



Patellar Tendon Repair With Ipsilateral Semitendinosus Autograft Augmentation

Jarret M. Woodmass, M.D., F.R.C.S.C., Joshua D. Johnson, M.D., Isabella T. Wu, B.A., Aaron J. Krych, M.D., and Michael J. Stuart, M.D.

Abstract: Patellar tendon ruptures are rare but potentially devastating injuries. Acute repair after patellar tendon rupture affords the best opportunity for tension-free restoration of the extensor mechanism. Biological augmentation of primary repair is believed to decrease strain across the repair site and reduce the risk of rerupture. We present a technique for primary patellar tendon repair with bidirectional fixation using transosseous tunnels, suture anchor fixation, and ipsilateral hamstring autograft augmentation in a distal patellar pole socket.

Patellar tendon ruptures are rare but potentially devastating injuries. Classically, these injuries are observed in patients younger than 40 years after a forceful eccentric contraction of the quadriceps against a resisted flexed knee.¹ Early diagnosis and treatment are imperative to prevent tendon retraction and scarring, which increase the rate of inferior outcomes.^{1,2} Excellent outcomes have been reported after acute repair of patellar tendon ruptures.³⁻⁵ However, rerupture rates ranging from 2% to 50% have been reported.⁶

Several authors have proposed augmentation strategies in an effort to decrease strain across the repair site, allow early knee motion, and reduce the risk of rerupture.⁷ Various augmentation techniques have been described including both nonbiological (cerclage wire, synthetic tape, or nonabsorbable suture) and biological (allograft or autograft) augmentation

strategies, but the optimal treatment method remains controversial.⁸⁻¹² We present a technique for primary patellar tendon repair with bidirectional fixation using transosseous tunnels, suture anchor fixation, and ipsilateral hamstring autograft augmentation in a distal patellar pole socket (Tables 1-3).

Surgical Technique

Patient Positioning and Visualization

The patient is positioned supine on the operating table. The lower extremity is prepared and draped in the usual sterile fashion. The extremity is exsanguinated with an elastic wrap and tourniquet inflated to 300 mm Hg. A 10- to 15-cm anterior incision is made in line with the medial third of the patella and tibial tubercle (Video 1). This ensures that the closure does not directly overlie the reconstructed patellar tendon. Dissection is carried down through the skin and subcutaneous tissues to the level of the paratenon, which is carefully preserved for a layered closure. The patellar tendon rupture is identified, and the hematoma is evacuated. After careful exposure of the patellar tendon ends, nonviable tissue is debrided. Two No. 2 FiberWire (Arthrex, Naples, FL) locking whipstitches are then placed in the distal patellar tendon remnant (Fig 1).

Semitendinosus Graft Harvest and Preparation

The sartorial fascia is sharply incised longitudinally and reflected off the underlying gracilis and semitendinosus tendons. A tendon hook is looped under the semitendinosus tendon, which is pulled into the wound. All fascial bands are identified and transected. Four-sided tendon mobility to the level of the

From the Department of Orthopedic Surgery and Sports Medicine Center, Mayo Clinic and Mayo Foundation, Rochester, Minnesota, U.S.A.

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Address correspondence to Aaron J. Krych, M.D., Department of Orthopedic Surgery, Mayo Clinic, Rochester, MN 55905, U.S.A. E-mail: krych.aaron@mayo.edu

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Table 1. Special Equipment Required to Perform Patellar Tendon Repair With Semitendinosus Autograft Augmentation and Bidirectional Fixation

TightRope
No. 2 FiberWire sutures (×2)
Cannulated drill
FASTak anchors (×2)
Tendon hook
Closed tendon stripper
Free suture needle

musculotendinous junction is confirmed by palpation before the surgeon proceeds to graft harvest. The semitendinosus is sharply incised off the tibia. A No. 0 FiberWire is whipstitched through the distal end of the tendon. A closed tendon stripper is used to harvest the semimembranosus tendon. The muscle fibers are debrided from the tendon, and a whipstitch is placed in the proximal tendon. The tendon is passed through a TightRope device (Arthrex) and folded into 2 arms of equal length. The tendon is sized for later drilling of the patellar socket.

Patella Preparation

Enthesophytes are removed, and the distal pole of the patella is debrided to expose healthy bleeding bone. A spade-tipped guide pin is inserted through the central, distal patellar pole, exiting through the center of the proximal pole (Fig 2A). A knife is used to longitudinally split the quadriceps tendon between fibers at the proximal pole and expose the exiting pin. A 2.5-mm drill is used to place 2 parallel holes in the patella 10 mm medial and lateral to the central socket (Fig 2B). The surgeon then inserts 2 FASTak suture anchors (Arthrex) into the distal pole, maintaining 5-mm osseous bridges from the transosseous tunnels (Fig 2C). A cannulated reamer of equal diameter to the doubled semitendinosus tendon (5-6 mm) is used to create a 10-mm-deep socket (Fig 2D).

Repair and Augmentation Sequence

The ends of the No. 2 FiberWire locking whipstitch suture in the distal patellar tendon are passed proximally through the transosseous tunnels. The most

Table 2. Advantages and Disadvantages of Patellar Tendon Repair Using Semitendinosus Autograft Augmentation and Bidirectional Fixation

Advantages
Transosseous and suture anchor fixation
Biological augmentation
Early mobilization
Reduced failure rate
Disadvantages
Donor-site morbidity
Increased operative time
Theoretical risk of patellar fracture
Increased direct operative cost

Table 3. Pearls and Pitfalls of Patellar Tendon Repair Using Semitendinosus Autograft Augmentation and Bidirectional Fixation

Pearls

Careful central positioning of the TightRope drill will allow 1-cm osseous bridges to be maintained between the medial and lateral tunnels.

If normal patellar height is not readily evident, a radiograph of the contralateral knee should be obtained as a reference.

The TightRope device should be directly visualized after it has been flipped over the proximal pole of the patella.

The final construct should be tested intraoperatively to assess the repair tension and confirm that the knee can be safely ranged during early mobilization.

Pitfalls

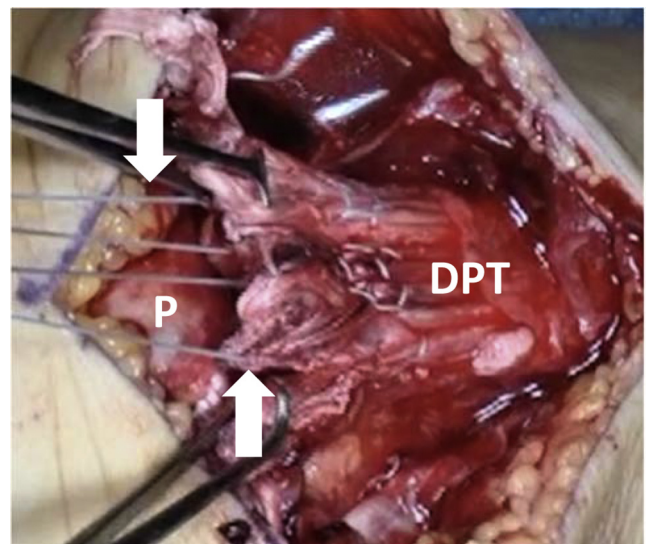
Failure to ensure an adequate distance between the transosseous tunnels may result in either tunnel coalition or an inability to use suture anchors in the distal pole of the patella.

Over-reduction of the patellar tendon with the initial transosseous sutures may lead to patella baja.

If the TightRope device flips within the quadriceps tendon, it can initially feel secure and later subside, resulting in gap formation.

medial suture is passed through the medial tunnel and the most lateral through the lateral tunnel. The 2 central sutures are then passed with the TightRope sutures through the central tunnel (Fig 3A). The TightRope button is flipped and engaged on the proximal patellar pole. Shortening strands are then used to pull the doubled semitendinosus graft into the distal patellar socket for a distance of 10 mm (Fig 3B). Tension is applied to the patellar tendon suture, and after satisfactory restoration of patellar height is confirmed, the sutures are tied over the proximal patellar pole.

The arms of the semitendinosus graft are tensioned beneath the patellar tendon and sutured to the native

**Fig 1.** Left knee arthrotomy with exposure of a torn patellar tendon. Two No. 2 FiberWire locking whipstitch sutures (arrows) have been placed. (DPT, distal patellar tendon remnant; P, patella.)

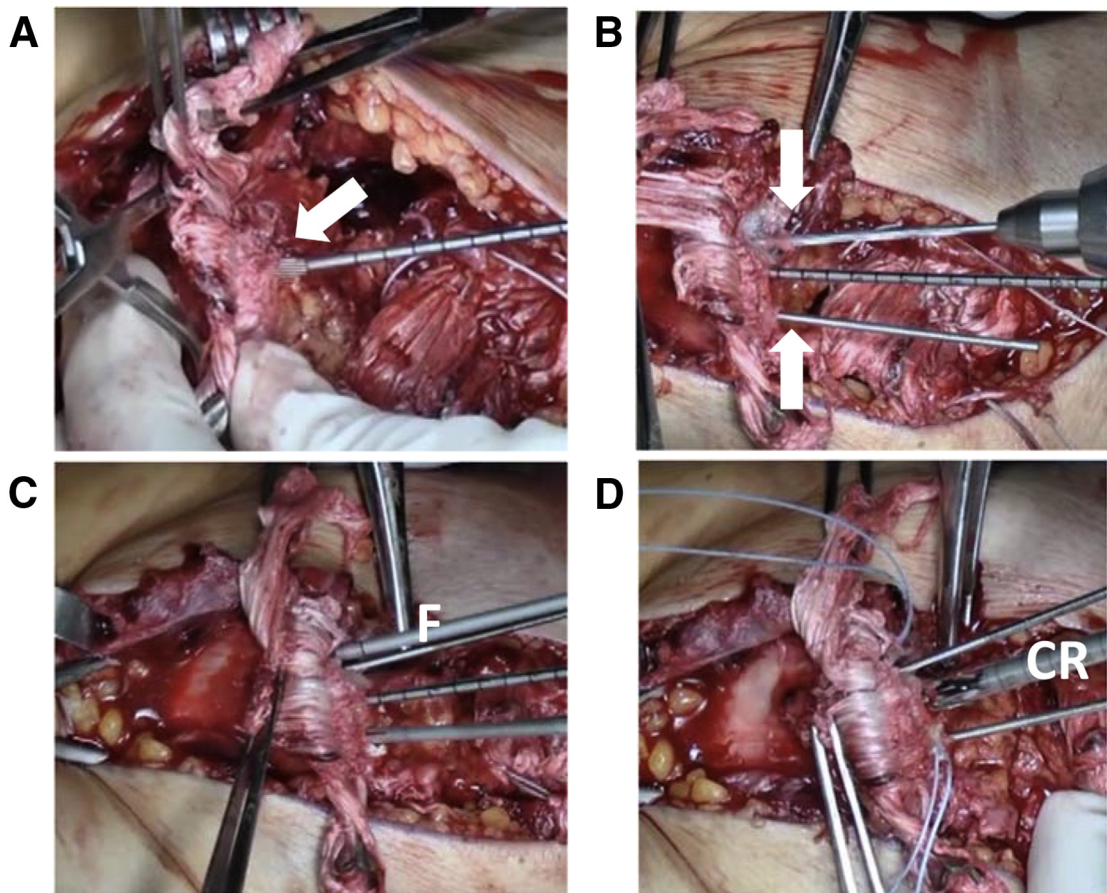


Fig 2. Left knee arthrotomy with exposure of a torn patellar tendon. The patellar instrumentation required for transosseous suture fixation with semitendinosus augmentation and bidirectional fixation is shown. (A) A spade-tipped drill is positioned at the distal pole of the patella (arrow), aiming to the proximal pole in the middle third of the patella. (B) Medial and lateral transosseous tunnels are drilled (arrows) parallel to the central tunnel. (C) FASTak (F) suture anchors are placed, leaving a minimum 5-mm osseous bridge between all devices. (D) A 5- to 6-mm cannulated reamer (CR) is passed over the spade-tipped pin to a depth of 10 mm to create the autograft socket.

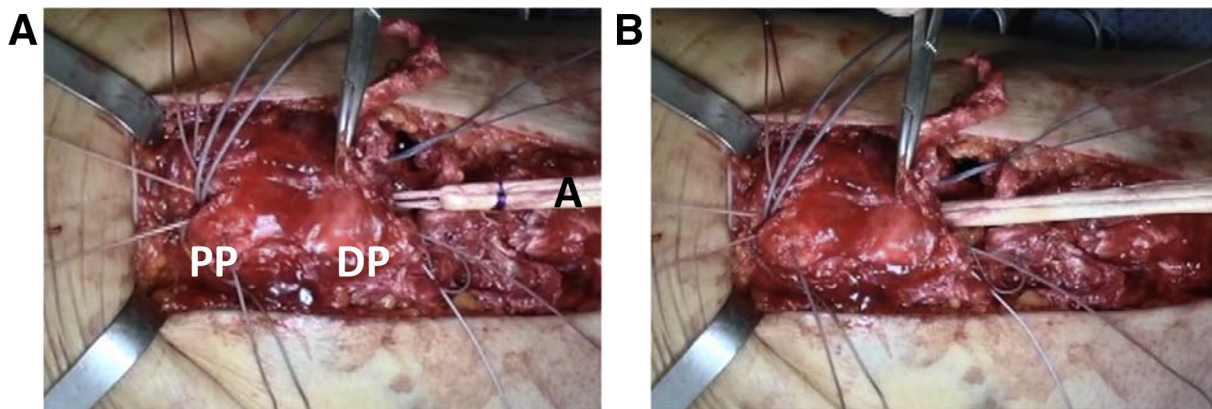


Fig 3. Left knee arthrotomy with exposure of a torn patellar tendon and a patella previously reamed in preparation for semitendinosus autograft placement into a patellar socket. (A) A TightRope button has been secured over the superior pole of the patella, and the proximal sutures are being used to shuttle the tendon into the socket. (B) The semitendinosus tendon is bottomed out within the 10-mm patellar socket. (A, autograft; DP, distal patella; PP, proximal patella.)

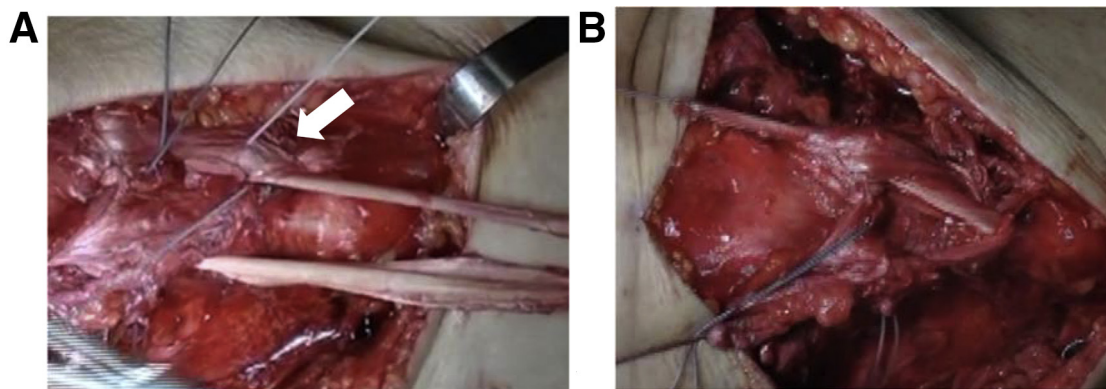


Fig 4. Left knee arthrotomy with semitendinosus graft augmentation after transosseous repair of a patellar tendon tear. (A) The autograft is tensioned and sutured to the native patellar tendon (arrow) to the level of the tibial tubercle. (B) The autograft tendon is folded proximally and then incorporated into the medial and lateral retinacular repairs to create a 4-stranded augmentation construct.

patellar tendon to the level of the distal tubercle insertion (Fig 4A). The remaining tendon is flipped proximally and again sutured to the native patellar tendon and the distal pole by use of the FASTak suture anchors. This provides a 4-stranded augmentation of the patellar tendon repair (Fig 4B). The frayed tendon ends are then sutured with interrupted No. 2-0 Monocryl suture (Ethicon, Somerville, NJ). The torn medial and lateral retinacula are closed with interrupted No. 0 Vicryl suture (Ethicon). Passive knee flexion is performed while the tendon construct is visualized. Typically, knee flexion of 60° to 90° is observed without undue tension. The wound is thoroughly irrigated. The skin and subcutaneous tissues are closed with No. 2-0 Monocryl followed by No. 3-0 Monocryl. A knee immobilizer is applied and locked in full knee extension.

Rehabilitation

At 0 to 6 weeks, the patient is restricted to crutch-assisted partial weight bearing with the knee locked in extension. Active and passive range of motion is allowed immediately from 0° to 60°. The patient should perform ankle pumps and straight-leg lifts. At 6 to 12 weeks, the patient is sequentially increased to full weight bearing while weaning from using crutches. Range of motion of 0° to 90° in a hinged knee brace is allowed. Active and passive knee range of motion is allowed as tolerated. After 12 weeks, resisted and strengthening exercises are allowed while the patient is weaned from using the knee brace.

Discussion

Acute repair after patellar tendon rupture affords the best opportunity for tension-free restoration of the extensor mechanism.¹³ Biological augmentation of primary repair is believed to decrease strain across the repair site and reduce the risk of rerupture.⁷ Mihalko et al.¹⁴ performed a matched-pair cadaveric analysis in

which primary suture repair was compared with suture repair with hamstring augmentation. Gap formation at the repair site was significantly larger in the standard suture repair group than in the augmentation group at all cycle points analyzed. Clinically, Larson and Simonian⁸ showed that semitendinosus augmentation allows implementation of an aggressive rehabilitation protocol including immediate postoperative mobilization with excellent functional results.

The currently described technique implements a multimodal approach to patellar tendon repair and augmentation. First, primary repair is achieved by suture fixation through transosseous, longitudinal tunnels. This technique is familiar to most surgeons and has shown satisfactory results when used in isolation.¹⁵ Second, suture anchors are placed in the distal pole of the patella, providing bidirectional repair. Biomechanical studies have shown significantly less gap formation and higher load to failure for repairs using suture anchor fixation.^{16,17} Last, a doubled semitendinosus autograft is inserted into a distal pole socket, suspended by a TightRope device, flipped proximally, and then fixed to the distal pole by the suture anchors. This 4-stranded construct provides added strength and biological augmentation to the repair. Cortical suspensory fixation results in significantly less gap formation and the ability to withstand twice the load to failure when compared with transosseous tunnels or suture anchor fixation.¹⁸ Biomechanical testing of a repair technique using a combination of transosseous sutures, suture anchors, biological augmentation, and cortical button fixation has not been performed to our knowledge. However, it is logical that this combination would provide greater resistance to strain and gap formation.

The major advantage of the described technique is the ability to perform early mobilization and weight bearing. In cases of primary repair without

augmentation, a period of immobilization to protect the repair from gap formation and reduce the risk of rerupture has been recommended.¹⁸ However, prolonged immobilization has several disadvantages including development of joint stiffness, poor cartilage nutrition, and muscle atrophy.¹⁹ The combination of transosseous sutures, suture anchors, cortical button fixation, and biological augmentation with a 4-stranded semitendinosus graft allows for more aggressive rehabilitation and reduced risk of tendon rupture. Potential disadvantages of our technique include morbidity from hamstring harvest and increased cost. Although there is morbidity associated with hamstring autograft harvest, Larson and Simonian⁸ in their original description of their hamstring autograft technique did not find quantifiable functional loss in their patients. The potential added expense is hopefully offset by a reduced rerupture rate with additional cost savings.

Clinical evidence is needed to verify the optimal treatment method for acute patellar tendon rupture. This report describes a surgical technique for patellar tendon repair with ipsilateral semitendinosus autograft augmentation using a patellar socket and suspensory fixation. The potential benefits of bidirectional suture fixation and biological augmentation with a 4-stranded graft include early mobilization and weight bearing with avoidance of further surgery for hardware removal. We consider this technique for acute repair of native patellar tendon ruptures with poor tissue quality, as well as selected cases of failed repair and symptomatic chronic tendinopathy.

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