

Reconstruction of a Chronic Quadriceps Tendon Rupture After Multiple Failed Repair Attempts: Technique and Case Report

Lauren Edge, DO¹; Elizabeth McLeod, DO, MSc¹; Om Pathak, OMSIV¹; Justin Bartley, MD²

¹Burrell College of Osteopathic Medicine, Las Cruces, New Mexico

²Lovelace Medical Group, Albuquerque, New Mexico

Corresponding Author Justin Bartley, MD. Lovelace Medical Group, 101 Hospital Loop NE, Suite 201, Albuquerque, NM 87109 (email: justin.h.bartley@gmail.com).

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ABSTRACT

Rupture of the quadriceps tendon is a relatively uncommon injury that requires prompt surgical intervention to restore the function of the extension apparatus of the knee. Early, definitive surgical intervention generally produces excellent results. In the case of delayed surgery or re-rupture, the tendon is often retracted and scarred, thus complicating subsequent repairs and resulting in poor outcomes. We describe a middle-aged man who presented 4 years after his initial quadriceps rupture, following two repair attempts that failed. Upon presentation, he was unable to perform any active extension at the knee, and he ambulated with the use of a hinged brace locked in extension. Owing to central tendon deficiency, previously described V-Y advancement was contraindicated, so we developed a novel surgical technique. His quadriceps tendon was successfully reconstructed using a combination of soft-tissue releases, tendon transposition, and allograft reinforcement. His postoperative course was uneventful, and at 5 months, he was ambulating comfortably without a brace, showing full active motion and good quadriceps strength.

Keywords: Tendon Injuries/Surgery, Lower Extremity, Orthopaedic Procedures

INTRODUCTION

Complete ruptures of the quadriceps tendon are relatively rare but debilitating injuries resulting in the loss of the extensor mechanism of the knee.¹ These injuries occur most commonly in middle-aged men and people with certain predisposing conditions, including diabetes, gout, renal failure, rheumatoid arthritis, fluoroquinolone use, and corticosteroid use.²⁻⁵ Traditional surgical treatment consists of a transosseous repair, in which sutures attached to

the quadriceps tendon are passed through vertical tunnels in the patella and secured at the inferior pole.^{2,3} More recently, the use of suture anchors has grown in popularity owing to the advantage of limiting surgical exposure and improving the biomechanical strength of the repair.^{6,7} When treated with prompt surgical intervention, regardless of repair technique, outcomes are generally excellent, with multiple studies reporting good to excellent subjective results, frequent return to pre-injury activity, and good range of motion and strength.^{2,3,8} When surgical repair is delayed, outcomes are far less favorable, commonly resulting in unsatisfactory results and limited range of motion.^{3,8} Failure of acute quadriceps repair is a relatively rare complication. In a systematic review including 319 patients with quadriceps tendon rupture who underwent primary repair, Ciriello et al³ reported failures in only 2.0% of cases. In the case of a failure, subsequent repairs are often complicated by tendon scarring and retraction. There is limited literature on surgical technique and management in this circumstance.⁹

We describe a patient who underwent quadriceps tendon reconstruction utilizing a novel technique following two unsuccessful surgical repairs. A successful result was obtained by transposing the vastus lateralis and medialis to midline, and then using an Achilles tendon allograft to reinforce the reconstructed quadriceps tendon (Figure 1). This case report represents a novel approach to surgical management in a patient with failed previous repairs and persistent loss of active knee extension.

CASE REPORT

A 53-year-old African-American man presented to our clinic with no active extension of the right knee 4 years after two unsuccessful quadriceps repairs. In the initial, acute, post-injury period, the

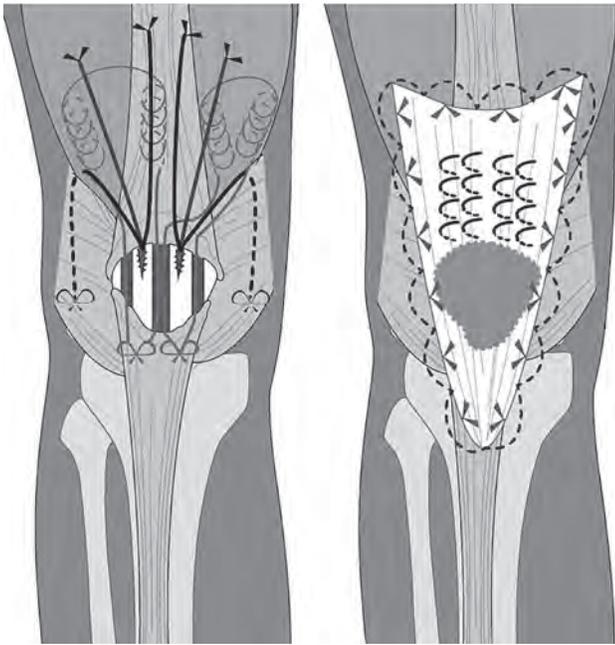


Figure 1. Schematic showing repair followed by graft augmentation. Figure printed with signed permission from Mary Ellis.



Figure 2. Right knee with evident defect above the patella and healed previous midline incision.

patient underwent quadriceps tendon repair with the traditional transosseous suture technique. His original postoperative course was complicated by a fall 3 weeks after surgery, resulting in dehiscence of the surgical incision and failure of the repair. Revision surgery was performed shortly thereafter using the same traditional bone-tunnel technique. Upon presentation to our clinic, his pain and swelling were managed with anti-inflammatory medication, and he had received several intra-articular steroid injections from other providers. His medical history was significant for a prior history of smoking, although now he is smoke-free. A complete preoperative workup showed no evidence of malnutrition, infection, or underlying diabetes.

His physical examination was remarkable for a reciprocal heel-toe gait, using a cane and hinged-knee brace locked in extension. The patient had a palpable defect 8 cm proximal to the superior pole of the patella,

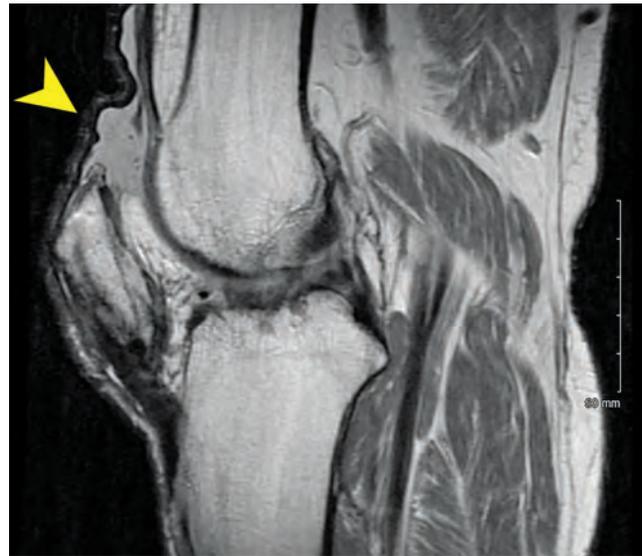


Figure 3. Magnetic resonance image showing complete rupture of the quadriceps tendon with retraction.

which was indicative of quadriceps tendon retraction and atrophy (Figure 2). He showed full, passive range of motion of the knee but no active extension whatsoever. The remainder of his examination was noncontributory. Magnetic resonance imaging confirmed the diagnosis of quadriceps tendon rupture with severe atrophy, severe retraction, and no discernible tendon fibers intact (Figure 3).

OPERATIVE TECHNIQUE

The repair was completed through the previous midline incision. The tear had extended through the medial and lateral retinaculum, resulting in a 15-cm retraction of the entire quadriceps tendon complex. No evidence of infection was observed, but a deep culture was completed that was ultimately negative. Quadriceps mobilization was completed with release of considerable scar tissue superficial and deep to the quadriceps, followed by medial and lateral release to try to obtain length. The quadriceps had atrophied so extensively that there was very little reasonable central tendon tissue to work with; therefore, the decision was made to transpose the vastus lateralis and medialis to the midline to reconstruct the quadriceps tendon. These tendons were transposed and combined using two 5-0 high-strength, nonabsorbable sutures in Krackow fashion, resulting in four tails exiting the quadriceps tendon distally (Figure 4). The superior pole of the patella was freshened with subsequent placement of two 5.5-mm triple loaded PEEK corkscrew anchors (Zimmer Biomet; Warsaw, IN) in between three vertical 3.5-mm bone tunnels (Figure 1 and Figure 5). Suture tails from the quadriceps tendon were then passed distally through the bone tunnels, while four sutures from each anchor were passed proximally through the previously placed Krackow sutures to create a “gift box” construct (Figure 1 and Figure 6). The additional two

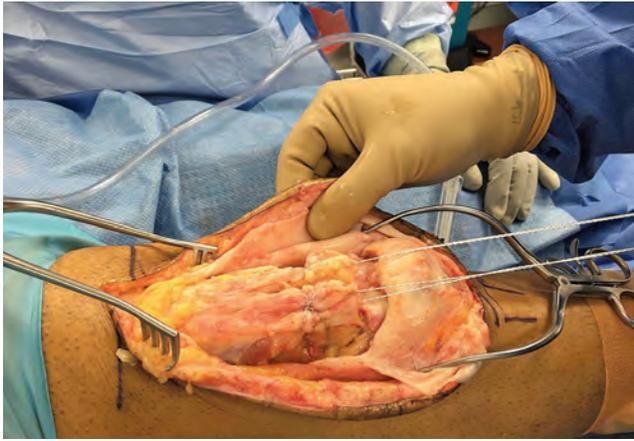


Figure 4. Quadriceps tendon after medial and lateral release with transposition.

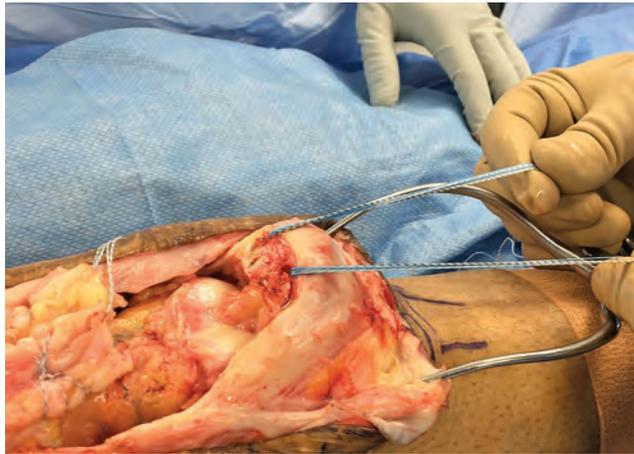


Figure 5. Suture anchors at the superior pole of the patella.

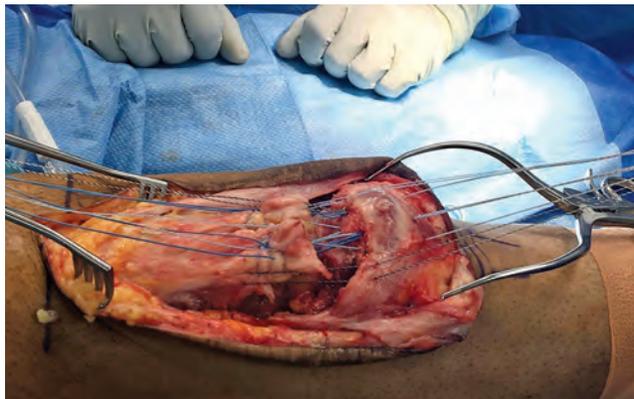


Figure 6. Following passage of sutures without tensioning or tying the suture repair.

sutures from each anchor were passed proximally at the outer margins of the reconstruction before passing distally to create a “pants over vest” construct (Figure 1 and Figure 6). Lastly, all sutures from the anchors were tied. The bone tunnel sutures tied over the inferior pole of the patella with the knee in maximum extension, thus creating excellent apposition of the reconstructed quadriceps to the superior pole of the patella without gap (Figure 7).

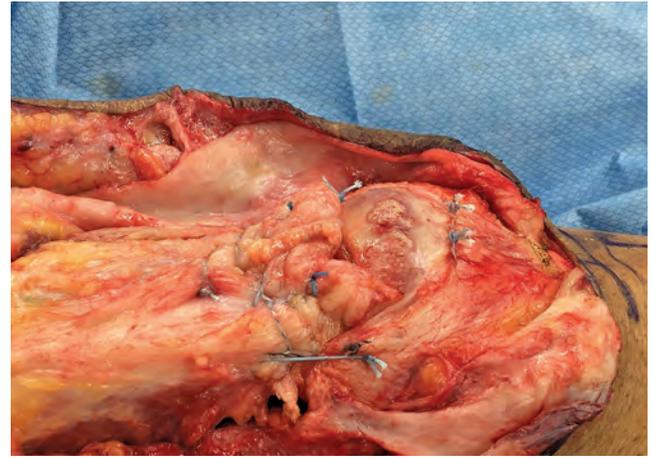


Figure 7. Quadriceps tendon repair after approximation to the patella.

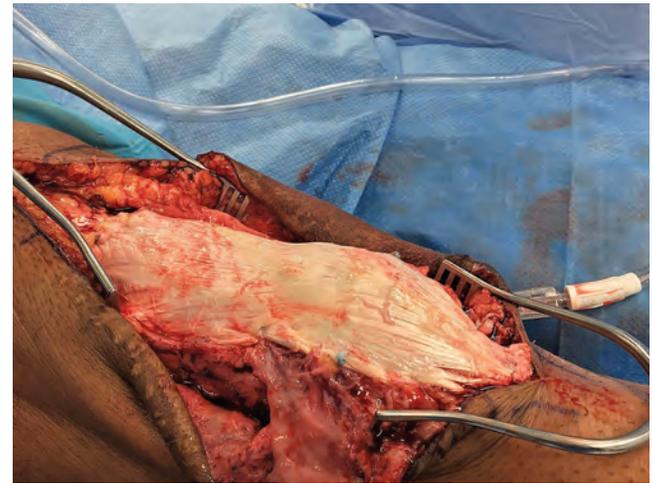


Figure 8. Achilles allograft positioned over distal quadriceps, patella, and patellar tendon.

The decision was made to further support the reconstructed quadriceps tendon using a nonirradiated Achilles allograft soaked in a vancomycin-saline mixture. The graft was positioned over the distal quadriceps, patella, and patellar tendon. Simple intermittent sutures were placed with a high-strength, nonabsorbable suture around the entire periphery of the graft (Figure 1 and Figure 8), which was reinforced with absorbable intermittent sutures throughout the substance of the graft. The retinaculum was repaired to the newly constructed quadriceps tendon using 2-0 high-strength, nonabsorbable sutures in a figure-of-eight fashion. The surgical wound was closed in a layered fashion, and the patient was placed in a hinged-knee brace locked in extension.

The patient had an uneventful postoperative recovery. He was kept non-weight bearing for 6 weeks and subsequently transitioned to weight bearing as tolerated with the brace locked in extension as he gradually increased his range-of-motion (0-30° initially and 30° progression every 2 weeks). The knee brace was unlocked during ambulation at 3 months

postoperatively, and he began strengthening the knee. At 5 months postoperatively, the patient was ambulating without pain or brace, and he showed 0° to 120° of active motion with good strength in extension of the knee. He was cleared to continue strengthening and pursue progressive activity as tolerated.

DISCUSSION

The rarity of unsuccessful quadriceps tendon repair limits the literature regarding intervention in the chronic setting. The poor tissue quality and loss of tendon length resulting from surgical delay leave patients with worse outcomes than repairs performed acutely.^{2,8-10} Patients are often burdened with severe limitations, including complete loss of active extension, requiring rigid knee braces and assistive devices. To address the unique challenges of a chronic repair failure, we performed the surgical technique of quadriceps reconstruction with soft-tissue releases,¹⁰ tendon transposition, reinforced fixation, and graft reinforcement.^{3,9,11}

Regarding lengthening measures, the well-known Codivilla method consists of an inverted V-to-Y advancement of the quadriceps tendon to gain length and is useful to address considerable shortening in chronic injuries.¹⁰ A second method, and our chosen technique, is medial and lateral release along the distal borders of the vastus medialis and lateralis, providing adequate mobility for apposition to the superior pole of the patella.¹²

After quadriceps length is developed, attention is turned to the quality of the residual tendon and the potential need for additional reinforcement. Even after the transposition of the vastus lateralis and medialis to reconstruct the quadriceps tendon, the residual tissue is often of poor quality. Techniques in modern literature describe a hamstring tendon (allograft or autograft) through transverse bone tunnels in the patella,¹³ or Achilles tendon allograft with bone block fixation in the patella.⁹ In revision cases, with pre-existing longitudinal bone tunnels, there is a considerable concern for patellar fracture, which guided our decision to use an Achilles allograft overlay to reinforce the reconstruction. The technique depicted in this report provides an additional novel and robust approach to reconstructing a chronically torn quadriceps tendon in the setting of multiple previous failures, poor tissue quality, and considerable tendon retraction with atrophy.

REFERENCES

1. Moura D, Fonseca F. Total ruptures of the extensor apparatus of the knee. *Rev Bras Ortop.* 2016;51(6):640-645. doi: 10.1016/j.rboe.2016.10.012.
2. Boudissa M, Roudet A, Rubens-Duval B, et al. Acute quadriceps tendon ruptures: a series of 50 knees with an average follow-up of more than 6 years. *Orthop Traumatol Surg Res.* 2014;100(2):213-216. doi: 10.1016/j.otsr.2013.09.014.
3. Ciriello V, Gudipati S, Tosounidis T, et al. Clinical outcomes after repair of quadriceps tendon rupture: a systematic review. *Injury.* 2012;43(11):1931-1938. doi: 10.1016/j.injury.2012.08.044.
4. Ilan DI, Tejwani N, Keschnner M, et al. Quadriceps tendon rupture. *J Am Acad Orthop Surg.* 2003;11(3):192-200. doi: 10.5435/00124635-200305000-00006.
5. Plessner S, Keilani M, Vekszler G, et al. Clinical outcomes after treatment of quadriceps tendon ruptures show equal results independent of suture anchor or transosseous repair technique used - A pilot study. *PLoS One.* 2018;13(3):e0194376. doi: 10.1371/journal.pone.0194376.
6. Kindya MC, Konicek J, Rizzi A, et al. Knotless suture anchor with suture tape quadriceps tendon repair is biomechanically superior to transosseous and traditional suture anchor-based repairs in a cadaveric model. *Arthroscopy.* 2017;33(1):190-198. doi: 10.1016/j.arthro.2016.06.027.
7. Amini MH. Quadriceps tendon repair using knotless anchors and suture tape. *Arthrosc Tech.* 2017;6(5):e1541-e1545. doi: 10.1016/j.eats.2017.06.013.
8. Siwek CW, Rao JP. Ruptures of the extensor mechanism of the knee joint. *J Bone Joint Surg Am.* 1981;63(6):932-937.
9. Druskin SC, Rodeo SA. Novel treatment of a failed quadriceps tendon repair in a diabetic patient using a patella-quadriceps tendon allograft. *HSS J.* 2013;9(2):195-199. doi: 10.1007/s11420-012-9285-9.
10. Scuderi C, Schrey EL. Ruptures of the quadriceps tendon. *Arch Surg.* 1950;61(1):42-54. doi: 10.1001/archsurg.1950.01250020045006.
11. Rocha de Faria JL, Barroso de Matos M, de Araújo Barros Cobra HA, et al. Surgical Treatment of Chronic Rupture of the Quadriceps Using a Modified Pulvertaft Weave Technique. *Arthrosc Tech.* 2019;8(10):e1163-e1169. doi: 10.1016/j.eats.2019.06.006.
12. Pocock CA, Trikha SP, Bell JS. Delayed reconstruction of a quadriceps tendon. *Clin Orthop Relat Res.* 2008;466(1):221-224. doi: 10.1007/s11999-007-0002-9.
13. Leopardi P, Vico Gd, Rosa D, et al. Reconstruction of a chronic quadriceps tendon tear in a body builder. *Knee Surg Sports Traumatol Arthrosc.* 2006;14(10):1007-1011. doi: 10.1007/s00167-006-0044-7.