Technical Note

Patellar Tendon Tenotomy for Treatment of Patella Baja and Extension Deficiency

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Abstract: Extension loss due to patella baja is a rare but devastating postoperative complication associated with knee surgery. The most common causes of patella baja are prolonged postoperative immobilization, over-distalization of the patellar tendon during patella-related surgical procedures (i.e., tibial tubercle osteotomy and patellar tendon reconstruction), and inadequate knee range-of-motion exercises postoperatively. Patella baja can cause significant functional limitations owing to knee-related stiffness, pain, and weakness. Arthroscopy with scar tissue debridement is the standard of care for patients with arthrofibrosis in whom conservative treatment has failed. However, when this surgical approach fails, patients with continued patella baja may be candidates for open patellar tendon tenotomy as a salvage procedure.

Patella baja describes a distally positioned patella in relation to the femoral trochlea, which has been reported to result from the shortening of patellar tendon fibers, as well as traumatic and postoperative scarring.[1-5] Although often presenting as a congenital abnormality, acquired patella baja has been reported to occur as a postoperative complication due to anterior cruciate ligament reconstruction, due to injury or weakness to the extensor apparatus, or as a consequence of a major knee operation.[5-7] In these cases, surgical intervention is recommended because failure to treat patella baja has been reported to result in limited range of motion (ROM) in extension, persistent anterior knee pain, and accelerated progression of patellofemoral osteoarthritis.[4-6,8,9]

Although recent literature has described several techniques to address this pathology,[5,10] there remains a lack of consensus regarding the gold-standard procedure for treatment.[6] The efficacy of surgical interventions such as soft-tissue procedures including patellar tendon elongation or reconstruction, as well as the proximalization of the tibial tubercle, has been limited by small case series and suboptimal postoperative outcomes in the literature.[6] In these studies, it has been suggested that restricted postoperative ROM and failure to directly address the shortening of the patellar tendon in the case of tibial tubercle osteotomy may be the reason for poor outcomes.[6]

Patients with severe pain and functional limitation associated with progressive shortening of the patellar tendon can be difficult to manage. Positive outcomes have been reported after patellar tendon tenotomy, which allows for proximal migration of the patella to a more anatomic and functional position. The purpose of this Technical Note was to describe our preferred surgical technique for a patellar tendon tenotomy to address acquired patella baja owing to previous tibial tubercle osteotomy and anterior interval release.

Diagnosis and Operative Indications

Surgery is indicated when the patellar tendon is significantly shortened and nonfunctional, which can be seen both in the clinic and on lateral radiographs (Fig 1). Increased load typically occurs within the patellofemoral joint in addition to functional limitations. Significant restraints along the medial and lateral aspects of the extensor mechanism with an inability to perform a straight-leg raise without an extension sag indicate definitive surgery. Otherwise, if the patella migrates proximally to a more functional

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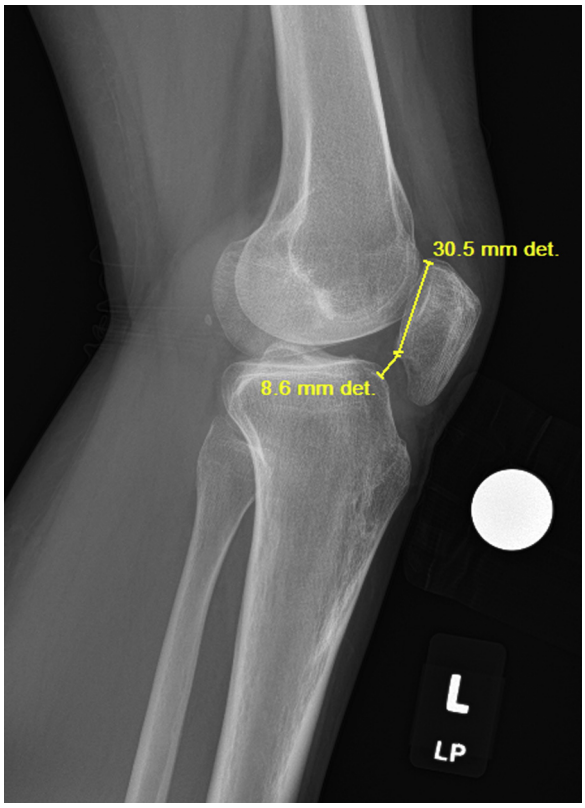

Fig 1. Lateral-view radiograph of left knee with calculation of patellar height using Caton-Deschamps ratio. This case shows a Caton-Deschamps ratio of 0.28, indicating significant patella baja. (det, distance estimated; L, left knee; LP, lateral.)

position over time but has a function limitation with an inability to perform a straight-leg raise without an extension sag, a patellar tendon reconstruction would be indicated.[11]

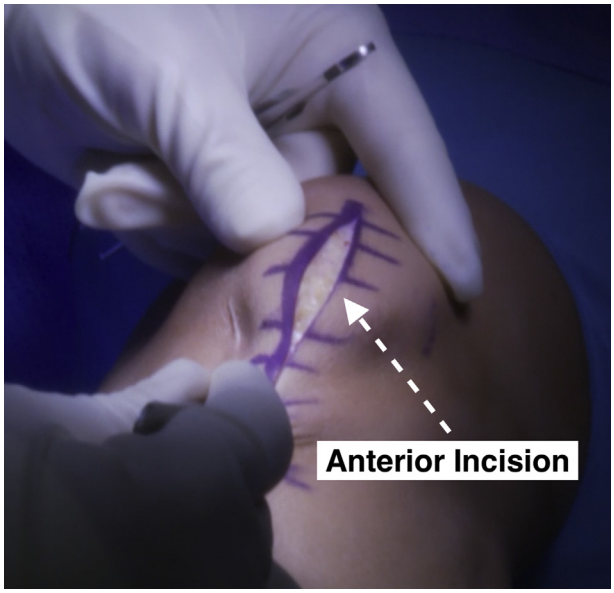

Fig 2. Anterior view of left knee. The anterior incision is made over the extensor mechanism and extends down from the distal aspect of the patella distal to the tibial tubercle.

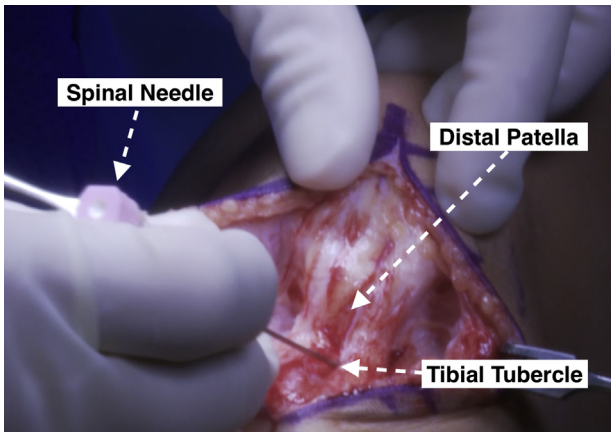

Fig 3. Anterior view of left knee. A spinal needle is used to identify both the distal aspect of the patella and the proximal aspect of the tibial tubercle.

Surgical Procedure

The surgical technique for this procedure is shown in Video 1.

Patient Positioning and Examination

A high-thigh tourniquet (Mizuho OSI, Union City, CA) is placed on the operative leg, and ROM is measured relative to the contralateral nonoperative leg. An examination under anesthesia is performed (Video 1), including the Lachman test, posterior drawer test, posterolateral drawer test, and varus and valgus stress testing, to ensure no concomitant injuries are present. Patellar tendon length and tracking are examined, usually displaying tight adherence to the anterior tibia and tibial tubercle area. The operative lower extremity is then prepared and draped in the usual sterile manner.

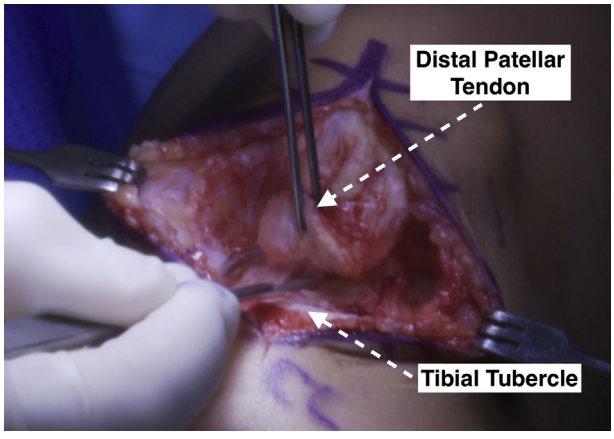

Fig 4. Anterior view of left knee. Patellar tendon tenotomy is performed by releasing the patellar tendon from the tibial tubercle along the entire attachment, after which the knee may be flexed to ensure restoration of patellar tracking.

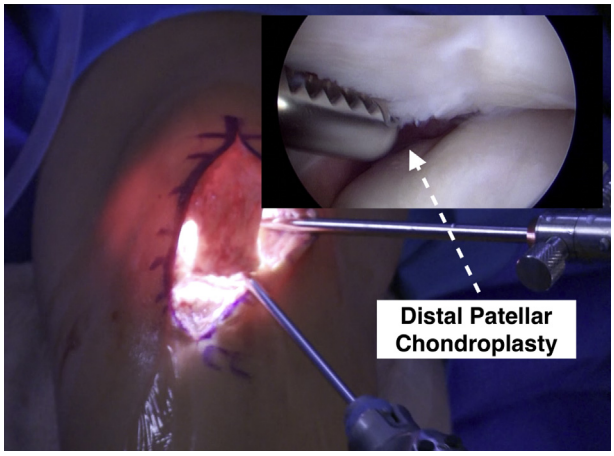

Fig 5. Anterior view of left knee. A distal patellar chondroplasty may be performed if the patella displays any form of chondromalacia.

Surgical Approach

An anterior incision is made over the extensor mechanism extending down from the distal aspect of the patella to about 3 cm distal to the tibial tubercle (Fig 2). Meticulous dissection is carried down to the peritenon, which is dissected medially and laterally off the patellar tendon. A spinal needle is then used to localize the distal aspect of the patella and the proximal aspect of the tibial tubercle (Fig 3).

A patellar tendon tenotomy is performed by releasing the patellar tendon off the tibial tubercle along its entire length (Fig 4). The tendon is often thickened to approximately 9 to 10 mm in thickness at this location, consistent with severe patella baja. After the patellar tendon is cut, fat pad release away from the patellar tendon is performed.

After creation of medial and lateral arthroscopic portals, a 3-compartment lysis of adhesions is performed to restore the contour of the suprapatellar pouch, and patellar mobility is ensured. A patellar chondroplasty (Fig 5) may be performed if the distal aspect of the patella displays chondromalacia. Before closure, full motion of the knee and patellar tracking are ensured by a manipulation under anesthesia, in addition to ensuring patellar height is similar to the contralateral knee. Finally, the deep tissues are closed with No. 0 and 2-0 Vicryl (Ethicon, Somerville, NJ) in a double layer followed by a subcuticular stitch. Steri-Strips (3M, St Paul, MN) are then very loosely applied, followed by application of a sterile dressing and a knee immobilizer in full extension. Pearls and pitfalls of this surgical technique are displayed in Table 1.

Postoperative Protocol

Weight bearing is allowed with a knee immobilizer (Ossur, Foothill Ranch, CA) as tolerated, and full quadriceps mechanism activation is necessary before use of the immobilizer is discontinued. No limitations on patellar mobility or knee flexion exercises are enforced, and physical therapy is begun on postoperative day 1 with initiation of ROM.

Discussion

Patella baja is a condition that has been treated by a multitude of surgical interventions. The current techniques described in the literature vary from simple tenotomy procedures (as in this Technical Note) to complex interventions such as a tibial tubercle transfer,[5] Z-plasty procedure,[10,12] or lengthening by quadriceps reinforcement.[6] Regardless of the surgical procedure, it has been well established that promotion of early postoperative mobilization by ROM and active quadriceps contraction exercises should be implemented to reduce the incidence of "re-baja."[5,6,10,12] With no clear consensus as to the superiority among patella baja treatments, the senior author (R.F.L.) advocates for surgical intervention by tenotomy as opposed to other surgical interventions (advantages and disadvantages are shown in Table 2). In most cases, patients have sufficient pain relief and restoration of extensor mechanism function such that the patellar tenotomy is the definitive procedure. If the patella migrates proximally and the patient has an extension sag, a patellar tendon reconstruction[11] with autogenous hamstring tendons may be performed.

The Z-plasty procedure was originally described by Dejour et al.[10]; this procedure along with recent modifications has been used for treatment of patella baja, and positive results have been reported regarding ROM and subjective outcome measures.[12] However, concerns about the Z-plasty procedure are present regarding reduced overlapping of the tendon surface with weakening of the tendon. Bruhin et al.[6]

Table 1. Pearls and Pitfalls

Pearls	Pitfalls
Adequate release of the patellar tendon and underlying scar tissue must be performed.	Continued patella baja can occur with an insufficient release.
A large incision is required for proper visualization and confirmation of patellar tendon detachment.	Knee extension weakness can occur due to disruption of the extensor mechanism.
The surgeon should perform arthroscopy with lysis of adhesions and anterior interval release in the first operation before performing open patellar tenotomy surgery.	The procedure requires a minimum of 2 surgical procedures.

Table 2. Advantages and Disadvantages

Advantages	Disadvantages
The procedure can be performed as a salvage procedure for patients with extension deficiency due to patella baja.	Potential dysfunction can occur as a result of detachment of the patellar tendon.
Patients are allowed to bear weight immediately after the procedure.	Surgical success is highly dependent on the postoperative physical therapy regimen.
The procedure results in improved knee flexion range of motion with improved patellar height.	A second surgical procedure may be required to reconstruct the patellar tendon if continued extensor mechanism deficits are present.

describeda differing elongation technique in which augmentation of the patellar tendon is used with the superficial aspect of the quadriceps tendon. This method is believed to be more advantageous than Z-plasty techniques by maintaining the tendon fibers in line, which is less likely to affect force vectors or compromise vascular supply to the tendon. One potential complication is the greater potential for quadriceps limitation owing to increased donor-site morbidity from the quadriceps tendon harvest. The benefit of an exclusive tenotomy procedure relative to these opposing techniques is that it allows a full restoration of patellar anatomy whereas opposing procedures may not achieve this as well.

Patella baja can cause significant functional limitations owing to knee-related stiffness, pain, and weakness. Arthroscopy with scar tissue debridement is the standard of care for patients with extension deficiency who have poor outcomes after conservative treatment. However, when this surgical approach fails, patients with continued patella baja may be candidates for open patellar tendon tenotomy as a salvage procedure.

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