tissue continuity and a reduced zone of hypoechoic signal (presumably related to edema). These subtle imaging changes were seen in the setting of dramatic improvements in patient function, which indicates that ultrasound resolution makes it relatively insensitive for predicting or tracking clinical outcomes at this time. In our MRI recovery images, the tendon showed gross healing. Interestingly, the MRI pixel values in the tendon were quantitatively different from normal tendon. To what extent novel MRI sequences may exploit such pixel differences to distinguish the type III collagen seen in scar versus the type I collagen seen in normal tendon is a future direction of imaging development, with exciting implications for evaluating tendon biology, aging, response to injury and healing [14].

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