

Quadriceps Tendon Repair Using Knotless Anchors and Suture Tape



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Abstract: Repair of a torn quadriceps tendon is necessary to restore the extensor mechanism of the knee. Traditional repair involves transosseous sutures tied over bone bridges on the inferior pole of the patella. Suture anchor repair has been shown to be stronger than transosseous repair and facilitates a smaller incision. Suture tape can improve the strength of the suture-tendon interface, and when combined with knotless anchors, leads to a stronger repair construct than even traditional suture anchors and surgeon-tied knots. Here we describe our technique of quadriceps tendon repair using suture tape and knotless anchors.

The extensor mechanism of the knee is critical for mobility and proper function of the knee. Complete disruption of the quadriceps tendon is relatively rare, often a result of eccentric contraction of the quadriceps during a fall. Chronic quadriceps tears lead to permanent impairment in the ability to extend the knee and perform basic lower extremity activities like ambulation.¹ Urgent operative repair is necessary to restore function to the extensor mechanism.² Clinical studies, however, demonstrate the continued functional deficits in patients who undergo quadriceps tendon repair. Many patients have loss of some degree of flexion, more than half do not return to their pre-injury level of athletic participation, and a large proportion have long-term quadriceps strength deficits.³⁻⁵

Traditional repair involves sutures passed through transosseous tunnels in the patella and tied over bone bridges. This, however, requires exposure from the quadriceps tendon to the inferior pole of the patella. Several studies have evaluated the relative strength of suture anchor repair with mixed results. A recent study

showed that repair using suture tape and knotless anchors has less displacement during cyclic loading, greater stiffness, and greater ultimate load to failure than both transosseous repair and suture anchor repair.⁶ This construct also eliminates knots that may cause soft tissue irritation in the prepatellar bursa and thin soft tissue envelope overlying the quadriceps tendon. We describe the surgical technique here ([Video 1](#)).

Technique

Positioning, Exposure, and Debridement

A well-padded tourniquet is placed as high as possible on the thigh. A small bump is placed under the hip to internally rotate the lower extremity to a more neutral position. After localizing the gap at the superior pole of the patella, a longitudinal incision is made, centered just above the superior pole ([Fig 1A](#)). The quadriceps tendon and the patella are exposed, and any hematoma is evacuated. The patellofemoral joint is now visible and is irrigated at this time, as the joint space will be closed off after tendon repair. The tendon is initially mobilized with an Allis clamp, taking care to minimize damage to the tendon. Either sharp scissors or a no. 10 blade is used to debride the tendinotic edge of the tendon back to healthy tissue, taking care not to overresect tissue. There is typically a small stump of tissue remaining on the patella, and this is debrided thoroughly back to bone. This is typically accomplished using a rongeur for bulk debridement, followed by a no. 10 blade used to scrape off any remaining tissue ([Fig 1B](#)). Care should be taken to avoid true decortication and removal of bone, as this weakens the fixation of the anchors.

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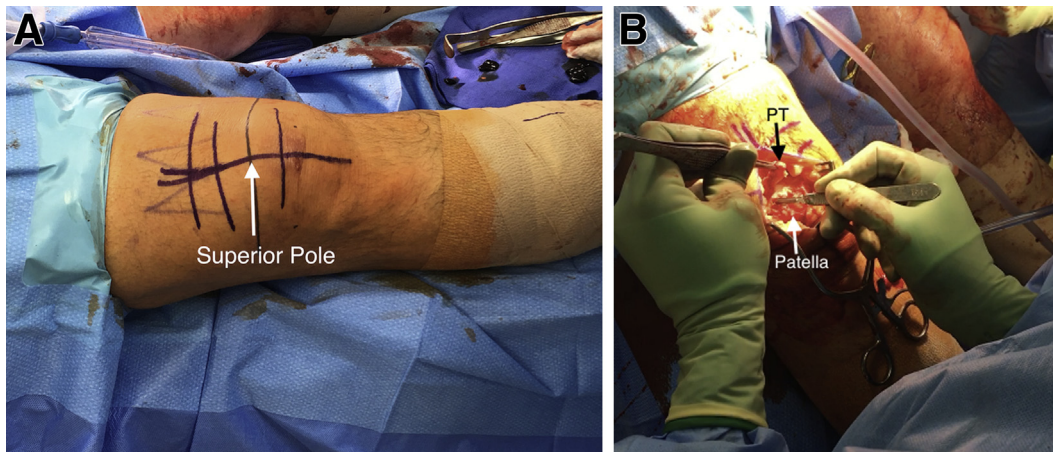


Fig 1. Exposure and debridement. (A) A bump is placed under the hip to maintain the limb in neutral rotation hands-free, and a tourniquet placed high on the thigh. A longitudinal incision is marked out, centered just proximal to the superior pole of the patella (white arrow). In this case, the incision will extend from the proximal (left) to the distal (right) hashmarks. (B) The superior pole is debrided of any remaining patellar tendon stump (PT, black arrow) back to healthy, bleeding bone (white arrow). Bulk is sharply excised, and the superior pole is scraped with a curette or a no. 10 blade. Care should be taken to avoid true decortication and removal of bone, as this weakens anchor fixation. Right knee, supine (head to left).

Suture Tape Passage

Two strands of FiberTape (Arthrex, Naples, FL), 36 in. long and tapered to no. 2 FiberWire on each end, are used to secure the quadriceps tendon using a running-locking Krackow configuration (Fig 2). This longer version of the suture tape is necessary, as the multiple locking throws will absorb a great deal of length. One strand will be used to secure the medial half of the tendon, and another for the lateral half. The individual suture tapes should be spaced appropriately so there is sufficient spread between the 2 anchors, which will be placed at the junction of the medial and middle thirds of the patella, and the junction of the middle and lateral thirds.

It is important to completely remove any slack before moving onto the next tissue pass. Once the first or second locking throws have been passed, the Allis clamp is removed to minimize further tendon damage, and the end of the suture tape is used for traction on the tendon during the remainder of the preparation. Four or 5 locking throws are passed proximally, before turning and returning distally to the torn edge. The last pass should be placed adjacent to the first, so both tails of the suture tape are entering and exiting near each other. The tails are then clamped for later use.

This is then repeated using the second FiberTape on the remaining half of the tendon. The locking throws through the tendon of the second suture tape may overlap the first. The tails are then clamped separately from those of the first suture tape.

Knotless Anchor Placement

The 2 tails of each FiberTape are then placed into a knotless 4.75-mm Biocomposite SwiveLock anchors (Arthrex). Before preparing the bone, the suture tapes are loaded into the anchors and clamped for later

insertion (Fig 3A). The proper positioning of the anchors on the superior pole is rechecked by pulling the suture tapes to the bone. These should be roughly evenly spaced out, at the junctions of the medial and middle thirds, and the middle and lateral thirds of the patella. The positions for anchor insertion are marked with electrocautery. Because of the bone density, the patella is then drilled using a 3.5-mm drill bit for the anchors, rather than punched. This is done while the surgeon holds a finger along the articular surface for proprioceptive feedback to ensure that the drill path is centralized in the bone, and not too far anterior or posterior (Fig 3B). The drill must be fully buried to create sufficient depth for the anchors. The holes are then tapped, again taking care to fully bury the tap into

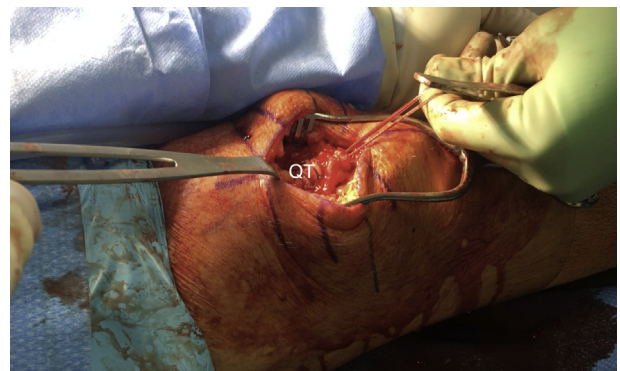


Fig 2. Securing the quadriceps tendon with suture tape. A suture tape is placed through the medial half of the quadriceps tendon (QT) in a Krackow configuration for a secure hold on the tendon. A second suture tape is placed in a Krackow configuration through the lateral half of the tendon. The passes of the second suture tape may overlap the first. Right knee, supine (head to left).

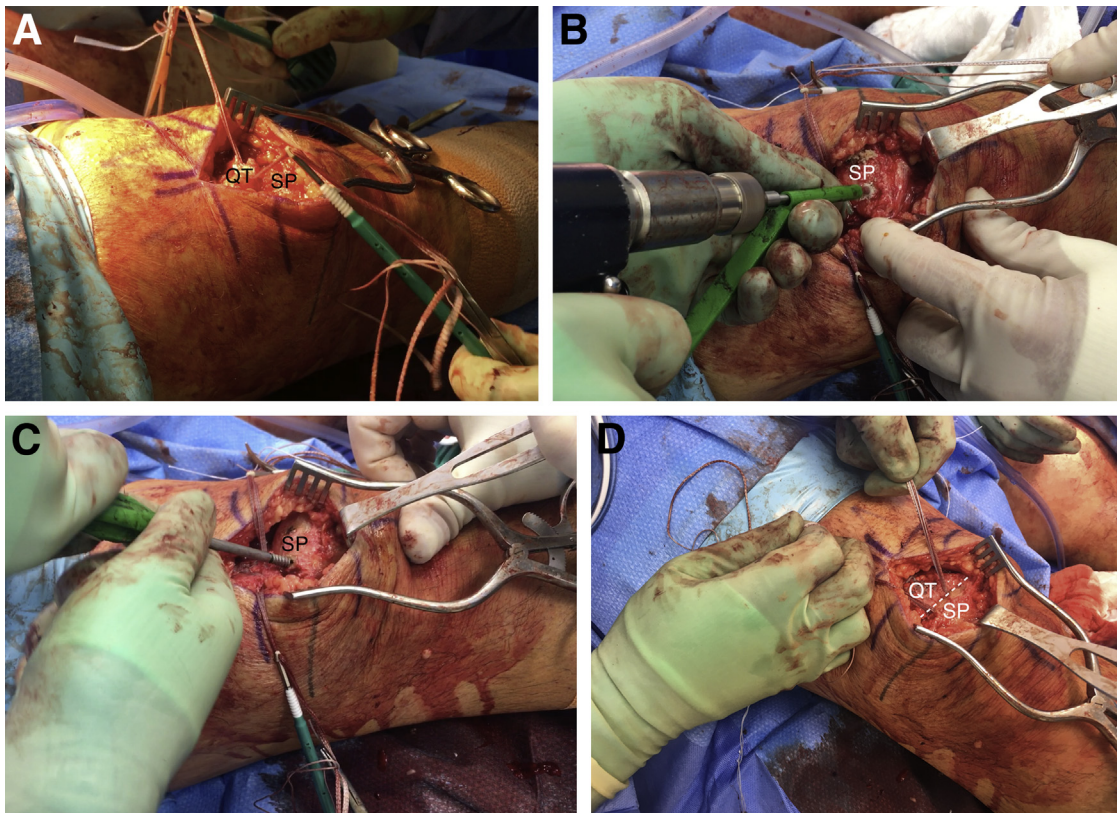


Fig 3. Anchor preparation and insertion. (A) The 2 limbs of each suture tape are passed into a knotless 4.75-mm anchor and clamped for later insertion. (B) A 3.5-mm drill is used to place 2 holes in the superior pole of the patella at the junction of the medial- and middle-thirds, and the junction of the middle- and lateral-thirds to allow a large bone bridge. The drill must be fully seated to create room for anchor insertion in the dense patellar bone. (C) A tap specific for the anchor is used to tap the drill holes for anchor insertion. Like the drill bit, it is important to fully seat the tap to facilitate anchor insertion in the dense patellar bone. (D) The limbs are tensioned, and the anchors are inserted flush with the bone, ensuring that the quadriceps tendon reduces firmly to the patella. Right knee, supine (head to left). (QT, quadriceps tendon; SP, superior pole of the patella, dashed line-repair site.)

each hole (Fig 3C). A small amount of irrigation is used to clear the holes of any loose debris to facilitate anchor insertion. The anchors, already loaded with the suture tapes, are then inserted into the bone tunnels with appropriate tension on the suture tapes to sufficiently reduce the quadriceps tendon to the patella (Fig 3D). This typically requires a mallet to start the insertion. Once the anchors are inserted flush to the bone, the extra tails of suture tape are cut flush with the bone using a knife.

Reinforcement and Closure

The SwiveLock anchors have a core suture of no. 2 FiberWire (Arthrex), and this is used to reinforce the repair. One tail of the suture is passed through a free needle, and a Modified Kessler stitch configuration is placed in the retinaculum, one off the superomedial pole of the patella, and another off the superolateral pole. The sutures are then tied and cut, completing the repair (Fig 4).

The remaining retinacular tear is closed using no. 0 Vicryl (Ethicon, Summerville, NJ). The wound is

irrigated, subcutaneous tissues are closed using no. 2-0 Vicryl, skin is closed using no. 3-0 STRATAFIX (Ethicon), and finally sealed with Dermabond (Ethicon).

Postoperative Rehabilitation

The patient is placed in a hinged T Scope (Breg, Carlsbad, CA), unlocked from 0° to 30° at rest, and locked in extension during ambulation with crutches. Weight bearing is progressed from touch-down to full weight-bearing over 4 weeks. The patient weans crutches typically over an additional 1 to 2 weeks after full weight bearing. Ambulation with the brace unlocked to 60° begins at 6 weeks, with progression 10° to 20° each week as tolerated. The brace is discontinued when 120° of motion is achieved, at 10 to 12 weeks. Strengthening begins at 12 weeks and return to sports at 24 weeks.

Discussion

Quadriceps tendon tears are a debilitating condition if left untreated and require urgent repair to restore

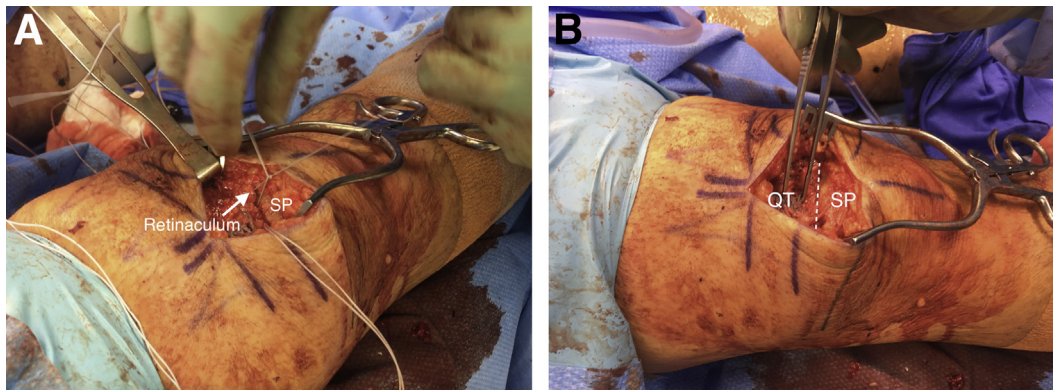


Fig 4. Retinacular reinforcement and completion of repair. (A) One limb of the core suture built into the medial anchor is used to pass a modified Kessler stitch through the retinaculum at the superomedial pole of the patella. This is then tied to the corresponding free limb of suture. The same is repeated with the core suture from the lateral anchor at the superolateral pole of the patella. (B) Image of the final repair. The quadriceps tendon and the suture tapes are visible at the tips of the forceps. Right knee, supine (head to left). (QT, quadriceps tendon; SP, superior pole of the patella, dashed line-repair site.)

function. Traditional repair included running-locking sutures in the quadriceps tendon passed through transosseous tunnels in the patella and tied over the inferior pole. However, clinical studies demonstrate the continued functional deficits in patients who undergo quadriceps tendon repair. Many patients have loss of some degree of flexion, more than half do not return to their preinjury level of athletic participation, and a large proportion have long-term quadriceps strength deficits.³⁻⁵

Recent biomechanical data⁶ demonstrated that repair using suture tape and knotless suture anchors has greater ultimate load to failure, less cyclic displacement, and greater stiffness than transosseous repair and traditional suture anchor repair. The strength of the repair construct does not rely on knots tied by the surgeon, as this has shown to be inconsistent. This construct also facilitates the use of a smaller incision, which could limit the risk of surgical complications such as infection or prominent knots. Furthermore, this may lead to less elongation of repair sites, lower risk of retear, and may also facilitate faster rehabilitation protocols. Potential risks include fracture of the patella,

slipping of the suture tapes, or pullout of the suture anchors (Table 1).

There are several key elements in this technique (Table 2). The first, and arguably the most important, is to ensure that all the slack has been removed from the Krackow suture configuration before each subsequent pass of the suture tape. Failure to remove the slack intraoperatively will lead to creep of the repair construct postoperatively. Additionally, to facilitate tendon-to-bone healing, thoroughly debride the superior pole back to bleeding bone, but do not decorticate

Table 1. Advantages and Disadvantages of Knotless Quadriceps Repair With Suture Tape

Advantages	Disadvantages
Stronger repair than transosseous or suture anchor repair	Requires larger holes in the patella than transosseous repair
Smaller exposure than transosseous repair	Increased cost compared with transosseous repair
Minimizes prominence of permanent sutures	
Strength of the repair not dependent on knots, which can be inconsistent	

Table 2. Technical Pearls and Pitfalls of Knotless Quadriceps Repair With Suture Tape

Pearls	Pitfalls
Fully debride soft tissue from the superior pole of patella.	Decortication and removal of bone during debridement of the superior pole may weaken anchor pullout strength.
Remove all slack from the Krackow configuration with each pass of the suture tape.	Residual slack in the Krackow suture tapes may lead to postoperative elongation at the repair site.
Fully seat the drill and tap into each hole, as the patella is typically very dense.	Inadequate drilling and tapping may lead to difficulty seating the anchor, or fracture of the patella or anchors.
To minimize the risk of fracture, adequately space the drill holes medial to lateral and place the drill holes along the central axis of the patella between the anterior and posterior cortices.	
Avoid articular penetration with the drill (and anchor).	
Appropriately tension suture tapes to firmly reduce tendon to bone during anchor insertion.	
Use the anchor's core suture to reinforce the retinaculum.	

or remove bone, as this weakens the pullout strength of the anchors. Adequately space the anchors in the bone to minimize the risk of fracture, and avoid anterior or posterior placement to avoid fracture or articular surface penetration, respectively. And ensure that the bone is fully predrilled and tapped before anchor insertion, as the patella is often very dense.

This repair construct using suture tapes and knotless anchors is a technique that is easy to reproduce and leads to a stronger repair than traditional methods to repair torn quadriceps tendon.

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