

# Suture Anchor Repair of Quadriceps Tendon Rupture

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**Abstract:** Quadriceps tendon rupture is an uncommon knee injury that warrants surgical treatment. Traditional surgery has been relatively successful, using trans-patellar-drilled suture repair for tendo-osseous avulsions and simple suture repair for intra-tendinous midsubstance tears. However, recent evidence has identified a unique complication previously unreported in the literature in these patients (displaced longitudinal patellar stress fracture). Suture anchor-based repair has biomechanical strength equivalent to trans-patellar-drilled repair and avoids the potential complication of postoperative fracture. A “pulley technique” with complete footprint coverage has been used for other tendinous avulsions (eg. proximal hamstring) and is described in this article. [*Orthopedics*. 2014; 37(3):183-186.]



**K**nee extensor mechanism rupture is an uncommon, but significant, injury. The inability to actively extend the knee precludes normal gait. Quadriceps tendon injuries usually result from a simple fall in middle-aged men.<sup>1</sup> Although

low-energy fall mechanism of injury is most common, spontaneous rupture tends to occur in a subset of medical conditions (**Table**).<sup>2,3</sup> Patients with quadriceps tendon ruptures are typically older (>40 years) than those who sustain patellar ten-

don injuries (<40 years).<sup>4</sup> Optimal treatment mandates early evaluation, diagnosis, and surgical treatment,<sup>5</sup> as operative treatment of chronic ruptures and nonsurgical treatment have inferior outcomes.<sup>2,6</sup>

Operative management of quadriceps tendon rupture has traditionally used either longitudinal (superior to inferior) trans-patellar drill holes (for tendinous avulsions) or simple suture repair with or without reinforcement (for intra-tendinous midsubstance ruptures).<sup>2</sup> The complication and re-rupture rates after surgical repair have been approximately 14% and 2%, respectively.<sup>2</sup> However, recent literature has demonstrated a previously unreported complication of displaced patellar stress fracture in patients undergoing extensor mechanism reconstruction using trans-patellar drill holes.<sup>7</sup> In addition, normal anatomic studies of the quadriceps-patella tendo-osseous junction illustrate a more superficial junction (anterior 50%) with a footprint on the superior and anterior surface.<sup>8</sup> Recently, surgeons

have used a novel “pulley technique” with suture anchors to anatomically re-create the anatomic footprint for other tendinous avulsion repairs, including proximal hamstrings.<sup>9,10</sup> Therefore, given the drill hole stress-riser effect and reproduction of normal anatomy, the authors recommend a suture anchor-based pulley technique repair that best replicates the normal anatomic footprint and may potentially avoid the risk of patellar fracture.

## SURGICAL TECHNIQUE

A 54-year-old healthy man sustained a low-energy fall and a triad of acute pain, inability to straight-leg raise, and a palpable gap above the patella (**Figure 1**). Radiographs and magnetic resonance imaging demonstrated a quadriceps tendon avulsion from the patella. Surgical treatment was elected and performed 3 days after injury.

General anesthesia with muscle relaxation was used, with the patient supine. A tourniquet was not used (avoids restriction of quadriceps mo-

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Table	
Causes of Both Traumatic and Atraumatic Quadriceps Tendon Rupture	
Mechanism	Inciting Event/Disease
Traumatic	Eccentric quadriceps contraction during simple fall (low energy)
	Sports injuries
	Penetrating injuries
Atraumatic	Chronic renal failure
	Uremia
	Hyperparathyroidism
	Diabetes mellitus
	Rheumatoid arthritis
	Systemic lupus erythematosus
	Psoriasis/psoriatic arthritis
	Gout
	Obesity
	Anabolic steroid use
	Chronic corticosteroid use
	Chronic statin use
Quinolone use	
Collagen gene variants	

bility). A midline anterior skin incision was employed, with superior extension 4 cm above the superior pole of the patella to the midpoint of the patella inferiorly. The tendinous void was identified with sharp dissection through layer I, expressing a large volume of liquefied hematoma. Extension of the fascial incision superiorly allowed retraction medially and laterally for identification of medial and lateral patellar retinacular tears, in addition to the quadriceps tendon avulsion, retracted 2 cm (Figure 2). Loose fibrous tissue was debrided from the tendon end, while the anatomic footprint of the quadriceps tendon on the anterior patellar surface was identified. The superior/anterior surface of the patella was roughened to a lightly bleeding surface using rongeur and curette.

Three suture anchors were placed on the anterosuperior surface of the patella (central, medial, and lateral) (Figure 3). Each anchor was composed of polyetheretherketone (PEEK) biocomposite non-absorbable material (2.3-mm diameter), single-loaded with one #2 high-strength nonabsorbable polyethylene suture. The anchor was oriented so that the suture limbs exited the anchor in a line parallel to the long axis of the extensor mechanism. The proximal suture limb was woven through the quadriceps tendon from inferior to superior 4 cm, then back inferiorly using a simple weave stitch. The ascending pass was superficial and the descending deep. Both initial suture entry and final suture exit were deep to the tendon surface, approximately



**Figure 1:** Intraoperative superior view photograph of the right leg, in supine position, with knee extended. A palpable gap exists above the superior pole of the patella indicating quadriceps tendon rupture.

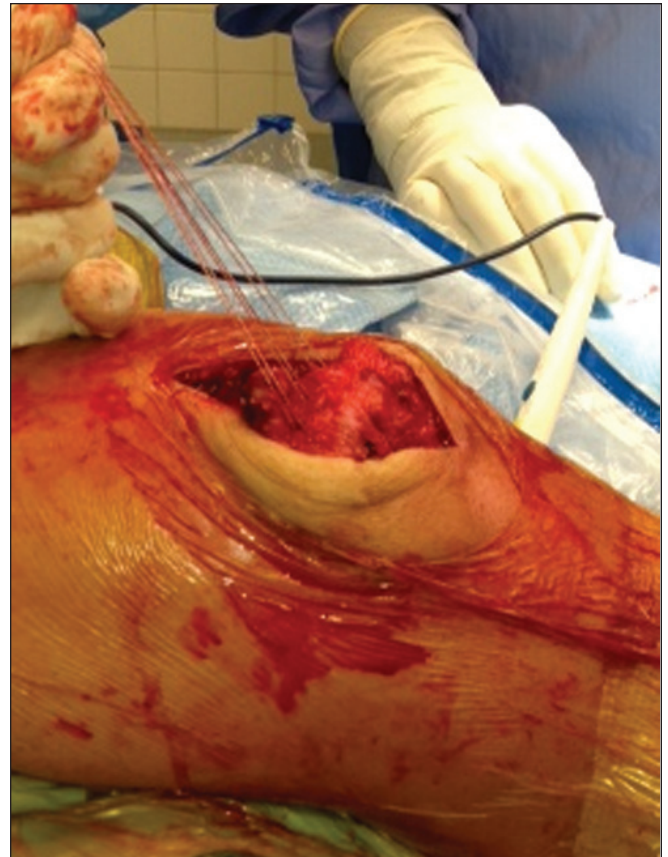
1.5 cm from the tendon end, such that when the knot was tied, the footprint on the anterosuperior patellar surface was completely covered with tendon. The pulley technique mechanism was initially effected by pulling the 3 free suture limbs at once to bring the tendon edge to bone, and tying the central limb first while holding the other 2 tightly coapted to the patella (Figure 4). An initial surgeon's knot was thrown, followed by reversing half-hitches. The other 2 limbs were similarly tied. The long untied suture remaining was not cut. A free needle was used to then pass the remaining suture from deep to superficial and a horizontal mattress stitch was achieved for each anchor at the distal tendon end. This covered the anatomic footprint of the quadriceps tendon on the patellar surface. The medial and lateral patellar retinacula were repaired using #2 Ethibond (Ethicon, Somerville, New

Jersey). The paratenon-fascia lata was closed using #0 Vicryl (Ethicon). The wound was copiously irrigated using sterile saline and the skin closed in layers.

Postoperatively, an intermittent flow cold-compression device and hinged brace were applied, allowing motion from 0° to 30° for the first 2 weeks postoperatively. The brace was locked in 0° extension while crutch-assisted gait was performed, weight bearing as tolerated. A transcutaneous electrical nerve stimulation unit was applied to the skin overlying the quadriceps. At 2 and 4 weeks postoperatively, motion was advanced from 0° to 60° and 0° to 90°, respectively. Full motion was allowed 6 weeks postoperatively. At 2 months postoperatively, the patient's motion was -2° to 120°. At short-term follow-up (9 months), the patient had normal gait, no pain or effusion, intact straight-leg raise (Video 1), 125° of knee



**Figure 2:** Intraoperative lateral view photograph of the right leg, in supine position, with knee flexed approximately 30°. The quadriceps tendon avulsion, with medial and lateral retinacular tears, from the superior pole of the patella, with retraction is shown.



**Figure 3:** Intraoperative lateral view photograph of the right leg, in supine position, with knee flexed approximately 30°. Polyetheretherketone suture anchor placement in the anterosuperior patella is shown.

flexion (Video 2), and 5/5 knee extension strength.

## DISCUSSION

The purpose of this investigation was to present a suture anchor-based pulley technique quadriceps tendon repair that best replicates the normal anatomic footprint and may potentially avoid the risk of patellar stress fracture. The senior author's (B.R.B.) 26-year computerized surgical database has revealed 26 acute primary non-augmented quadriceps tendon repairs. Three of these patients (11.5%) developed displaced longitudinal patellar fractures

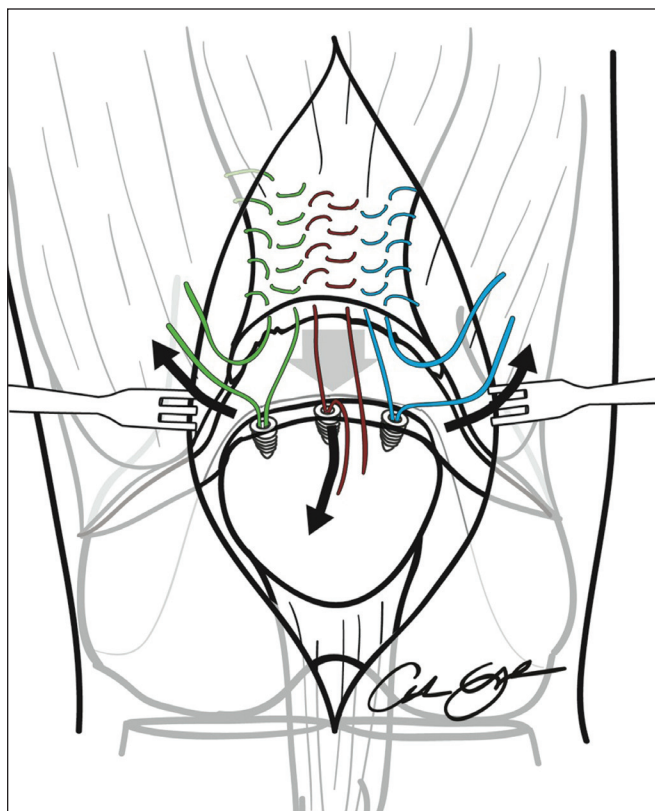
(2 required surgical treatment) via trans-patellar superior-to-inferior drill holes.<sup>7</sup> Given this risk, the senior author has changed his practice to suture anchor-based repair using PEEK anchors and high-strength nonabsorbable suture. Proximal hamstring avulsions have been successfully treated using a pulley technique suture anchor-based repair.<sup>9,10</sup> This technique is now being used for the quadriceps tendon. To the authors' knowledge, this is the first reported case of bio-composite suture anchor-based quadriceps repair in the literature.

A recent systematic review of 319 patients (mean age, 57 years) undergoing quadriceps tendon repair (50% of patients treated via transosseous patellar drill holes) revealed good or excellent motion and return to preinjury activities in most patients.<sup>2</sup> Further, the risk of complications was low, as was the rate of re-rupture (2%). Complications included heterotopic ossification, deep venous thrombosis, pulmonary embolism, and infection. Patellar fracture was not reported in that review. Biomechanical evidence has demonstrated no difference in cyclical loading

and load-to-failure strength between trans-patellar tendon suture and suture anchor repair.<sup>11,12</sup> Using a force of 150 N at a frequency of 0.5 Hz, no significant difference in displacement on initial loading or cyclical (1000 cycles) loading was identified comparing suture anchor and trans-patellar-drilled repair of quadriceps tendon ruptures.

Although implant cost of anchor repair is higher than that of trans-patellar-drilled suture repair, anchor repair may avoid potential complications. Both longitudinal and oblique drill holes through the





**Figure 4:** Illustration of the “pulley technique” with 1 suture limb in the tendon and 1 limb free. (Courtesy of Adam B. Yanke, MD.)

patella induce a stress-riser effect, with subsequent weakening and risk of fracture.<sup>7</sup> This is confounded by a potential foreign-body reaction to non-absorbable intraosseous suture, with subsequent osteolysis. In addition, chronic repetitive micromotion within the drilled tunnel creates suture grooves within the tunnel at their points

of fixation, with eventual loosening and tendon-bone gapping.<sup>13</sup> Further, suture anchor repair allows for a smaller skin incision over the patella, potentially reducing the risk of skin breakdown postoperatively. In addition, suture anchor repair is advantageous in that it avoids large non-absorbable suture knot placement

within the patellar tendon, as done with transosseous suture repair. Despite these benefits, the long-term complications of suture anchor repair are not yet known and require further evaluation.

No study has compared outcomes of quadriceps tendon repair using suture anchor-based repair vs trans-patellar-drilled suture repair. Further, no study has compared metallic and biocomposite anchor repair. Given the uncommon nature of the diagnosis, only large, multicenter, prospective, randomized studies would afford the opportunity to definitively address these issues.

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