Technical Note

Combined Reconstruction of the Medial Patellofemoral Ligament and Medial Quadriceps Tendon Femoral Ligament in Skeletally Immature Patients

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Abstract: The medial patellofemoral ligament (MPFL) reconstruction is challenging in skeletally immature patients due to the anatomical particularities at this age. Recently, the medial quadriceps tendon femoral ligament (MQTFL) has received great interest for its ability to restrain the patella's instability along with MPFL. No gold-standard technique has been described so far to reconstruct both MPFL and MQTFL in skeletally immature patients. We present a technique to safely reconstruct the MPFL and the MQTFL in children and adolescents. The gracilis tendon autograft is harvested and passed through the medial collateral ligament as a pulley. The free ends of the graft are passed through the patella by an "L-shaped tunnel" and tied to itself. The other free end of the graft is pulled through the medial third of the quadriceps tendon and tied to itself to achieve tension. Our technique is reproducible, implant-free and avoids complications associated with femoral drilling and graft fixation. However no long-term follow-up results are available.

The pathophysiology of patellar instability comprises a variety of factors that have long-term consequences, such as pain and arthritis,[1] which limit the activities of daily living and sports performance.[2] Most patients presenting with patellar instability are children and adolescents, but adults also can be affected.[3,4] Following a patellar dislocation, the chances are almost 100% that the medial patellofemoral ligament (MPFL) was injured.[4-7] Many procedures for MPFL restoration are now available,[2,8-13] especially developed to restore this main contributor in preventing lateral patellar dislocation.[1] Recently, several studies have revealed the importance of the medial quadriceps tendon femoral ligament (MQTFL) in restoring patellar stability.[14-17] To our knowledge, there is no "gold standard" for the MPFL reconstruction in skeletally immature patients. We present a technique in which the autologous gracilis graft is used to reconstruct both MPFL and MQTFL in skeletally immature patients. The graft is secured to the patella and to the quadriceps tendon using strong sutures, avoiding screws or anchor fixation. Soft-tissue fixation is also used to achieve femoral reinsertion. This is a safe and reproducible technique, with applications in treating skeletally immature patients and also adults.

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Surgical Technique (With Video Illustration)

Patient Positioning

The patient is positioned supine, with a tourniquet on the proximal thigh. An arthroscopic lateral post and a distal foot positioner are installed to hold the leg with the knee flexed at 60°, then then the limb is disinfected and draped. Anatomical landmarks are drawn on the skin over the medial aspect of the patella, the medial epicondyle of the femur, and over the hamstring insertion on the tibia.

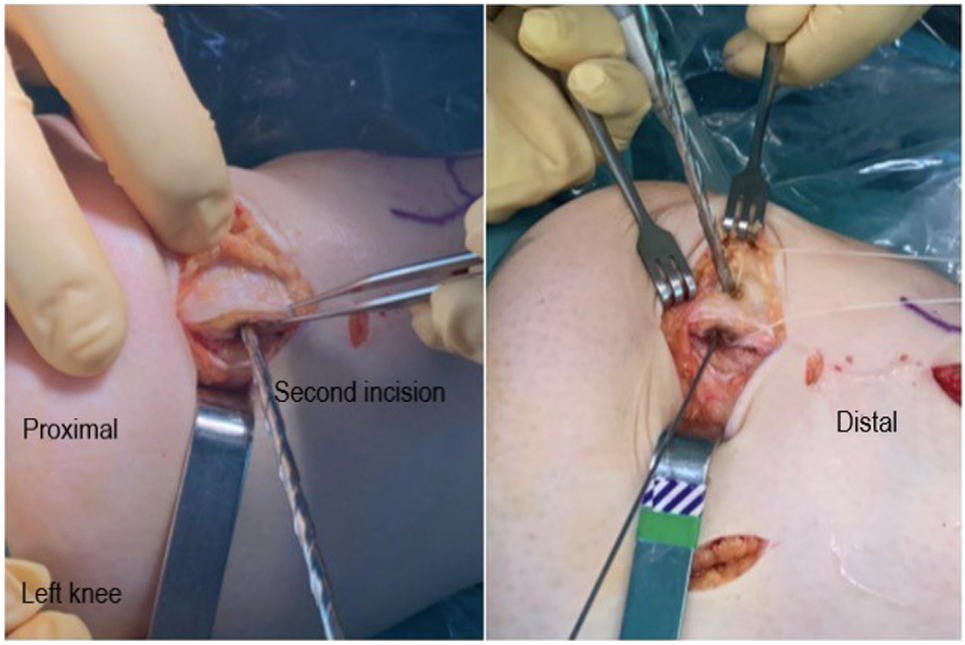

Fig 1. The patient is supine, with the left knee in extension. Drill a 1-cm long L-shaped tunnel through the patella. First the transverse one, right where the medial patellofemoral ligament insertion lies (left), then the perpendicular one (right).

Graft Harvesting

The skin is incised at 2 cm medial to the tibial tuberosity. After dissection of subsequent layers, the gracilis tendon is identified and isolated at the pes anserine insertion using a 90° Mixter forceps. The tendon is prepared at the distal end with no. 2 ultra-high-molecular-weight polyethylene (UHMWPE) braided suture, detached from the pes anserinus and harvested

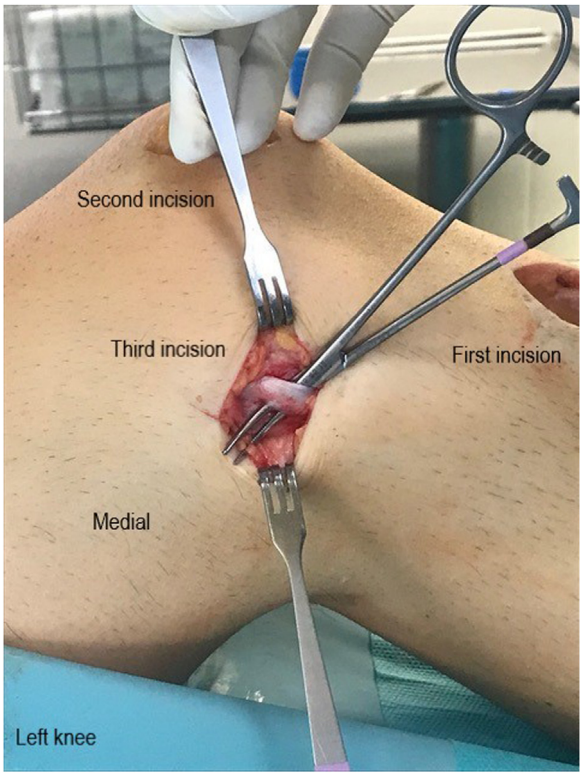

Fig 2. Disection of the posterior third of the medial collateral ligament, which will act as a pulley for the graft.

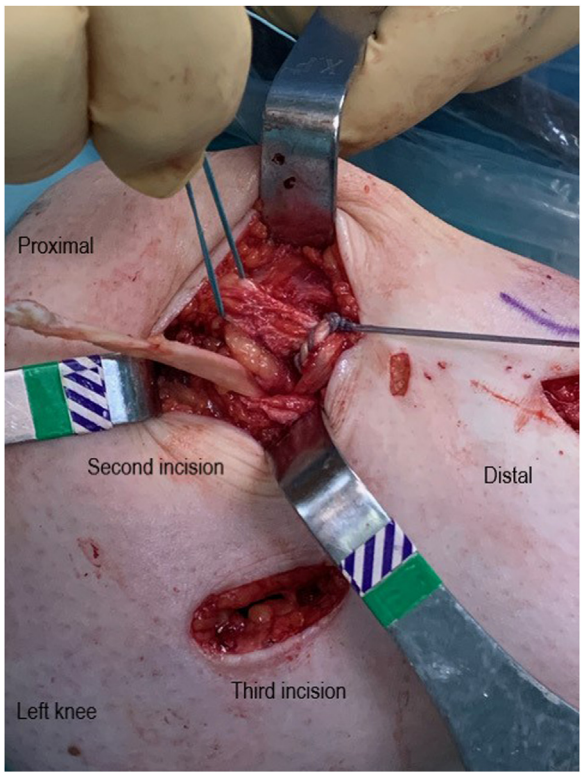

Fig 3. Graft is passed through the L-shaped patella tunnel and fixed to itself.

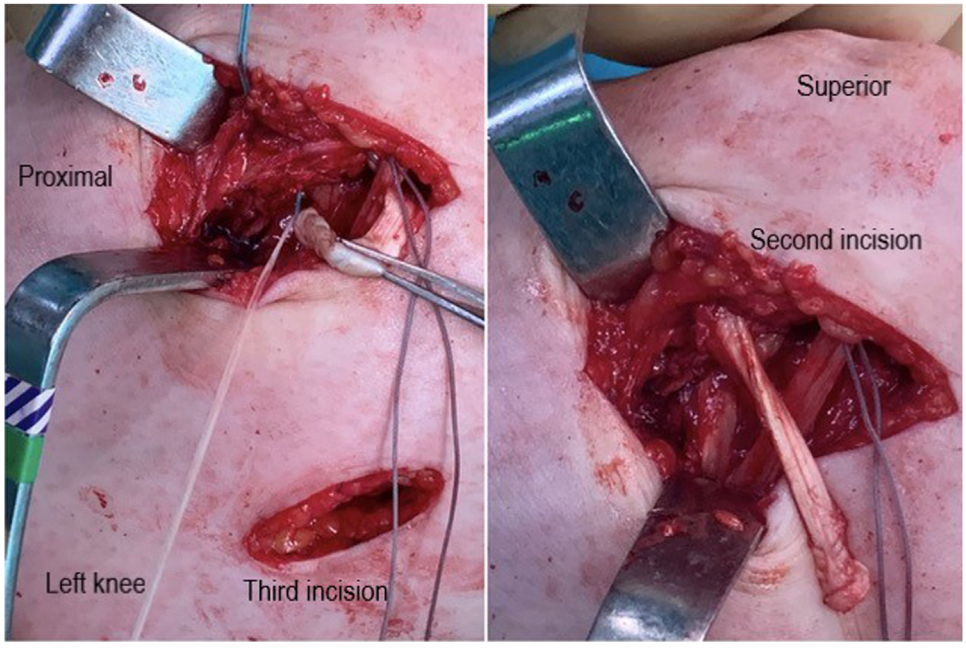

Fig 4. Graft is passed through the medial third of the quadriceps tendon, tensioned at 30° of flexion and tied to itself and to the quadriceps tendon.

using a closed tendon stripper. The graft is cleaned of muscle and fatty tissue and prepared at the proximal end with no. 2 UHMWPE braided whipstitch suture. We found no problem with the lack of length of the graft with this technique.

Surgical Approach

A 2-cm longitudinal incision is made on the medial aspect of the patella to identify and carefully dissect the medial retinaculum. A 1- to 2-cm incision is made in the medial retinaculum and a curved Pean forceps is introduced in the sub-vastus space (layer 2) pointed towards the medial collateral ligament (MCL) insertion. On the superomedial aspect of the patella, just where the anatomic insertion of the MPFL lies, a 1-cm long transverse bone tunnel is performed using a 3.2-mm drill bit and another anteroposterior tunnel with the same diameter that should intersect the first one at a 90° angle (Fig 1). Sometimes, if the graft is thicker, these tunnels are amplified with a 4.5-mm drill. In the distal part of the quadriceps tendon, just at the level of patellar insertion, a stab incision is made with a no. 15 scalpel blade at the intersection of the medial and middle third of the tendon width, close to the vastus medialis obliquus. Care must be taken not to damage the capsule or enter the articular space.

A 2- to 3-cm longitudinal skin incision is made at the level of the medial epicondyle. The femoral bony attachment of the MCL is exposed. The gracilis autograft is passed under the posterior one-third of the MCL femoral insertion (Fig 2), which acts as a pulley and returned onto the patella with the aid of the shuttle suture then its both ends are pulled through the sub-vastus space. The distal (thinner) end of the graft is passed through the patellar bone tunnel and is tied to itself (Fig 3). The other free end of the graft is pulled through the quadriceps incision and overlapped tensioning the MPFLR in 30° of knee flexion and sutured to the quadriceps tendon and to itself with no. 2 UHMWPE braided suture (Fig 4). The excess graft tip is trimmed off. The incised medial retinaculum is sutured back in an advanced plicated position on the patella to cover the graft and further stabilize the patella.

Passive knee flexion–extension is performed to check the patellofemoral tracking and to confirm the correct tensioning of the ligamentous reconstruction. 2-0 subcutaneous polyglycolic-acid sutures and 3-0 polyglycolic-acid rapid resorbable sutures are used for skin closure.

Additional procedures, such as percutaneous lateral retinaculum release, patellar tendon distalization and/or medialization, femoral derotation osteotomy, can be performed before this procedure to treat other patellar instability factors.

Postoperative Rehabilitation

After isolated MPFL reconstruction, active flexion of the knee is allowed immediately but limited to 90° for the first 2 weeks. We recommend partial weight-bearing during the first 2 postoperative weeks. Range of motion is increased as tolerated and assisted full weight bearing is permitted starting third week. Rehabilitation is focused on pain management and restoring full knee range of motion, patellar mobilization, quadriceps muscle strength and activation. Return to sport is restricted to a minimum of 4 months. Additional tips

Table 1. Tips and Tricks

First, identify the tibial tuberosity and place the incision 2 cm medially and distally. Proper identification will aid to harvest the graft
Use a braided suture to prepare the gracilis tendon at the distal end, then detach and harvest it
The length of the graft is not usually a problem
First drill the transverse tunnel, then the anteroposterior one. This way you don't risk drilling too much and entering the articular space
Start with drilling a 3.2-mm tunnel. If the graft does not fit, use a 4.5-mm drill to expand it
Take care not to damage the capsule or enter the joint during the incision in the distal part of the quadriceps tendon
Place a shuttle suture on the graft to aid in its passage under the MCL and retrieval on the patella
Reconstruct the MPFL first, then the MQTFL. This way, the overtensioning risk stays low
To properly tension the graft, perform the suture in 30° of knee flexion
Suture the medial retinaculum on the patella before closing

MCL, medial collateral ligament; MPFL, medial patellofemoral ligament; MQTFL, medial quadriceps tendon femoral ligament.

and tricks to this surgical technique (Video 1) are listed in Table 1.

Discussion

Restoring the MPFL in pediatric patients is challenging. Several specific complications can occur, like femoral growth plate injury, patellar fractures, and residual pain after overtightening the graft.[3,14] The presented technique is easy, reproducible, cost effective, and can be performed without implants. We developed this technique aiming for absolute safety during surgical restoration of both MPFL and MQTFL in skeletally immature patients (Fig 5).

The femoral attachment for MPFL reconstruction in skeletally immature patients is a reason for ongoing debate. Several techniques were proposed, using adductor magnus tendon, MCL, or an anatomic epiphyseal tunnel.[12] Deie et al.[1] were the first to use the MCL for femoral attachment in their reconstructions: the harvested proximal end of semitendinosus is looped around the posterior third of the MCL and fixed on the periosteum of the patella, while its distal tibial end remains anatomically attached. It has the disadvantage that it uses only one arm of the semitendinosus tendon and the patellar fixation is quite weak since the graft is sutured to the patella. The authors stated that, during flexion, the graft is rather isometric. We tend to agree more with the "favorable anisometry" concept described by Chotel et al.,[18] as the graft is loose during flexion since the patella is fully engaged in the trochlear groove but tightened in extension. This fact is very useful in patients with patella alta, since the patella engages later in the trochlear groove.

Kumahashi et al.[9] used a similar technique as Deie et al.,[1] but the semitendinosus was completely detached, looped around the MCL, and secured via a 6.5-mm patellar tunnel with a screw. As the diameter of the tunnel is big (6.5 mm in a relatively small pediatric patella), there is a greater chance of iatrogenic patellar fracture.[11] Chotel et al.[18] also used the MCL as a pulley but with 2 patellar tunnels for fixation, which also increased the risk of fracture at this level in the pediatric population.

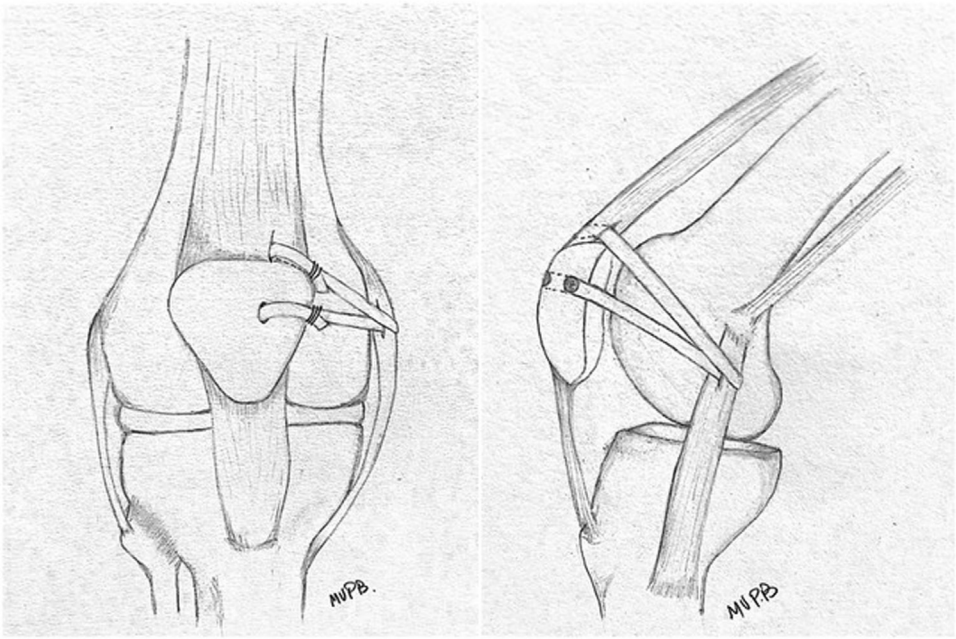

Fig 5. Schematic image of the technique in a right knee, anteroposterior (left) and lateral view (right).

Table 2. Advantages, Limitations, and Risks

Advantages	Limitations and Risks
Suitable for skeletally immature patients since no harm is done to the growth plate	No long-term follow-up
Both the MPFL and MQTFL are reconstructed	This procedure does not restore normal anatomy, as the graft is slightly anterior and distal at the femoral site
Using the MCL as a graft sling tightens the graft in knee extension	Low risk of patella fracture (one small 3.2- or 4.5-mm diameter tunnel is drilled)
Fracture risk stays low (one small 3.2- or 4.5-mm diameter tunnel is drilled)	
Useful in patients with patella alta	
No radiation exposure	
Simple and safer than the techniques using implants and femoral tunnels	
Lower cost	

MCL, medial collateral ligament; MPFL, medial patellofemoral ligament; MQTFL, medial quadriceps tendon femoral ligament.

The role of the MQTFL in patellar stability has recently been discussed. Mochizuki et al.[17] emphasized its importance in restoring patellar stability and recognized that most of the MPFL reconstruction techniques do not restore its integrity. Espregueira et al.[14] used both the semitendinosus and gracilis tendons looped around the adductor magnus tendon and sutured both to the patella and quadriceps. Being a soft-tissue fixation only, the patellar attachment is rather weak. However, our technique manages to restore both the MQTFL and MPFL with the help of only one tendon (gracilis). Another difference is that, instead of choosing the adductor magnus tendon as a sling for the graft, we use the MCL which, in our opinion, provides a less elastic pulley. We believe that by doing so, the chances of graft loosening over time are smaller. Second, since the insertion point of the MCL is distal to the original attachment of the MFPL, it tends to tighten the graft in knee extension, exactly when the tension is needed, and not in flexion.

Many techniques for MPFL reconstruction in children, adolescents, and adults have been described over time.[12,19,20] An advantage of our technique is that it is implant-free, so the cost of the procedure is lower. The likelihood of residual pain[11] is reduced due to the "manual" tensioning at the quadriceps level, which is not a stiff point. The fixation is still strong because the graft is passed through the "L-shaped" patellar tunnel. At the same time, by using a smaller tunnel (3.2 or 4.5 mm in diameter), the fracture risk stays low. The MCL as a pulley at the femoral level also has several advantages: since there is no need to drill a femoral tunnel, no possible harm is done at the growth plate and no fluoroscopy is needed intraoperatively, another advantage in pediatric patients. Using a slightly anterior and distal point of graft insertion compared with the original MPFL site gives another biomechanical advantage: the direction of force applied to stabilize the patella is distally and medially directed, useful in patella alta, a major risk factor for patellar instability in children.[19,21] In contrast, femoral insertions distal to the physis do not tend to be tight in midflexion having less risk of failure in time.[22,23] Advantages and limitations of our technique are stated in Table 2.

We presented a simple and reproducible technique that avoids the complications associated with femoral drilling, graft fixation, and the use of implants like in other MPFL reconstruction methods. One disadvantage of this procedure is that there are no long-term follow-up results available. It is recommended to keep revision options in mind until these become accessible.

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