Technical Note

Patellar Tendon Repair With Suture Tape Augmentation for Proximal Patellar Tendon Rupture

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Abstract: Patellar tendon ruptures are severe but uncommon injuries that require surgical treatment. Primary repair for acute patellar tendon ruptures using augmentation techniques has shown good results in terms of biomechanical and clinical outcomes. This Technical Note details patellar tendon repair with suture tape augmentation for proximal patellar tendon rupture. Because this surgical technique does not require harvesting of the hamstring tendon and hardware removal, it is minimally invasive. In addition, it is simple and quick to perform.

Patellar tendon ruptures are severe but uncommon injuries that require surgical treatment. Conditions such as previous patellar tendinitis and previous knee surgery have been associated with a high risk of patellar tendon rupture.[1] Systemic diseases, such as rheumatoid arthritis and lupus erythematosus, are also known risk factors for patellar tendon rupture. Good clinical outcomes have been reported for the primary repair of acute patellar tendon ruptures.[2,3] However, many biomechanical studies have shown improved performance with primary repair and augmentation techniques compared with primary repair alone.[4-7]

This Technical Note describes the surgical technique of patellar tendon repair with suture tape augmentation for proximal patellar tendon rupture.

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Preoperative Evaluation and Radiographic Imaging

The patient's physical examination shows positive tenderness at the site of the patellar tendon rupture. In cases of complete patellar tendon rupture, patella alta may be observed. Routine radiography is required to exclude fractures. The Insall-Salvati ratio should be measured because the ratio of the contralateral knee is helpful as a reference during surgery. Magnetic resonance imaging, which is important for diagnosing concomitant injuries, shows a proximal patellar tendon rupture (Fig 1A). The preoperative location of the rupture should be confirmed because this surgical technique is indicated only for proximal patellar tendon rupture.

Surgical Technique

The patient is placed on the operating table in the supine position under general or spinal anesthesia. A tourniquet is placed on the operative thigh and used if necessary. Knee arthroscopy is not performed in cases of isolated patellar tendon rupture because of leakage of joint effusion from the knee joint. A midline incision centered on the patella is made from the proximal patella to the tibial tubercle. After the skin incision, dissection of subcutaneous tissues is performed, and the prepatellar bursa is excised. The patellar tendon and location of the rupture are identified. Scar tissue at the patellar tendon rupture is removed to enhance healing potential. If adhesion or scarring exists, it should be removed to allow for full mobilization. Two Krackow

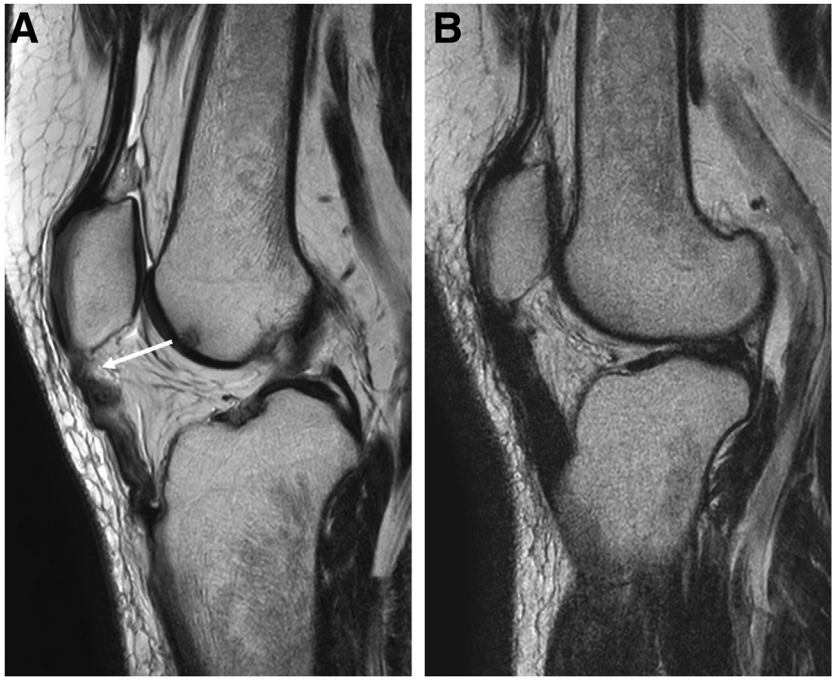

Fig 1. Magnetic resonance imaging of the left knee shows a proximal patellar tendon tear (arrow) (A) and continuity of the patellar tendon at 6 months postoperatively (B).

sutures are placed using UltraTape (Smith & Nephew, Andover, MA) (Figs 2A and 3). The use of different colored UltraTapes is recommended to prevent mistakes when suturing. Three 2.4-mm bone tunnels (medial, central, and lateral) are made using an Acufex Director Drill Guide (Smith & Nephew). Medial suture is passed through the medial tunnel, lateral suture is passed through the lateral tunnel, and 2 central sutures are passed through the central tunnel. Thereafter, a transosseous patellar tendon repair is performed at 30° of knee flexion (Figs 2B and 4). The normal patellar height (contralateral knee) should be used as a reference during patellar tendon repair. Intraoperative radiography in the lateral view is also helpful as a reference. After repair of the patellar tendon, 120° of passive knee flexion is applied to confirm stability of the repaired tendon. Two tunnels are prepared for a 4.75-mm SwiveLock anchor (Arthrex, Naples, FL) by predrilling and tapping. The FiberTape (Arthrex) is fixed with two 4.75-mm SwiveLock anchors on the distal patella. The fixation point is outside the medial and lateral bone tunnels. Then, 2.4-mm Kirschner wires are inserted at the medial and lateral edges of the distal patellar tendon. The 2 free ends of the FiberTape of both SwiveLock anchors are passed through the eyelet of the SwiveLock anchor. The depth of the FiberTape position is marked at 90° of knee flexion. The Kirschner wires are over-drilled using a 4.5-mm cannulated drill

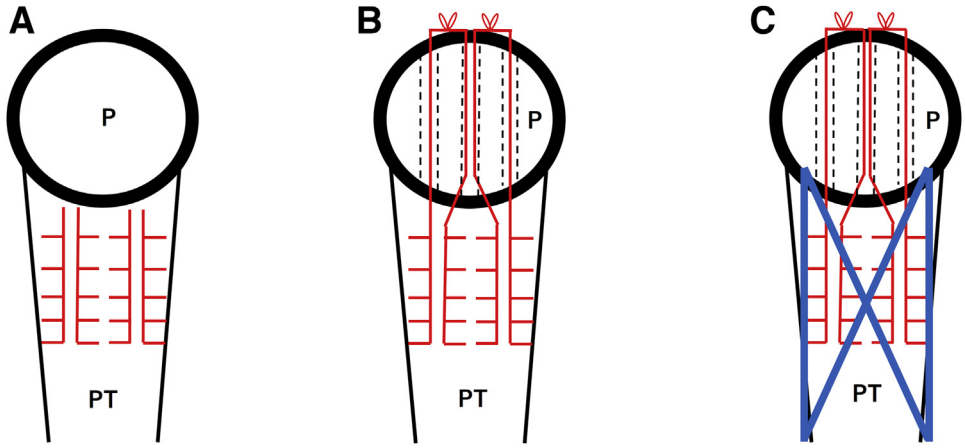

Fig 2. Schemas of operative procedure. (A) Two Krackow sutures (red lines) are placed using UltraTape. (B) Transosseous patellar tendon (PT) repair is performed. (C) After transosseous PT repair, suture tape augmentation (blue line) is performed using FiberTape and SwiveLock anchors. The dotted lines indicate the transosseous bone tunnel. (P, patella.)

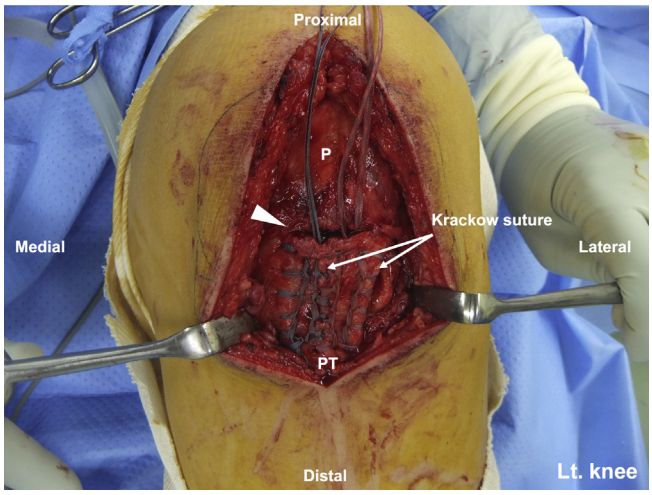

Fig 3. Patellar tendon (PT) rupture in left (Lt) knee. Proximal PT rupture (arrowhead) is observed. Two Krackow sutures (arrows) are placed using UltraTape. (P, patella.)

to a depth of 25 mm. The FiberTape is fixed using a 4.75-mm knotless anchor on the medial edge of the distal patellar tendon; this is repeated on the lateral edge (Fig 5, Video 1). The FiberTape should be slightly loose when the extension is completed. If the patella is over-tightened at knee flexion, the tibial SwiveLock is removed and the FiberTape is fixed again. The retinaculum and subcutaneous tissues are closed with No.

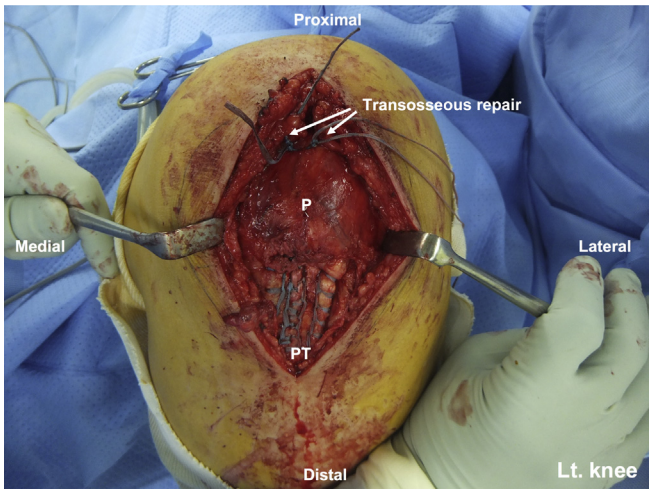

Fig 4. Patellar tendon (PT) repair in left (Lt) knee. Three 2.4-mm bone tunnels (medial, central, and lateral) are made using an Acufex Director Drill Guide. Medial suture is passed through the medial tunnel, lateral suture is passed through the lateral tunnel, and 2 central sutures are passed through the central tunnel. Transosseous PT repair (arrow) is performed at 30° of knee flexion. The normal patellar height (contralateral knee) should be used as a reference during PT repair. Intraoperative radiography in the lateral view is also helpful as a reference. After repair of the PT, 120° of passive knee flexion is applied to confirm stability of the repaired tendon. (P, patella.)

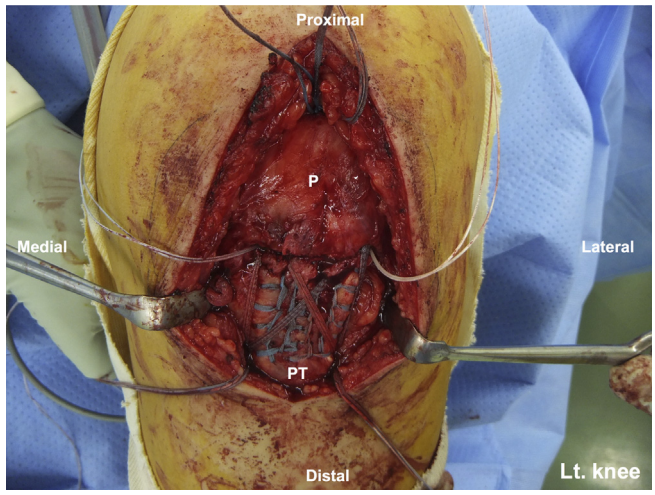

Fig 5. Patellar tendon (PT) repair with suture tape augmentation in left (Lt) knee. The FiberTape is fixed with two 4.75-mm SwiveLock anchors on the distal patella (P). The FiberTape is fixed using a 4.75-mm knotless anchor on the medial and lateral edges of the distal PT. The FiberTape should be slightly loose when the extension is completed. If the patella (P) is over-tightened at knee flexion, the tibial SwiveLock is removed and the FiberTape is fixed again.

3-0 PDS (Ethicon, Somerville, NJ), and the skin incisions are closed using skin tape. Postoperative magnetic resonance imaging also shows continuity of the patellar tendon (Fig 1B). Pearls and pitfalls of this surgical technique are summarized in Table 1.

Postoperative Management and Rehabilitation Protocol

After surgery, the patient is restricted to the use of crutches and a knee brace in full extension and is non–weight-bearing for 3 weeks. Active and passive range-of-motion exercises are allowed from 0° to 60° at 3 weeks, 90° at 4 weeks, and 120° at 5 weeks postoperatively. Partial weight bearing is permitted at 3 weeks postoperatively, and full weight bearing, at 6 weeks.

Table 1. Pearls and Pitfalls of Patellar Tendon Repair With Suture Tape Augmentation

Pearls
Identify the location of the patellar tendon tear
Remove scar tissue at the patellar tendon rupture to enhance healing potential
Use the normal patellar height (contralateral knee) as a reference during patellar tendon repair
Pitfalls
Perform preoperative examination to avoid misdiagnosis of concomitant injuries
Pay attention to the positioning and direction of transosseous bone tunnels
Pay attention to the positioning and direction of anchor insertion
Note that the FiberTape should be slightly loose when the extension is completed

Table 2. Advantages and Disadvantages of Patellar Tendon Repair With Suture Tape Augmentation

Advantages
Simple and quick procedure
No need to harvest hamstring tendon
No risk of donor-site morbidity
No need for hardware removal
Strong fixation compared with primary repair only
Disadvantages
Synthetic augmentation
Risk of patellar fracture
No indication for midsubstance or distal patellar tendon ruptures
Greater cost of implants compared with primary patellar tendon repair only

Discussion

This Technical Note explains patellar tendon repair with suture tape augmentation for proximal patellar tendon rupture. This surgical technique is minimally invasive (there is no need to harvest hamstring tendon and remove hardware) and is a simple and quick procedure (Table 2). It is expected to have strong fixation compared with primary repair only.

Recently, many biomechanical studies have shown improved performance with primary repair and augmentation techniques compared with primary repair only.[4-7] Black et al.[4] reported lower mean gap formation for their augmentation stitch group than for their control group (Krackow suture). Rothfeld et al.[6] reported that patellar tendon repair augmented with suture anchor internal brace augmentation is biomechanically superior to repair without augmentation and is equivalent to repair with augmentation using an 18-gauge stainless steel cerclage wire. These biomechanical studies support the technique presented in this article.

Good clinical outcomes of primary repair with augmentation have also been reported.[8-10] El-Desouky et al.[8] reported that 14 of 15 patients had good or excellent Lysholm scores after primary repair of ruptured patellar tendon augmented by semitendinosus tendon. Otsubo et al.[9] reported good outcomes (postoperative Lysholm score of 98.8 and International Knee Documentation Committee score of 86.8) of primary patellar tendon repair with strong sutures in 6 patients. Their surgical technique requires an EndoButton (Smith & Nephew) and double-spike plates (Meira, Aichi, Japan). Core et al.[10] reported that 25 of 28 patients had excellent or good Lysholm scores after patellar tendon repair with synthetic ligament augmentation. In their review article, Gilmore et al.[1] stated that the most popular acute repair technique was primary repair with augmentation. An advantage of this technique is thought to be the lack of requirement for hardware removal or harvesting of autologous hamstring tendon. Systemic diseases, such as rheumatoid arthritis and lupus erythematosus, are known risk factors for patellar tendon rupture. It is especially beneficial for these patients not to require removal of hardware or harvesting of autologous hamstring tendon because hamstring quality may be poor. The absence of the risk of donor-site morbidity is thought to be another advantage of this technique. Moreover, the augmentation technique using suture tape with knotless anchors has become popular for various injuries, such as medial collateral, medial patellofemoral, and anterior talofibular ligament injuries.[11-14]

The described surgical technique has some disadvantages (Table 2). First, suture tape augmentation is a synthetic augmentation. Because synthetics cannot be replaced by autologous tissues, their long-term effects are unknown. Thus, further clinical studies are necessary to determine the long-term outcomes of this technique. Second, there is a risk of patellar fracture when anchors are inserted. Therefore, bone tunnels for transosseous patellar tendon repair should be created in parallel, and anchors should be inserted so that they do not overlap the transosseous bone tunnels. Third, this surgical technique is only indicated for proximal patellar tendon rupture. Fourth, surgical costs are greater than for primary patellar tendon repair because implants such as suture tape and suture anchors are needed.

In conclusion, this Technical Note describes patellar tendon repair with suture tape augmentation for proximal patellar tendon rupture. With this technique, proximal patellar tendon rupture can be repaired with minimal invasiveness.

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References

1. Gilmore JH, Clayton-Smith ZJ, Aguilar M, et al. Reconstruction techniques and clinical results of patellar tendon ruptures: Evidence today. *Knee* 2015;22:148-155.
2. Roudet A, Boudissa M, Chaussard C, et al. Acute traumatic patellar tendon rupture: Early and late results of surgical treatment of 38 cases. *Orthop Traumatol Surg Res* 2015;101:307-311.
3. O'Dowd JA, Lehoang DM, Butler RR, et al. Operative treatment of acute patellar tendon ruptures. *Am J Sports Med* 2020;48:2686-2691.
4. Black JC, Ricci WM, Gardner MJ, et al. Novel augmentation technique for patellar tendon repair improves strength and decreases gap formation: A cadaveric study. *Clin Orthop Relat Res* 2016;474:2611-2618.
5. Schliemann B, Gruneweller N, Yao D, et al. Biomechanical evaluation of different surgical techniques for treating patellar tendon ruptures. *Int Orthop* 2016;40:1717-1723.
6. Rothfeld A, Pawlak A, Liebler SAH, et al. Patellar tendon repair augmentation with a knotless suture anchor internal brace: A biomechanical cadaveric study. *Am J Sports Med* 2018;46:1199-1204.

7. Gould HP, Weiner DA, Tomaszewski PM, et al. High-strength suture tape augmentation improves cyclic gap formation in transosseous patellar tendon repair: A biomechanical study. *Arthrosc Sports Med Rehabil* 2020;2:e469-e473.
8. El-Desouky II, Mohamed MM, Al Assassi M. Primary repair of ruptured patellar tendon augmented by semitendinosus. *J Knee Surg* 2014;27:207-213.
9. Otsubo H, Kamiya T, Suzuki T, et al. Repair of acute patellar tendon rupture augmented with strong sutures. *J Knee Surg* 2017;30:336-340.
10. Core M, Anract P, Raffin J, et al. Traumatic patellar tendon rupture repair using synthetic ligament augmentation. *J Knee Surg* 2020;33:804-809.
11. Van der List JP, DiFelice GS. Primary repair of the medial collateral ligament with internal bracing. *Arthrosc Tech* 2017;6:e933-e937.
12. Golden T, Friedman AMB, Jazayeri R, et al. Primary repair of the medial collateral ligament with a double row suture technique and suture tape augmentation for acute tibial-sided injuries. *Arthrosc Tech* 2019:e395-e398.
13. Ishibashi Y, Kimura Y, Sasaki E, et al. Medial patellofemoral ligament reconstruction using FiberTape and knotless SwiveLock anchors. *Arthrosc Tech* 2020;9:e1197-e1202.
14. Hopper GP, Benson DM, Wilson WT, et al. Anterior talofibular ligament repair with suture tape augmentation. *Arthrosc Tech* 2020;9:e1893-e1897.