

Patellar Tendon Shortening for Treatment of Patella Alta in Skeletally Immature Patients With Patellar Instability



Kevin C. Parvaresh, M.D., Hailey P. Huddleston, M.D., and Adam B. Yanke, M.D., Ph.D.

Abstract: Aberrant anatomy, such as patella alta, can be a risk factor for recurrent patellar instability or inferior clinical outcomes after medial patellofemoral ligament reconstruction. In patients with significant patella alta (Caton Deschamps Index >1.2), tibial tubercle distalization may be considered to improve outcomes. However, despite patellar instability commonly affecting pediatric patients, a distalization osteotomy is not feasible in this patient population due to the presence of open physes. Our article presents a technique describing an alternative soft-tissue distalization approach whereby patellar height is decreased by shortening the patellar tendon.

Recurrent lateral patellar instability is a relatively common orthopaedic pathology that may significantly limit athletic function and cause pain.¹ For patients who do not respond to conservative management, medial patellofemoral ligament (MPFL) reconstruction is the most commonly recommended surgical treatment.² While MPFL reconstruction has demonstrated good outcomes,³⁻⁵ a variety of pathoanatomic factors have been cited as risk factors for recurrent patellar instability.⁶ One such risk factor is patella alta, which alters medial patellofemoral complex length changes⁷⁻⁹ and necessitates greater degrees of flexion for the patella to engage in the trochlea.¹⁰

Different approaches have been described for performing an MPFL reconstruction in skeletally immature patients to protect the growth plates, such as moving

the femoral tunnel distally or using a soft tissue–based approach (medial quadriceps tendon femoral reconstruction).¹¹⁻¹³ In patients with recurrent instability and significant patella alta (Caton Deschamps Index [CDI] > 1.4),¹⁴ a concomitant distalization or shortening procedure in addition to MPFL reconstruction may be necessary to correct this pathoanatomy and decrease the risk of subsequent failure. However, concerns surround addressing significant patella alta in the skeletally immature patient, as an osseous distalization cannot be performed in patients with open physes. Previous techniques in this setting have been described, such as the Roux–Goldwait procedure, Galeazzi procedure, and the Grammont procedure; however, literature on the outcomes of these procedures remains limited and mixed.¹⁵⁻²⁰ The patellar tendon shortening technique presented is similar to the two brief descriptions previously published by Servien and Archbold²¹ as well as Andrish.²² In this technique, we describe a soft tissue–based approach to shorten the patellar tendon to correct significant patella alta in a skeletally immature patient.

Surgical Technique

We recommend performing the distalization before any ligamentous reconstruction as the patellar height will alter the length changes of patellar ligaments (Table 1). The patient is placed on a well-padded operating table in the supine position. General anesthesia is induced with local anesthesia provided at the conclusion of the case. A standard examination under anesthesia is performed to evaluate range of motion,

From Rush University Medical Center, Chicago, Illinois, U.S.A.

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Address correspondence to Adam B. Yanke, M.D., Ph.D., Rush University Medical Center, 1611 W Harrison St., Chicago, IL 60612. E-mail: Adam.Yanke@RushOrtho.com

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Table 1. Pearls and Pitfalls

Pearls	Pitfalls
<ul style="list-style-type: none"> • Appropriate preoperative planning to ensure measured shortening results in a Caton–Deschamps index of < 1.2 • Perform the shortening before any ligamentous work to assist with ligament isometry • Ensure a uniform thickness of 50% is taken during coronal tendon division to avoid iatrogenic patellar tendon tearing 	<ul style="list-style-type: none"> • Overshortening, leading to patella baja and excessive patellofemoral compression • Performing shortening after ligamentous work, leading to excessive ligament anisometry • Excessive tendon splitting, leading to intraoperative or postoperative patellar tendon rupture

patellar tracking, and stability testing (Video 1). Frequently in the setting of patella alta, the patella will still be unstable during the exam under anesthesia even in higher degrees of flexion.

A tourniquet is placed high on the thigh and a circumferential leg holder is placed just distal to the tourniquet. The contralateral leg is placed in a stirrup away from the operative field. The table leg is dropped to allow for intraoperative positioning. A leg holder (Spider; Smith & Nephew, London, UK) is placed on the operative leg side to assist with positioning. The leg is then prepared and draped in standard sterile fashion. If indicated, knee arthroscopy is performed initially. An Esmarch is then used to exsanguinate the leg and the tourniquet is inflated.

A 10-blade is used to make a longitudinal anterior incision over the patellar tendon from the inferior pole of the patella to the tibial tubercle. Medial and lateral full thickness skin flaps are made over the paratendon. The paratendon is then divided longitudinally and

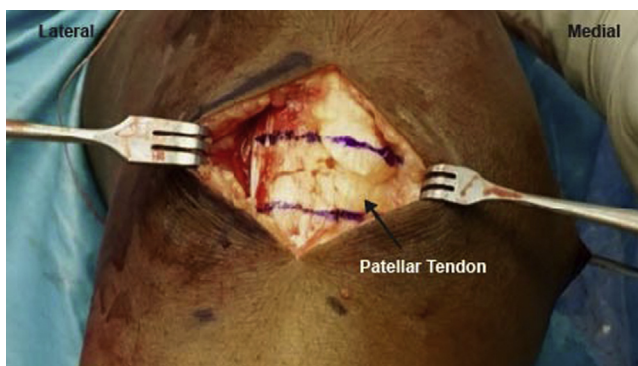


Fig 1. The patient is placed on the operating table in the supine position. On the right knee, using a surgical marker, the distance the patellar tendon will be shortened is marked directly onto the patellar tendon. We suggest correcting patella alta to a Caton–Deschamps Index of 1.2.

dissected medial and lateral to the edges of the patellar tendon. Metzenbaum scissors are used to dissect posterior to the tendon to release the fat pad along the entirety of the tendon.

The patellar tendon is then marked to prepare for the shortening (Fig 1). The distance to be shortened based on preoperative templating is marked in the central aspect of the tendon. We prefer to correct patella alta to a CDI of 1.2 to prevent excessive patella baja (Fig 2). The tendon is split in the coronal plane for 50% of its thickness along the length of the markings (Figs 3, 4). A 15-blade is used to cut the anterior half along the distal mark.

The tendon is then manually pulled to confirm appropriate shortening, which can be confirmed intraoperatively with fluoroscopy. Three tape sutures (medial, central, and lateral) are passed in a buried horizontal mattress fashion entering and exiting at the proximal and distal markings (Figs 5, 6A). A second set is then passed in a similar fashion but inverted from the original sutures as seen in Figure 6B. The sutures are then tied individually to fix the shortening (Figs 7, 8). A #1 VICRYL suture is used in a figure-of-eight fashion to fix the distal flap for reinforcement. Care should be taken to not entrap the fat pad deep to the tendon during placement of these sutures.

A repeat examination under anesthesia is then performed to reassess range of motion, tracking, and patellar stability. The MPFL reconstruction is fixated after the patellar tendon shortening has been completed. The incision is thoroughly irrigated, and hemostasis is obtained after tourniquet release. Standard sequential layered closure is performed, and a local anesthetic is injected around the incision. Sterile dressings and a hinged knee brace locked in extension are secured.

Immediate postoperative mobilization is encouraged with heel-touch weight-bearing with crutches as needed in a hinged range of motion brace locked in extension until the first postoperative visit. In addition, patients are advised to perform straight leg raises and ankle pumps during which time the brace is unlocked to allow for flexion up to 90°. Patients are given a prescription for physical therapy at their first postoperative visit. Formal physical therapy focuses on improving range of motion and core strengthening exercises. Closed chain strengthening is initiated after 6 weeks. Progressive strengthening, stability, and sport-specific exercises are introduced after 12 weeks.

Discussion

Patellar instability is a common pathology, especially in the young athletic population. While there are a number of operative techniques available for treatment, surgical options are limited in the skeletally immature population due to the presence of open physes. Patella

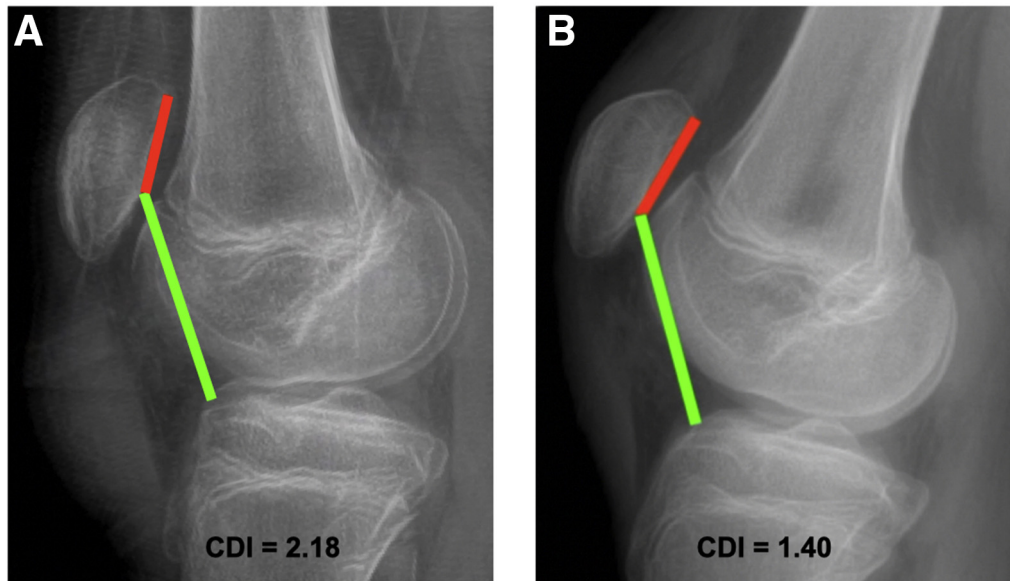


Fig 2. Perfect lateral radiographs of the right knee. (A) Preoperative radiograph demonstrating significant patella alta and a Caton–Deschamp Index (CDI) of 2.18. (B) 6-week postoperative radiograph demonstrating significant reduction in patella alta (CDI = 1.40).

alta has been demonstrated to be a significant risk factor for recurrence if left uncorrected during initial surgical stabilization.⁶ Therefore, in combined cases of patellar instability and patella alta in the skeletally immature patient, patellar tendon shortening may be used as an adjunct procedure to limit postoperative recurrence and improve outcomes.

The effectiveness of patellar distalization through tibial tubercle osteotomy for patella alta has been well demonstrated in numerous clinical studies. In patients with a CDI >1.2 and severe trochlear dysplasia (Dejour

B, C, or D), Allen et al.²³ reported a 6.67% postoperative patellar instability rate in a cohort of 30 knees who underwent distalization with concomitant MPFL reconstruction. Furthermore, patients demonstrated good postoperative outcomes on International Knee Documentation Committee score (IKDC) Tegner, and Kujala. In addition, Mayer et al.²⁴ reported good clinical outcomes and no postoperative dislocations in a cohort of 27 knees who underwent tibial tubercle distalization combined with patellar tenodesis.

Two previous techniques involving patellar shortening and have been described in the literature on which the current method is based. Andrish²² originally described a patellar imbrication technique for skeletally immature patients with instability and patella alta. In his technique, the same half width of the patellar tendon imbrication is performed. In an outcomes study of 27 patients at minimum 2-year follow-up using this technique, no complications were reported, and the patellar tendon maintained an average of 1 cm of shortening at final follow-up.²⁵ Servien and Archbold²¹ also described a shortening technique that is similar, although no outcomes were reported. In all cases, it is integral to perform preoperative planning to determine the amount of distalization necessary.

Regarding the calculation of the length for shortening, many surgeons normalize the CDI to 1.0.²⁶ The order of surgery is also important in cases of concomitant procedures. It is recommended that patellar tendon shortening be performed before any ligamentous intervention as ligament isometry is significantly altered following shortening and may require

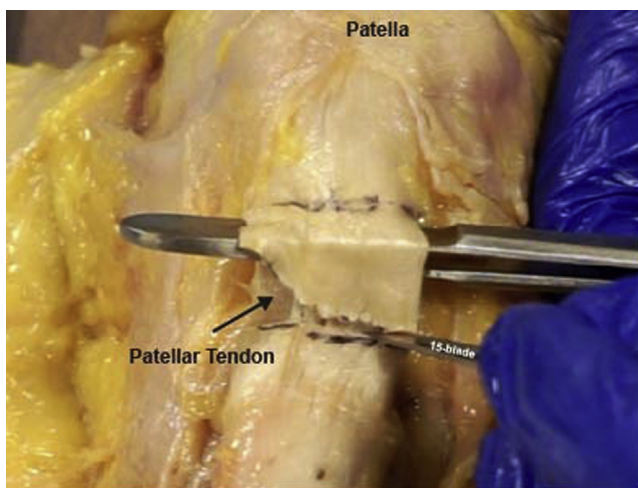


Fig 3. The patient is placed on the operating table in the supine position. On the right knee, using a 15-blade an incision of 50% depth in the patellar paratendon is made along the previously marked distal line.

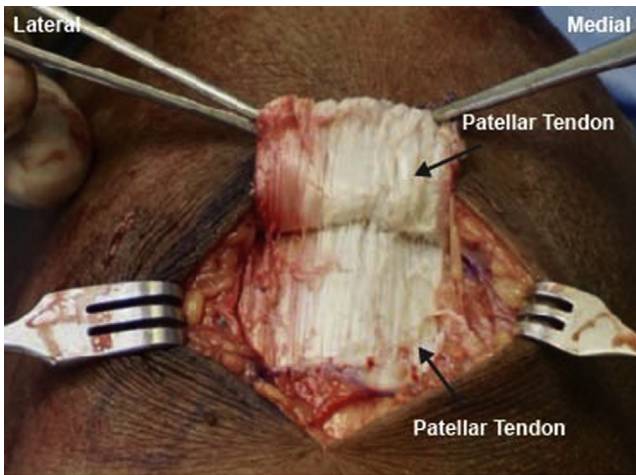


Fig 4. The patient is placed on the operating table in the supine position. On the right knee, the distal aspect of the patellar paratendon is released and the 50% tendon split can be visualized.

rebalancing if the medial or lateral patellofemoral ligaments were adjusted before shortening.⁹ This is similar to the sequence recommended when using tibial tubercle osteotomy for patellar shortening.

There are a few potential complications that may arise from this technique that warrant discussion. Patella baja, or overshortening, is a known complication of distalization through osteotomy and may also occur with over-shortening. This may have deleterious effects on the patellofemoral articulation as well as chronic damage to the chondral surface. Biomechanical studies have shown excessive patella baja can lead to

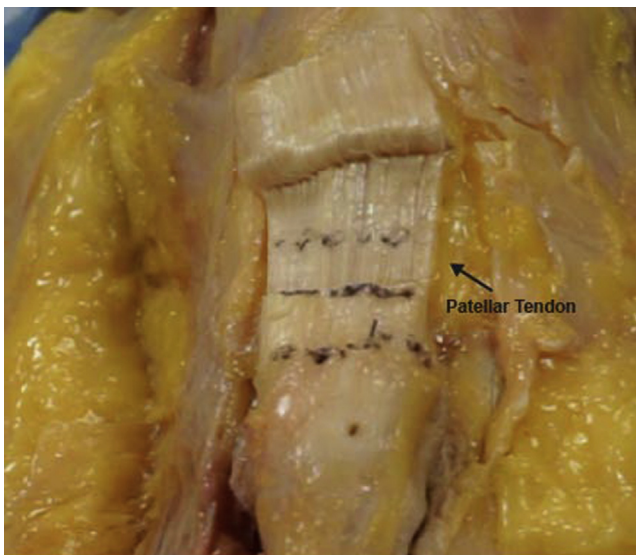


Fig 5. The patient is placed on the operating table in the supine position. On the right knee, an additional line in the midline of the incised patellar tendon is marked. These 3 markings will guide suture placement.

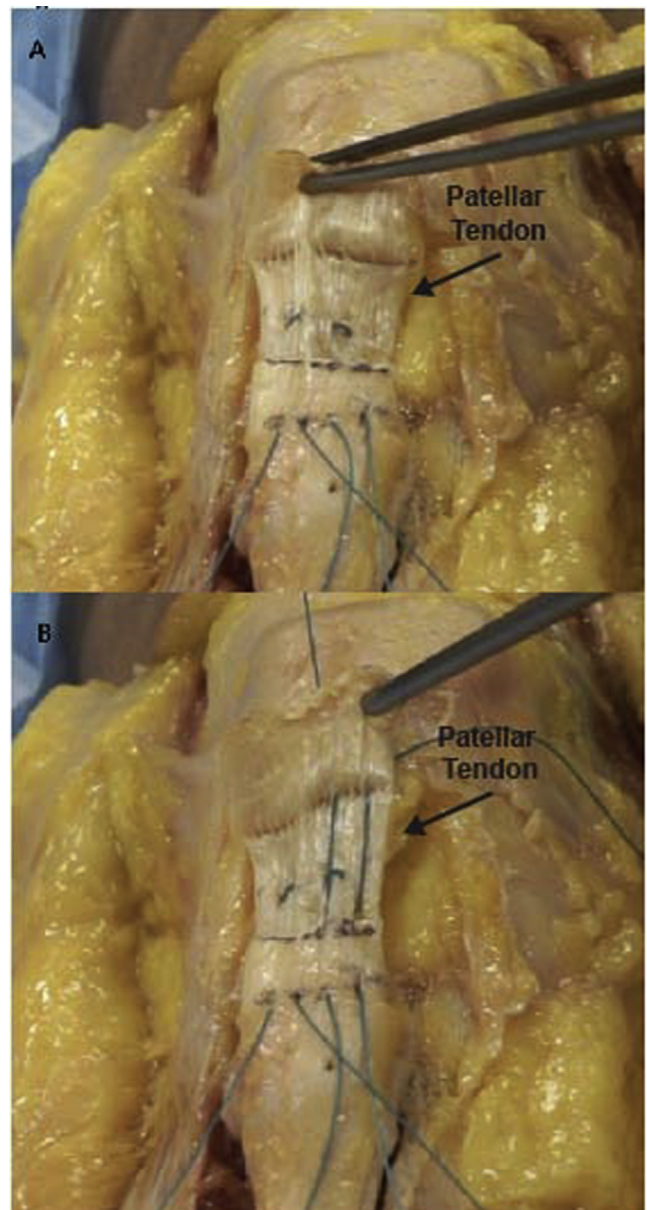


Fig 6. The patient is placed on the operating table in the supine position. On the right knee, suturing of the patellar tendon is performed in a buried horizontal mattress fashion (A) entering and exiting at the proximal and distal markings, (B) an addition suture is then passed in a similar fashion but inverted from the original sutures.

significantly increased contact pressures in the patellofemoral joint throughout early flexion.²⁷ Another specific complication may include extensor mechanism rupture through the imbrication site at the patellar tendon. As this can have disastrous effects on knee function, it is critical the tendon dissection is performed very carefully. Subsequent patellar tendon repair can be performed, although it may lead to worse outcomes with a prolonged recovery. Time and quality of life lost

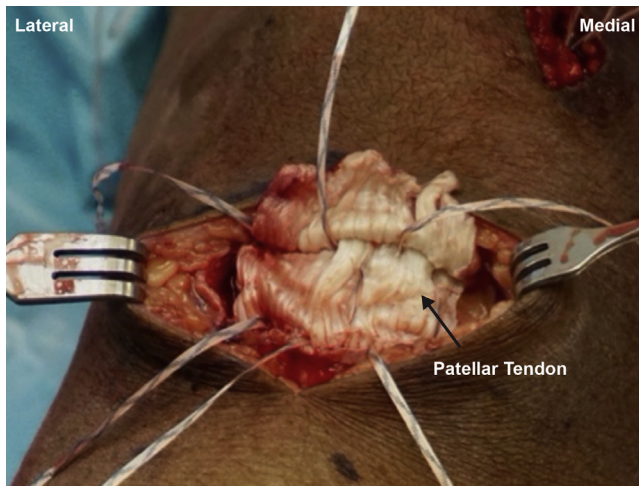


Fig 7. The patient is placed on the operating table in the supine position. On the right knee, the patellar tendon is pulled to achieve adequate shortening after three sutures are passed through the paratendon.

from these complications may be especially significant in these young athletic populations.

As a technique article, there are obvious limitations in terms of clinical outcomes regarding this technique. Although the individual patient reported a satisfactory result with improvement in patient reported outcomes, with an increase in the Kujala (81-100) and IKDC (54.20-72.41) at 3 months' postoperatively, the generalized outcomes of this technique are still unclear. Further research evaluating short- and long-term outcomes as well as incidence of sequelae may provide more support for this technique in the future.

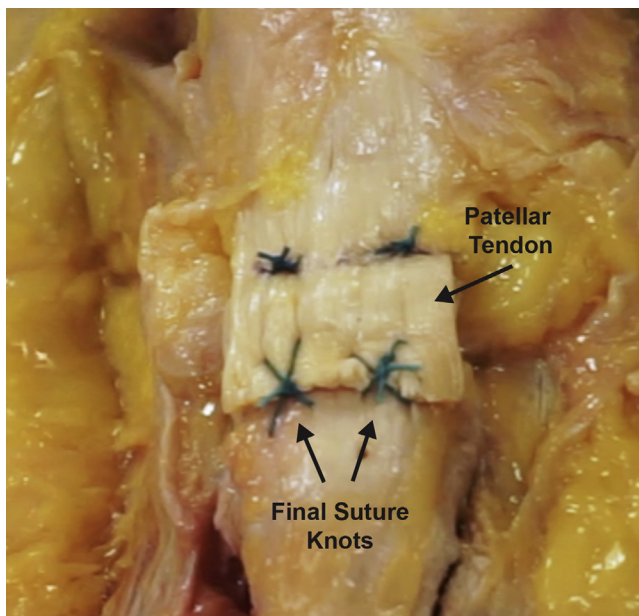


Fig 8. The patient is placed on the operating table in the supine position. On the right knee, the final sutures tied along the patellar tendon are visualized.

Conclusions

Patellar instability with combined patella alta in skeletally immature patients presents a significant surgical challenge. Surgical options are limited due to the presence of open physes, but patellar tendon shortening is a viable option to correct patella alta. This may be combined with medial or lateral patellofemoral ligament balancing to optimize patellar stability. Future studies should evaluate short- and long-term outcomes to optimize techniques and outcomes.

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