

# Open Isolated Distal Rectus Tendon Repair



Eddie K. Afetse, B.S., B.A., Ajay C. Kanakamedala, M.D., Haruki Nishimura, M.D., Ph.D.,  
Olivia M. Jochl, A.B., and Joseph J. Ruzbarsky, M.D.

**Abstract:** Isolated distal rectus femoris avulsions from the common quadriceps tendon are rare and may be missed due to the integrity of the remaining extensor mechanism. In healthy, active patients, surgical repair is recommended due to the potential for persistent pain, cramping, and weakness. In the case of isolated distal rectus femoris avulsions, however, there are important surgical considerations and differences when compared with the treatment of complete quadriceps tendon ruptures. This Technical Note describes an open repair of an isolated distal rectus femoris rupture with reinsertion into the common quadriceps tendon.

Injuries to the quadriceps complex are a prevalent source of pain and weakness in athletes, especially for those who participate in sports that involve repetitive kicking and sprinting efforts. The rectus femoris is the most commonly affected muscle in quadriceps complex injuries.<sup>1,2</sup> The direct head of the rectus femoris originates proximally from the anterior inferior iliac spine (AIIS) above the iliofemoral ligament, while the reflected head originates from the hip capsule and the superior acetabular rim.<sup>3</sup> The distal end of the rectus femoris muscle connects with the vastus medialis, vastus lateralis, and vastus intermedius muscles to form the common quadriceps tendon, which attaches to the patella.

Eccentric contractions of the rectus femoris during sporting activities can lead to various injuries, including proximal avulsions from the AIIS or myotendinous junction ruptures, involving the direct head, the reflected head, or both.<sup>3</sup> Although there are numerous reports on the surgical management of proximal rectus femoris avulsions, there is limited information available on the surgical management of distal rectus femoris

ruptures. In this Technical Note and associated video (Video 1), we present a technique for open direct repair of isolated distal rectus femoris ruptures with reintegration into the common quadriceps tendon.

## Technique

### Indications and Preoperative Planning

Indications for open repair of distal rectus femoris ruptures include reduced knee extension strength coupled with anterior knee/thigh pain and swelling. In cases of suspected proximal retraction or involvement of the injury, magnetic resonance imaging without contrast of the thigh and the knee should be obtained (Fig 1). The advantages and disadvantages of this technique are shown in Table 1.

### Open Distal Rectus Tendon Repair

**Patient Setup.** The patient is placed in a supine position with a bump under the ipsilateral hip. General anesthesia is administered. A sterile tourniquet is available but not applied. The entire ipsilateral extremity up to the iliac crest is prepped and draped to allow access to the entire rectus femoris (Fig 2A).

**Approach.** A 5-cm longitudinal incision is made in the midline and centered just distal to the retracted rectus femoris bulge that is often palpable (Fig 2B). Dissection is carried down to the level of the rectus femoris tendon and the common quadriceps tendon. Next, the fascia or pseudo-capsule overlying the rectus femoris tendon is incised, and a fluid blush or hematoma is frequently encountered in the event of acute ruptures.

From the Steadman Philippon Research Institute, Vail, Colorado, U.S.A. (E.K.A., A.C.K., H.N., O.M.J., J.R.) and The Steadman Clinic, Vail, Colorado, U.S.A. (A.C.K., J.R.).

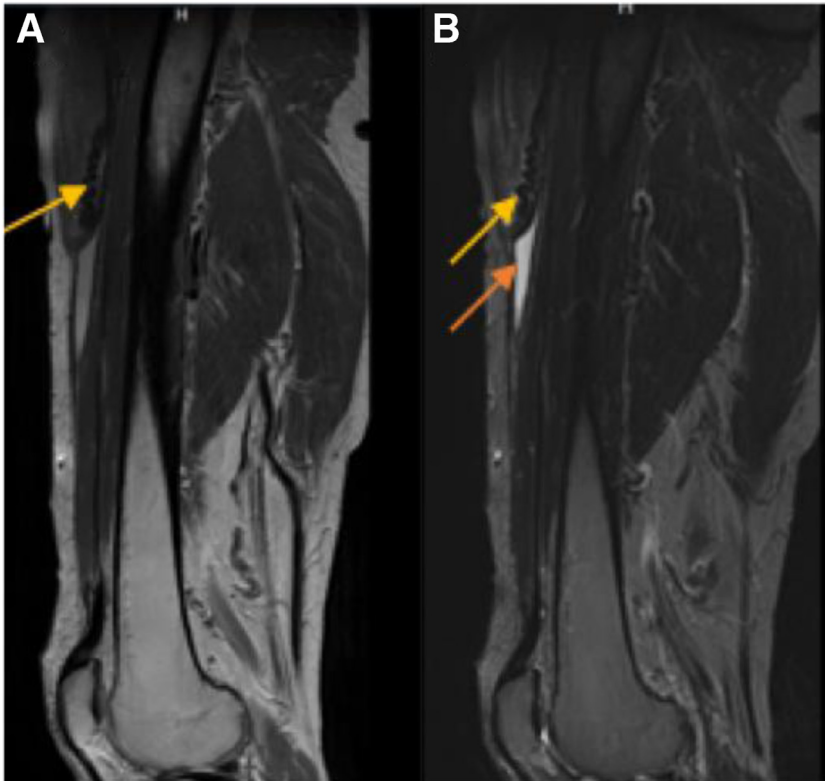
Received February 15, 2024; accepted March 13, 2024.

Address correspondence to Eddie Afetse, B.S., B.A., Steadman Philippon Research Institute, 181 W. Meadow Dr, Vail, CO, 81657, U.S.A. E-mail: [kafetse@sprivaail.org](mailto:kafetse@sprivaail.org)

© 2024 THE AUTHORS. Published by Elsevier Inc. on behalf of the Arthroscopy Association of North America. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

2212-6287/24250

<https://doi.org/10.1016/j.eats.2024.103004>



**Fig 1.** Sagittal magnetic resonance imaging of the right thigh. Plain T2-weighted image (A) indicates the rupture and proximal retraction of the rectus femoris (yellow arrow), and plain short tau inversion recovery image (B) demonstrates both the proximal retraction of the rectus femoris (yellow arrow) and the effusion (orange arrow).

**Preparation of Distal Rectus Femoris Tendon.** The tendinous portion of the rectus femoris is then identified and mobilized, which can require significant releasing from the scar in subacute and chronic cases (Fig 2C). These adhesions and any tethering to the adjacent vastus musculature are freed and dissected using forceps and Metzenbaum scissors. Next, a No. 2 FiberLoop suture (Arthrex) is used to whipstitch the distal tendon and fascia (Fig 2D).

An assistant holds tension on the retracted muscle for approximately 5 minutes to elongate the muscle-tendon and sarcomere units. While an assistant holds tension, the dissection is carried distally in the wound to identify the donor site on the common extensor tendon. Next, the tendon mobility is reassessed to see if the tendon can be advanced to the donor site.

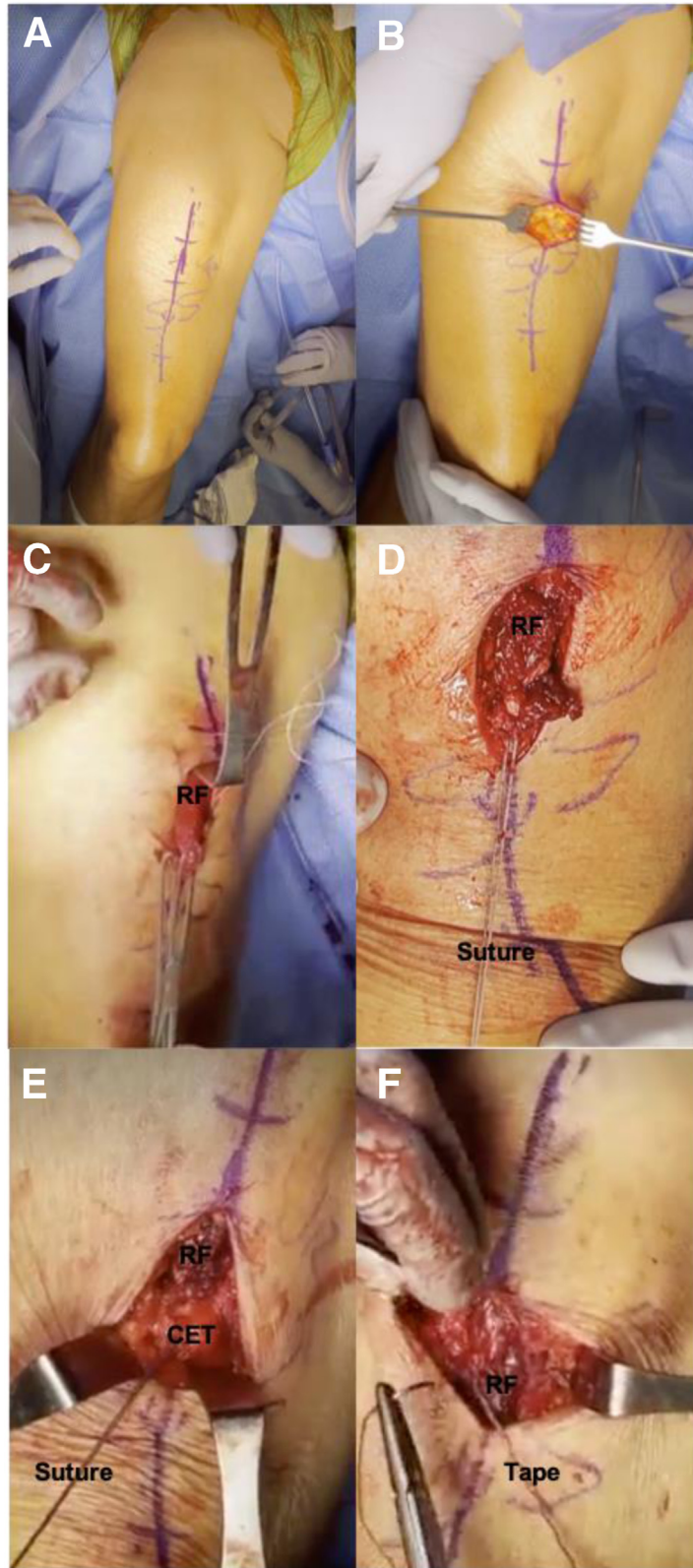
**Repair.** With the knee in full extension, a free needle is used to pass 1 limb of the tendon's whipstitch suture as far distally as possible and is then passed into the common extensor tendon approximately 8 cm distally.

**Table 1.** Advantages and Disadvantages

Advantages	Disadvantages
Greater healing potential with a higher chance of complete functional recovery	Risk of impaired knee flexion
Least likely to result in fibrosis	Risk of gait instability
	Risk of infection

The other limb of the FiberLoop whipstitch suture is then passed in a Mason-Allen-type fashion. Using a tension slide technique, the rectus femoris tendon is pulled distally to its insertion on the common quadriceps tendon, effectively providing maximal lengthening of the previously shortened rectus femoris tendon, and knots are tied (Fig 2E). Next, an epitendinous stitch using a 1.3-mm high-strength nonabsorbable tape suture (1.3 mm SutureTape; Arthrex) is run on both sides of fascia to act as secondary reinforcement of the advanced muscle (Fig 2F). Prior to proceeding with closure, the knee is gently flexed to assess the amount of knee flexion that can be achieved before there is any at the repair site. This will help determine the maximal amount of flexion that will be allowed immediately postoperatively and facilitate early, safe range of motion. The wounds are copiously irrigated and closed in a standard layered fashion. Pearls and pitfalls of this procedure are summarized in Table 2.

**Rehabilitation.** Postoperatively, the patient is placed into a hinged knee brace locked in extension for ambulation and is allowed to weight bear as tolerated. The brace is discontinued at 6 weeks. Physical therapy begins at 2 weeks and includes safe passive and active-assist knee flexion up to the degree obtained intraoperatively and then proceeds by adding 10° a week. For athletes, return-to-competition decisions are made based on return-to-sport testing at 4 to



**Figure 2.** Operative technique of the right knee. (A) The patient is placed in the supine position, and the entire ipsilateral extremity up to the iliac crest is prepped and draped. (B) A 5-cm incision is made just distal to the superficial thigh bulge that is present, and dissection is carried down to the level of the deep fascia. (C) The tendinous portion of the distal rectus femoris is identified and mobilized. (D) A strong nonabsorbable suture is used to whipstitch the distal tendon and fascia. (E) The limbs of the strong suture are passed into the common extensor tendon and tied with the knee in full extension. (F) An epitendinous stitch using small suture tape is run on both sides of fascia to act as secondary reinforcement of the advanced muscle. (CET, common extensor tendon; RF: Rectus femoris.)

**Table 2.** Pearls and Pitfalls of Open Distal Rectus Femoris Repair

Pearls	Pitfalls
In young and active patients with isolated rectus femoris distal tendon tears, repair should be attempted due to the significant contribution made to the rectus muscle to the extensor mechanism.	In the setting of a fall onto a flexed knee with knee muscle bulge of the anterior thigh with an intact extensor mechanism, ultrasound or magnetic resonance imaging should be obtained to rule out isolated rectus femoris tendon ruptures.
The combination of a tendon-to-tendon stitch with a running epitendinous/fascial stitch will help obtain a stronger repair.	To ensure optimal excursion, the distal tendon should be whipstitched, adhesions freed, and tension should be held on the tendon in order to aid in freeing of the retracted muscle belly and in order to relax the sarcomere units.
Intraoperative assessment of safe knee flexion allows for early appropriate postoperative knee flexion, which is tailored to each individual patient.	The repair should commence with the knee in full extension or hyperextension to allow for maximum advancement of the avulsed tendon.
A palpable and visible bulge in the upper anterior thigh after trauma with maintained ability to straight leg raise should heighten suspicion for a distal rectus tendon avulsion.	

6 months when side-to-side comparative indices are within a 10% difference.

### Discussion

In this Technical Note, we describe open surgical repair of an isolated distal rectus femoris tendon rupture. While quadriceps muscle strains frequently occur in young athletes, isolated distal ruptures of the rectus femoris muscle are a rare occurrence, with only a limited number of published reports to date.<sup>4-8</sup> While both the nonoperative and operative management of proximal rectus femoris injuries can yield favorable clinical outcomes, there are fewer studies examining outcomes after surgical and nonsurgical treatment of complete distal rectus femoris ruptures. Although most prior reports have described nonoperative treatment,<sup>4,6,8</sup> the optimal treatment is unclear. Given that rectus femoris constitutes at least one-fourth of the extensor mechanism, we feel that surgical repair of these injuries may yield optimal outcomes and minimize the risk of irreversible weakness in patients with reduced knee extension strength or persistent pain,

To our knowledge, there are currently 2 case reports on the conservative management of rectus femoris tendon distal tendon rupture. Fernandes et al.<sup>5</sup> reported the successful nonsurgical treatment of a grade 4c rectus femoris muscle injury in a professional football player who returned to play after 21 weeks, remained injury free for over a year following their return, and continues to perform at the professional level. Similarly, Weber et al.<sup>8</sup> described the successful conservative treatment of a complete distal rectus femoris muscle tear in a 42-year-old male nonprofessional triathlon athlete. In this instance, the athlete opted for nonoperative treatment due to the absence of functional deficits or muscle weakness 3 months postinjury.

Despite the successful outcomes reported in the aforementioned cases, more studies are needed to validate the conservative management of rectus femoris

distal tendon tear. Managing a complete muscle tear is extremely challenging. The intrinsic healing potential of the injured muscle without surgical repair is typically reduced with greater potential for fibrosis and incomplete restoration of function or deterioration. The rehabilitation process is rigorous, and frequently, inefficient healing occurs due to the formation of scar tissue within the muscle structure. Therefore, surgical management should be considered in the case of isolated rectus femoris tendon ruptures.

Limited evidence exists on open isolated distal rectus femoris tendon repair. However, the body of literature regarding the surgical management of quadriceps and patellar tendon rupture is significantly broader, and therefore, we can infer that similar results for this technique may be possible, such as a potentially higher rate of tendon healing, in addition to the possibility of performing accelerated postoperative rehabilitation in a safer manner because of the added strength and a decreased incidence of retears. However, this has yet to be validated in rectus femoris repairs.

### Disclosures

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: A.C.K. is on the Editorial Board for *Arthroscopy: The Journal of Arthroscopic and Related Surgery*. J.J.R. is a consultant or advisor for Smith & Nephew. All other authors (E.K.A., H.N., O.M.J.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### References

1. Begum FA, Kayani B, Chang JS, Tansey RJ, Haddad FS. The management of proximal rectus femoris avulsion injuries. *EFORT Open Rev* 2020;5:828-834.



2. Mendiguchia J, Alentorn-Geli E, Idoate F, Myer GD. Rectus femoris muscle injuries in football: A clinically relevant review of mechanisms of injury, risk factors and preventive strategies. *Br J Sports Med* 2013;47:359-366.
3. Knapik DM, Trasolini NA, Diaz CC, Chahla J, Forsythe B. Avulsion injuries and ruptures of the proximal rectus femoris in skeletally mature, high-level athletes: A critical analysis review. *JBJS Rev* 2021;9:e20.00269.
4. Cross TM, Gibbs N, Houang MT, Cameron M. Acute quadriceps muscle strains: Magnetic resonance imaging features and prognosis. *Am J Sports Med* 2004;32:710-719.
5. Fernandes A, Pinto J, Cunha P, et al. Complete distal rupture of the rectus femoris in an elite football player: A non-operative treatment. *Cureus* 2023;15, e45494.
6. Knapik DM, Alter TD, Ganapathy A, Smith MV, Brophy RH, Matava MJ. Isolated, full-thickness proximal rectus femoris injury in competitive athletes: A systematic review of injury characteristics and return to play. *Orthop J Sports Med* 2023;11:23259671221144984.
7. Matar HE, Sanger R. Isolated distal rectus femoris rupture. *Br J Hosp Med (Lond)* 2019;80:617.
8. Weber M, Knechtle B, Lutz B, Stutz G, Baumann P. Nonoperative treatment of a complete distal rectus femoris muscle tear. *Clin J Sport Med* 2010;20: 493-494.