



Anatomical Double-Bundle Medial Patellofemoral Ligament Reconstruction With Autologous Semitendinosus, a Single Patellar Tunnel Technique

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Abstract: Patellofemoral instability is one of the knee problems that can be found in up to 3% of knee injuries, especially in younger aged females. Recent biomechanical studies showed that the main soft tissue stabilizer for patellofemoral stability is the medial patellofemoral ligament (MPFL). More than 200 articles on MPFL reconstruction have been published. Some surgical techniques create multiple holes in the patellar area that may increase the risk of patellar fractures. This technique that we present here attempts to reduce the chance of patella-related complications, while maintaining stability of the reconstructed construct, reducing the use of a lengthy tendon graft within the patella and covering the footprint at the border of the patella closed to the native anatomy of the MPFL.

Introduction

Patellofemoral instability is one of the knee complications that can be found in up to 3% of knee injuries, especially with younger patients and female patients.¹⁻³ After the initial dislocation, in as many as 96% of cases, patients will have a medial patellofemoral ligament (MPFL) injury. The etiology of the instability is multifactorial. Soft tissue and bone are the main stabilizers of physiological patellar tracking. Recent biomechanical studies showed that the main soft tissue stabilizer for patellofemoral stability is the MPFL.⁴⁻⁶

Recent studies have shown indications for MPFL reconstruction, and they are noted in [Table 1](#).⁸ However, there is some concern regarding underlying conditions that make simple reconstruction not sufficient, and additional procedures are required to create a more successful outcome.^{8,9}

Restoration of the MPFL to prevent lateral patellar dislocation has become more popular.¹⁰ There are many techniques of MPFL reconstruction.^{11,12} However, there are no gold standards for techniques, choices for graft reconstruction and fixation options.¹³

We propose a feasible option for MPFL reconstruction that is reproducible, may reduce complications, and shortens operative time. This technical note shows an anatomic double-bundle MPFL reconstruction with a hamstring autograft, a single tunnel through the patella without fixation that requires just one interference screw at femoral insertion.

Technical Note

A demonstration of the anatomical double-bundle medial patellofemoral ligament reconstruction with autologous semitendinosus, a single patellar tunnel technique is available in [Video 1](#). Advantages, disadvantages, and technical pearls and pitfalls are summarized in [Tables 2](#) and [3](#).

Table 1. Indications for MPFL Reconstruction

- Failed conservative treatment
- Recurrent patellar instability
- Patellar subluxation/dislocations
 - With ongoing instability, pain, or symptomS
 - Associated osteochondral fracture
- Loose osteochondral fracture
- Active sports participation

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Table 2. Advantages and Disadvantages

Advantages	Disadvantages
Small incision	Donor-site morbidity
Reduces the chance of patellar fractures	Necessity for drilling of the patella
Large and strong tendon graft	
Covering the footprint at the border of the patella	
Reduces foreign-body reaction	
Reproducible technique	
Lower cost	
Shortened operative time	

Patient Positioning

A supine position on a radiolucent table is preferred for examination of the knee under anesthesia to evaluate patellar tracking. We also do an arthroscopic examination to evaluate and correct the intraarticular pathology.

This position is considered as the preferred position for reconstructing the MPFL, as fluoroscopy can easily access the proper landmark for femoral insertion.

Graft Harvesting

An oblique incision is made on the medial aspect of the tibial tuberosity, approximately 3 fingerbreadths from the joint line. The sartorial fascia is incised, and then, the semitendinosus tendon is identified and stripped with use of a tendon stripper (Fig 1). The muscle tissue is cleared from the tendon. The two ends of the graft are whipstitched using nonabsorbable



Fig 1. The patient is in supine position with knee flexion at 90° in the left knee. The semitendinosus tendon is sutured and harvested via a tendon stripper (white arrow).

suture, No.2 Ultrabraid suture (Smith & Nephew, Andover, MA) (Fig 2).

The graft for the double-bundle technique needs to be a minimum of 150-200 mm of a single strand at total length and ~5-6 mm in diameter at the femoral fixation (conjoint of the double strand).

Arthroscopic Examination

The diagnostic arthroscopy is performed before MPFL reconstruction to evaluate patellar tracking and the intraarticular pathology. All intra-articular compartments are accessed, and removal of particulates and loose bodies and debridement or chondroplasty are performed.

Patellar Tunnel Preparation

A longitudinal incision is made along the medial border of the patella, ~1-2 cm. from the lower one-third of the patella. An incision is made to the superficial fascia, and the second layer of the medial patellofemoral complex and the native insertion of the MPFL is identified. A 2.0-mm Kirschner wire (K-wire)

Table 3. Technical Pearls and Pitfalls

Pearls	Pitfall
Create a proper landmark before drilling.	Inadequate exposure prior to drilling can set the wrong position for reconstruction. ²³
Perform a suture augmentation at the border of the patella to create a fan shape.	Multiple drilling at the patella may cause iatrogenic fractures.
Use a curved clamp to create a space for graft placement.	Overtensioning the graft may cause excessive medial restraint.
Pass that graft between the medial retinaculum and the medial joint capsule.	
Avoid penetrating the joint capsule	
It requires a true lateral view of the knee to obtain the Schöttle's point for a femoral footprint.	
So as not to overtension the graft, always maintain knee position in flexion at 45-60°.	
Constantly recheck the patellar tracking.	
If lateral tightness is present, a lateral release can be performed. ²²	

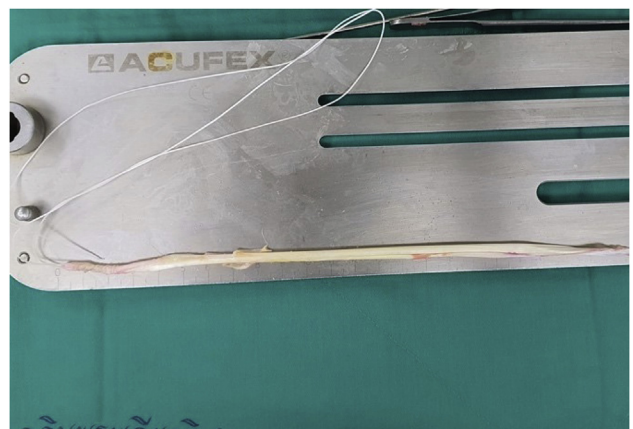


Fig 2. Semitendinosus graft length at 180 mm. and 4.0-4.5 mm. diameter. The two ends of the graft are whipstitched using nonabsorbable suture no.2 Ultrabraid suture.



Fig 3. External photograph of the left knee. A 2.0-mm K-wire is inserted at the midpoint of the medial border of the patella (white arrow) through the center of patella.

is inserted at the midpoint of the medial border of the patella through the center of the patella (Fig 3).

The single tunnel is created with a 4.5-mm EndoButton reamer (Smith & Nephew, Andover, MA) (Fig 4), and then a suture loop is passed through the tunnel (Fig 5).

The semitendinosus graft is passed through the tunnel by suture loop (Fig 6). The upper limb of graft is redirected to the upper part of patella by suture hang with the medial retinaculum and separating the graft to the upper and lower limbs.

Secure the graft to the patella by suturing with the medial retinaculum and patella with no. 1 absorbable suture (no.1 Vicryl, Ethicon, Johnson & Johnson, Blue Ash, OH) (Fig 7).

Femoral Tunnel Preparation

A 2-cm skin incision is performed at the posteromedial of the knee. In order to avoid neurovascular injury, the

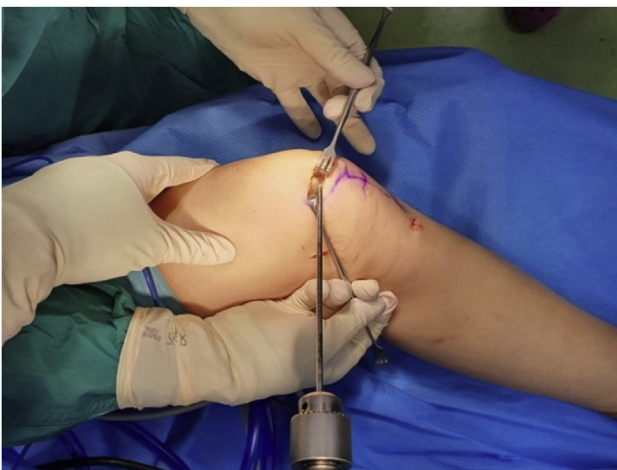


Fig 4. External photograph of the left knee. A single tunnel is created with a 4.5-mm EndoButton reamer at the middle area of the patella.

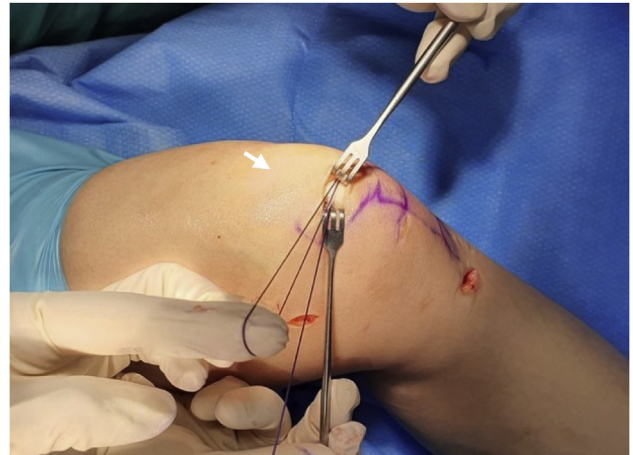


Fig 5. External photograph of the left knee. The suture loop is passed through the patellar tunnel (white arrow).

medial epicondyle and adductor tubercle need to be identified. Fluoroscopy is then used to identify an anatomical landmark. We use the radiographic method to create the proper landmark for MPFL insertion with Schöttle's point⁷ and a 2.0-mm K-wire is drilled into this point (Fig 8), perpendicular to the medial aspect of the knee, throughout the lateral cortex.

Then, a 4.5-mm EndoButton reamer is used and reamed through the lateral cortex. Then, the Beath pin is inserted into the EndoButton hole, and drilling is performed with a reamer until the tunnel reaches a maximum of 3-5 cm depth and a diameter of 5.0-6.0 mm, depending on the double-bundle graft length and diameter.

Graft Placement and Fixation

The space for graft placement is created between the medial retinaculum and medial joint capsule by carefully dissecting the plane above the medial joint capsule. The graft is then passed from the anteromedial to the medial side and shuttled with the suture loop. The two ends of the tendons are passed through the



Fig 6. External photograph of the left knee. The semitendinosus graft is passed through the patellar tunnel with a suture loop.

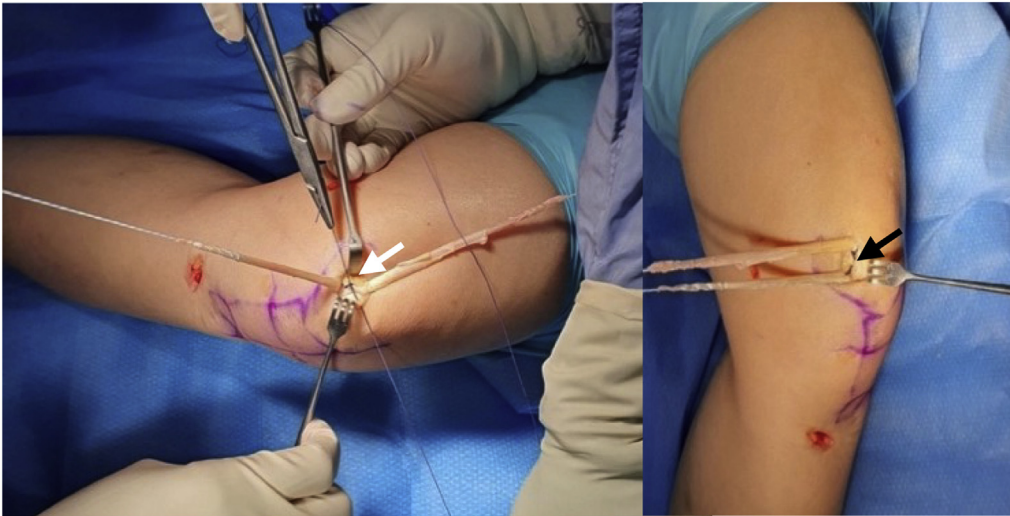


Fig 7. External photograph of the left knee. The upper limb of the graft is redirected to the upper part of the patella by a suture hang with the medial retinaculum and separating graft to the upper and lower limbs (white arrow). Secure the graft to the patella by suturing with the medial retinaculum and patella with a no. 1 absorbable suture (black arrow).

lateral cortex following the guidewire (Fig 9). After applying guidewire, an interference screw, 6 mm in width and 25 mm in length, (Biosure HA, Smith & Nephew, Andover, MA, USA.) is inserted with the proper tension at a knee flexion of 45-60° (Fig 10).

Postoperative Rehabilitation

Following MPFL reconstruction surgery, patients are required to wear a knee brace to prevent the

recurrence of dislocation and aid in the healing of ligaments. The rehabilitation protocol is shown in Table 4.

Discussion

MPFL reconstruction surgery is an effective operation that prevents recurrent dislocation.¹⁰ More than 200 publications on MPFL reconstruction have been published since 2014.^{3,14}

Fig 8. The method of Schöttle et al.⁷ creates an anatomical femoral MPFL insertion via fluoroscopy in a lateral view of the left knee. Line 1: Straight line along posterior cortex of the femur. Line 2: Perpendicular to Line 1 passing through the origin of the medial femoral condyle. Line 3: Parallel to Line 2 passing through the posterior aspect of the Blumensaat line. The landmark is anterior to Line 1 and between Lines 2 and 3 (white circle).

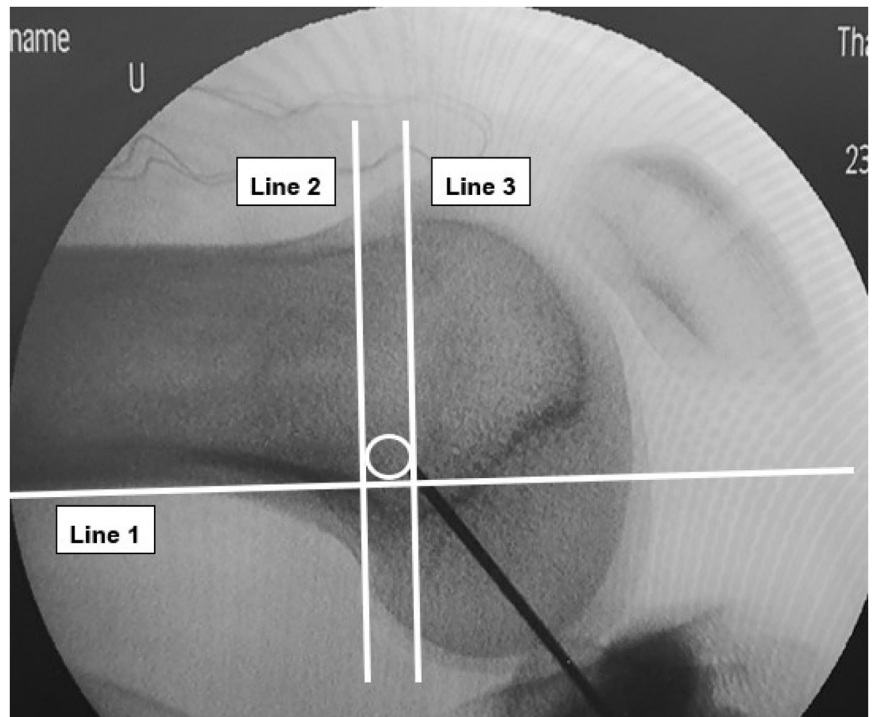




Fig 9. External photograph of the left knee. After space between medial retinaculum and medial joint capsule is created, the semitendinosus graft is passed from the anteromedial aspect to the medial side (black arrow). The two ends of tendon are passed through the lateral cortex (white arrow).

Some surgical techniques that create multiple holes in the patellar area may increase the risk of patellar fractures; thus, we use an alternative technique that creates a single hole and inserts the tendon graft. The tendons are passed through the front of the patella to reduce the chance of fractures. Then, the suture augmentation is performed on the edges of the patella to primarily cover the footprint at the border increasing the strength of the tendons. This is in accordance to the technique of using a double-bundle span inserted in a fan shape closer to the native anatomy of the MPFL.

The MPFL is located at the femur in the second layer of tissues at the medial side of the knee.¹⁵⁻¹⁷ A study of human bones, according to research by Schöttle et al.⁷, shows that at the femoral insertion of the MPFL, a radiographic image with a true lateral view of the knee is used to identify the landmarks (Fig 9).

There have been numerous studies regarding the selection of graft choice in replacing the original MPFL.¹⁸ For example, synthetic graft, allograft,³ quadriceps tendon,¹⁹

and hamstring grafts,²⁰ including semitendinosus, gracilis, or a combination of semitendinosus and gracilis.^{6,21} However, there is no research comparing the pros and cons for each graft choice. In the usage of a hamstring graft, the semitendinosus is better than the gracilis, as it is larger, longer, and more suitable for the double-bundle techniques.

It can be seen that MPFL reconstruction surgery with this technique has several advantages. It reduces the chance of patellar fractures, creates larger and stronger tendons, and covers the footprint at the border of the patella close to the native anatomy of the MPFL. The surgical procedure is not very complicated, and results are reproducible. At the femur insertion area, we use only one interference screw for fixation.

Conclusion

This presented technique attempts to reduce the chances of patella-related complications, while preserving good stability of the reconstruction, reduces the use of the length of the tendon graft within the

Fig 10. External photograph of the left knee. Insert the guidewire prior to interference screw insertion (black arrow). An interference screw, 6 mm in width and 25 mm in length, is inserted with the proper tension with a knee flexion of 45-60°.

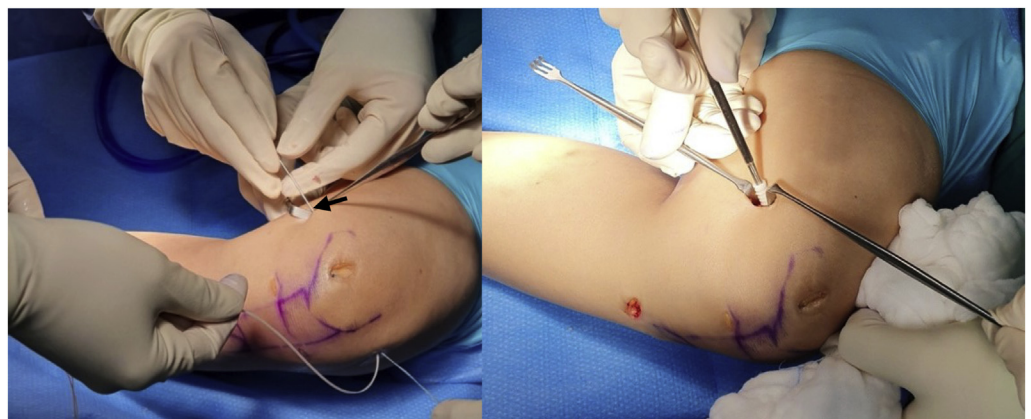


Table 4. The rehabilitation protocol following isolated MPFL reconstruction

At Time Period	Rehab Protocol
1-4 Weeks	<ul style="list-style-type: none"> • On knee brace • Limit knee flexion 0-30° • Full weight bearing as tolerated
4-6 Weeks	<ul style="list-style-type: none"> • Isometric quadriceps exercises • Removable brace • Limit knee flexion 0-90°
6-12 weeks	<ul style="list-style-type: none"> • Semi-squat exercise with knee flexion at 45° • Promote to full knee flexion as possible • Semi-squat exercise
12-16 weeks	<ul style="list-style-type: none"> • Open kinetic chain quadriceps exercise • Return to light sports especially cycling, jogging, and swimming
After 16 weeks	<ul style="list-style-type: none"> • Return to sports

patella, and covers the footprint at the border of the patella closer to the native anatomy of the MPFL.

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