[Orthopaedics]

Operative Treatment of a Complete Rupture of the Origination of the Rectus Femoris

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A 23-year-old male athlete reported both feeling and hearing a pop in his anterior thigh while sprinting. This was followed by immediate pain and an inability to walk. He had swelling and tenderness in his inguinal region. Radiographs were normal. An magnetic resonance imaging revealed a complete avulsion of the rectus femoris from its origin on the anterior inferior iliac spine. Following discussions of his treatment options, the patient chose to undergo operative management of the injury. A surgical repair was performed of the tendon of the direct head to the anterior inferior iliac spine through bone tunnels. He had a full recovery over the next 6 months and subsequently returned to unrestricted active military duty.

Keywords: rectus femoris; avulsion; tendon repair; quadriceps; muscle

Although muscle strains, including grade III avulsion injuries, are often treated nonoperatively, the surgical treatment of a complete tendon avulsion can allow anatomic repair and return to full activities following rehabilitation.

The following is a clinical case vignette involving acute anterior thigh and groin pain in an athlete, sustained while sprinting. The differential diagnosis and work-up are discussed. Operative intervention was chosen to repair a complete avulsion of the direct head from the origin of the rectus femoris muscle in his thigh. The patient fully recovered and resumed full activities at 6 months, postoperatively.

CASE

A 23-year-old active-duty male athlete presented with sudden onset of severe right proximal anterior thigh pain, which occurred during sprinting. He was unable to continue running because of the pain and was transported to the emergency room. On examination, he had diffuse swelling over his anterior thigh. He was able to perform a straight leg raise but with significant pain. His plain films were unremarkable; for his MRIs, see Figures 1, 2, and 3.

DIAGNOSIS

This patient incurred a complete tear (grade III) of the direct head of his rectus femoris, proximal to the musculotendinous

Figure 1. Sagittal fast-spin echo inversion recovery T2-weighted image of right thigh performed approximately 6 hours after injury.

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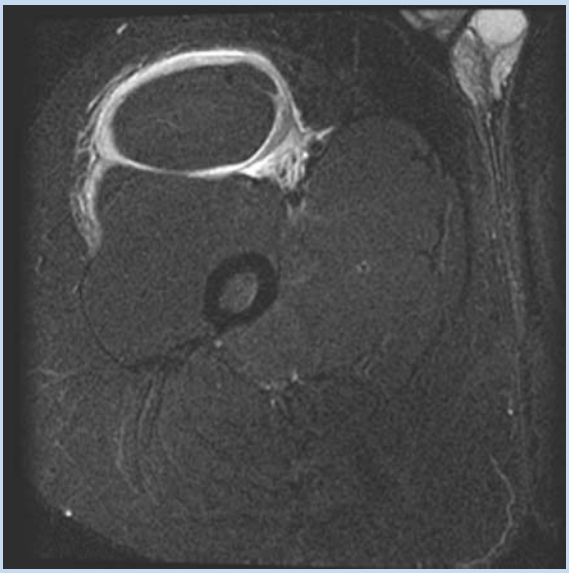

Figure 2. Axial fast-spin echo inversion recovery T2-weighted image through right proximal thigh.

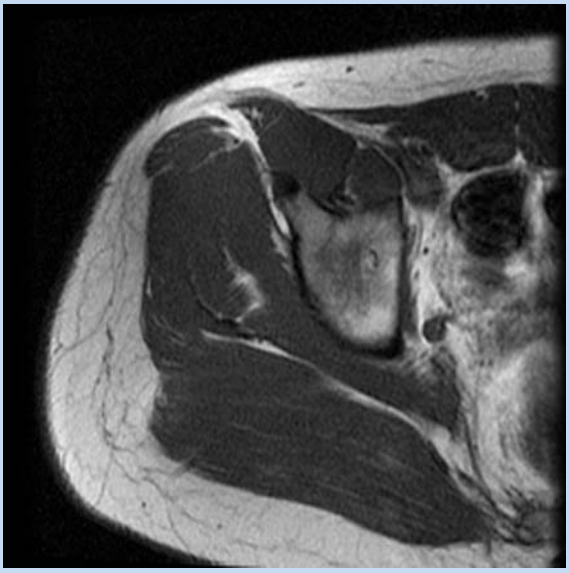

Figure 3. Axial T1 image superior to dome of acetabulum.

junction. There was no bony avulsion of the anterior inferior iliac spine (AIIS). Figure 3 shows an intact AIIS with the footprint of the direct head still attached. The muscle length is maintained (Figure 1), indicating that the indirect head is still attached to the acetabulum.

After being presented with the operative and nonoperative options, the patient elected to undergo surgical repair. The direct head was explored via an anterior surgical approach

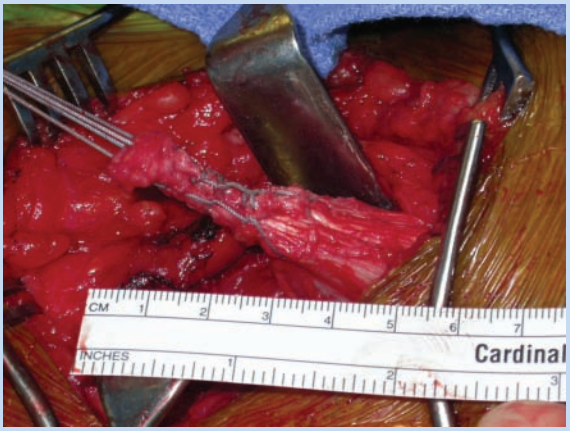

Figure 4. Intraoperative view of rectus femoris tendon secured with No. 2 FiberWire in a locking stitch.

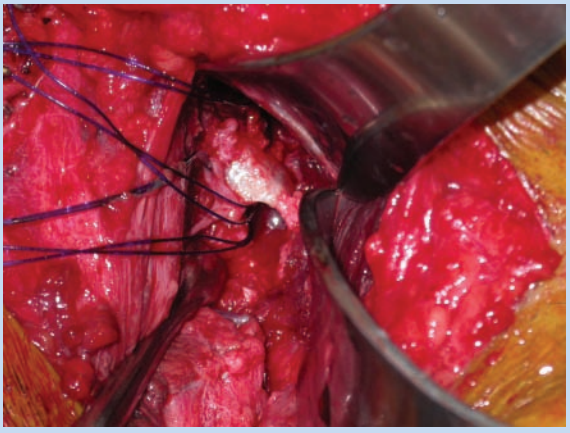

Figure 5. Bone tunnel made at rectus femoris insertion at anterior inferior iliac spine.

(Smith-Peterson). The rectus tendon was found to be completely torn from the AIIS, as demonstrated in Figure 1. Two parallel grasping sutures (Krackow) with No. 2 FiberWire (Arthrex Inc, Naples, Florida) were used to anchor the proximal tendon to the AIIS (Figure 4). The tendon stump was inserted into a bony trough prepared in the AIIS, and the sutures were tied over bone tunnels (Figure 5). The repair was verified as being secure while moving the hip and knee through a full range of motion.

Postoperatively, passive range of motion was initiated for the patient's hip for 4 weeks, with weightbearing (as tolerated) in a knee brace locked in extension. He started active range of motion at 8 weeks after surgery and was cleared for full military duty within 4 months. At that point, he was able to participate in sports (including sprinting) without any limitations.

DISCUSSION

The differential diagnosis of groin pain in athletes can be challenging. Renstrom and Peterson[3] found that groin injuries represent 5% of all soccer injuries, whereas Ekstrand and Hilding[1] found that such injuries represent 8%. The most common cause of acute groin pain in athletes is a musculoskeletal injury, such as a muscle strain. However, the differential diagnosis can include a variety of causes. Musculoskeletal causes of groin pain include osteitis pubica; acetabular labral tears; muscle strains and avulsion injuries; stress fractures of the pubis, ilium, and femoral neck; nerve injuries; and referred pain from the lumbosacral spine. Abdominal causes include hernias—of which indirect and direct inguinal, femoral, abdominal wall (Spigelian hernia), and obturator hernias can cause groin pain. Unique injuries to pediatric athletes include slipped capital femoral epiphysis and apophysis avulsions.

In this athlete, a quadriceps injury was suspected from his physical exam. Specifically, exquisite local tenderness and pain, as exacerbated by quadriceps contraction, suggested a tendon injury. The rectus femoris is the most anterior of the 4 quadriceps muscles. Its origination is via 2 heads: the direct head from the AIIS and the indirect head from the hip capsule. It distally coalesces with the other tendons of the quadriceps to insert into the superior aspect of the patella.[5] It is the most commonly injured component of the quadriceps mechanism because it is the only muscle in the group that crosses 2 joints. It is at risk with an eccentric contraction while the hip is extended and the knee flexed, thus placing the fibers at maximal stretch while initiating contraction. It has a high percentage of Type II muscle fibers, resulting in fast and forceful contractions, and it functions to decelerate knee flexion at heel strike. As a result of these factors, the rectus is prone to injury during activities involving powerful acceleration or deceleration and during those involving the coupling of hip and knee kinematics, such as sprinting and kicking.

Proximal quadriceps tears have been reported as avulsions of the direct head,[4] injuries at the myotendinous junction of the direct head, and indirect head myotendinous disruptions.[2] To our knowledge, there have been no reports of avulsions of the indirect head from its origin. MRI is an excellent imaging modality to differentiate between these injuries, and it is a useful adjunct to preoperative planning.

Because of its rare occurrence, no controlled trials have been conducted for treatment of direct head avulsions or, to our knowledge, for treatment of proximal rectus ruptures in general. However, Straw et al[4] describe their treatment of a chronic rupture of the direct head in a semiprofessional soccer player. Their report offers objective data showing decreased function of the quadriceps and the hamstring muscles as a result of this patient's nonoperative treatment. The impact on the hamstrings was hypothesized to be a result of hamstring wasting attributed to a decreased need for their antagonist function. The power and performance of both muscle groups improved to levels comparable to those of the uninjured side after repair and rehabilitation of the rectus tear. This work suggests that the long-term effect of an unrepaired rectus femoris tear is more than cosmetic. It may lead to subjective and objective findings of weakness and loss of power: sequelae that may be intolerable to the performance athlete. Our postoperative use of a knee immobilizer is consistent with that of Straw et al,[4] who indicated that immobilizing the hip was impractical and not as crucial as limiting the knee, with its much greater arc of potential eccentric motion and the consequent risk of stress to the repair.

With little published data in the literature, there is no definitive treatment protocol to recommend. Nonoperative treatment could be an acceptable alternative in this case, especially because the indirect head was still in continuity. A period of rest, followed by a rehabilitation program similar to those of other Type III musculotendinous injuries, could be justified. However, given the options, our patient opted for surgical repair of his injury.

After direct primary repair of the avulsion, our patient made a full recovery and was able to return to full military duty and resume unrestricted activity. Failure to repair this injury may have resulted in a permanent decrease in quadriceps function and, possibly, hamstring function. Although the low-demand patient may find this to be tolerable, it would likely prove unacceptable for high-demand individuals, such as performance athletes and military members. As such, we recommend direct repair in this patient population.

REFERENCES

1. Ekstrand J, Hilding J. The incidence and differential diagnosis of acute groin injuries in male soccer players. *Scand J Med Sci Sports.* 1999;9(2):98-103.
2. Hasselman CT, Best TM, Hughes CT, et al. An explanation for various rectus femoris strain injuries using previously undescribed muscle architecture. *Am J Sports Med.* 1995;23(4):493-499.
3. Renstrom P, Peterson L. Groin injuries in athletes. *Br J Sports Med.* 1980;14(1):30-36.
4. Straw R, Colclough K, Geutjens G. Surgical repair of a chronic rupture of the rectus femoris muscle at the proximal musculotendinous junction in a soccer player. *Br J Sports Med.* 2003;37(2):182-184.
5. Zeiss J, Saddemi SR, Ebraheim NA. MR imaging of the quadriceps tendon: normal layered configuration and its importance in cases of tendon rupture. *AJR Am J Roentgenol.* 1992;159(5):1031-1034.