

Wide Patellar Insertion Medial Patellofemoral Ligament Reconstruction with Internal Bracing

Jin Tang, B.M., and Jinzhong Zhao, M.D.



Abstract: Medial patellofemoral ligament (MPFL) reconstruction is a common procedure to address MPFL deficiency. Various techniques have been reported, with the best method still being pursued. Previous studies have revealed the advantage of internal bracing and possible advantage of wide patellar insertion in MPFL reconstruction. Thus, we would like to introduce a technique that combines the internal bracing and wide patellar insertion in MPFL reconstruction, in which the critical points are proper location of the patellar and femoral tunnels and proper tensioning of the augmenting sutures and the whole graft complex. Our clinical experience indicates that the proper application of this technique can lead to satisfactory clinical outcome. We consider the introduction of this technique will provide more insight to MPFL reconstruction.

The medial patellofemoral ligament (MPFL) is an important structure for maintaining medial stability of the patella. MPFL insufficiency may be the consequence of developmental, degenerative, or traumatic causes; aggravates in turn patellofemoral disorders; and is indicated for MPFL augmentation in many cases.¹ There are many methods of MPFL augmentation reported for adult patients, among whom MPFL reconstruction outperformed medial retinaculum plication² and MPFL reconstruction with internal bracing outperformed that without internal bracing.³ Regarding the anchorage of the reconstructed MPFL on the patella, it can be narrow or wide, with the latter mimicking the native MPFL insertion better.^{4,5} We describe a wide patellar insertion MPFL reconstruction

technique in which 2 patellar tunnels are fabricated and 1 tendon graft is used. Furthermore, we perform internal bracing in the current technique. The main contra indications of the current technique are patients who have too thin or too short a patella (Table 1).

Table 1. Indications and Contraindications of MPFL

Indications for MPFL reconstruction

1. Primary patellar dislocation with less than or equal to one-third of patellofemoral contact surface.
2. Primary patellar dislocation with more than one-third of the patellofemoral contact surface but combined osteochondral fractures requiring operation.
3. Primary patellar dislocation with more than one-third of the patellofemoral contact surface but dynamic lateral displacement of the patella more than two-thirds of the lateral patella width.
4. Recurrent patella dislocation.
5. Habitual or fixed patella dislocations.
6. Patellofemoral arthritis with less than or equal to one-third of the patellofemoral contact surface.

Relative indications for MPFL reconstruction

1. Recalcitrant patellofemoral pain with less than or equal to one-third of the patellofemoral contact surface.
2. Patellar instability with less than or equal to one-third of the patellofemoral contact surface.
3. Patellar instability with more than one-third of the patellofemoral contact surface but dynamic lateral displacement of the patella more than two-thirds of the of the lateral patella width.

Contraindications for femoral tunneling MPFL reconstruction

1. Skeletally immature patients with high growth potential.

Contraindications for patellar tunneling MPFL reconstruction

1. Too thin a patella.

Contraindications for two patellar tunnel MPFL reconstruction

1. Too short a patella.

MPFL, medial patellofemoral ligament reconstruction.

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Table 2. Step-by-Step Procedure of Wide Patellar Insertion Medial Patellofemoral Ligament Reconstruction With Internal Bracing

1. The anterior half of peroneus longus tendon (AHPLT) is harvested. Both ends of the tendon is braided with nonabsorbable sutures.
2. All parts of the knee, especially the popliteal hiatus, the space under the lateral meniscus, and the posteromedial and posterolateral compartments are examined and debrided.
3. The point on the medial edge of the patella at the level of the junction of the middle and proximal one-third (MPJ) of the patella is defined. A medial patellar incision is made over the MPJ.
4. Two tunnels are created from the medial edge of the patella to the midline of the anterior surface of the patella, at levels respectively 5 mm proximal and distal to the MPJ.
5. A longitudinal incision of about 2 cm long is made over the medial femoral epicondyle and the adductor tubercle.
6. The femoral tunnel is located in the middle of the medial femoral epicondyle, the adductor tubercle, and the gastrocnemius tubercle and created.
7. Two guide sutures are passed through the patellar tunnels.
8. The graft tendon along with 1 no. two ultra-high molecular weight polyethylene sutures are passed through the proximal tunnel and pulled back through the distal tunnel.
9. Lateral retinaculum release is performed as indicated.
10. The tendons and the augmenting sutures are pulled subcutaneously out of the medial incision.
11. A cortical suspensory fixation device with an adjustable loop is passed through the femoral tunnels from medial to lateral side.
12. Each tendon end, as well as the augmenting sutures, are tied to the adjustable loop.
13. A 2-mm lateral incision is made at the anterior edge of the iliotibial band at a level at the proximal pole of the patella.
14. The sutures from the adjustable loop are pulled through the soft-tissue fissure resulting from the lateral retinaculum release out of the lateral incision.
15. The cortical fixation device is pulled through the femoral tunnel until the tendon ends are pulled into the femoral tunnel.
16. The arthroscope is placed to the lateral gutter of the knee through the anterolateral portal. The adjustable loop is reduced until the flipping button is pulled back against the lateral orifice of the femoral tunnel.
17. At 30° flexion of the knee, lateral displacement of the patella is checked to make sure the medial stability of the patella is restored.

MPJ, medial–proximal junction.

Preoperatively, a computed tomography scan of the knee is necessary. The lateral deviation of the patella is checked to compare with its postoperative position. The size of the patella is evaluated to find out whether there is a too-small patella, in which a double or even single patella tunnel cannot be created and other method of anchorage of the graft tendon to the patella should be considered, and to define the suitable distance between the 2 patella tunnels. On the 3-dimensional reconstruction of the computed tomography images, the medial side of the medial femoral condyle is scrutinized to detect the medial femoral epicondyle, the adductor tubercle, and the gastrocnemius tubercle, as well as the existence of the sulcus among the three tubercles for intraoperative palpating location of the femoral tunnel.⁶

Surgical Procedures (With Video Illustration)

The patient is placed in the supine position. Two lateral posts are used respectively at the level of the proximal thigh and the femoral condyle.

Tendon Harvesting

The semitendinosus tendon, gracilis tendon, or the anterior half of peroneus longus tendon can be used for MPFL reconstruction. Compared with the hamstring tendon, the incision of anterior half of peroneus longus tendon is small and subtle, and graft harvesting is extremely convenient, so it is the most-used graft for MPFL reconstruction at present.^{7,8} Both ends of the tendon is braided with nonabsorbable sutures. The

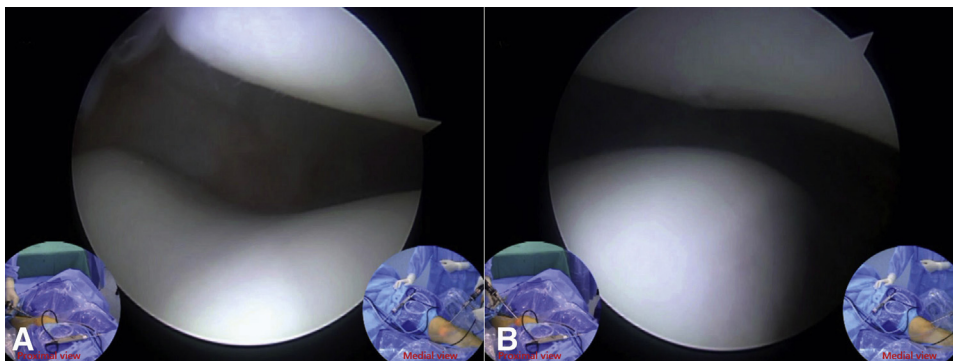
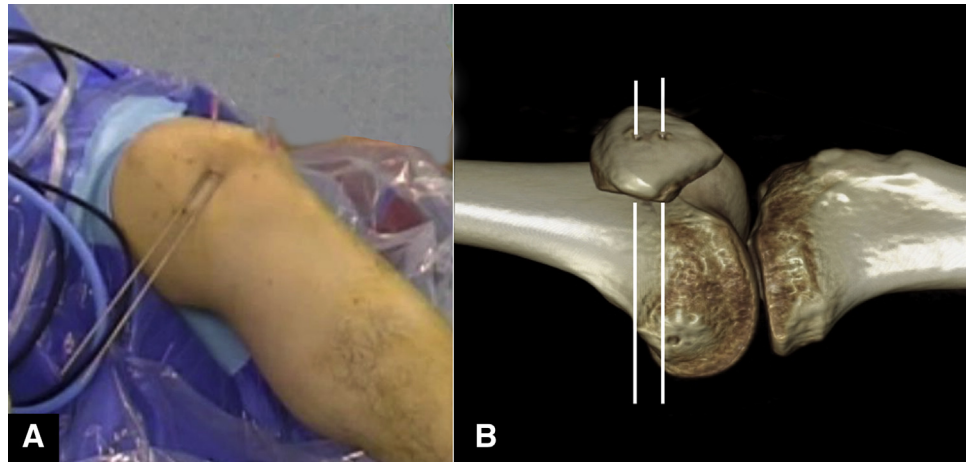


Fig 1. Checking the position of the patella arthroscopically (arthroscopic view of left knee through the anterolateral portal). (A) The patella deviates laterally. (B) The patella rides over the lateral femoral condyle.

Fig 2. Creating the 2 patellar tunnels. (A) intraoperative photo indicating the drilled in K-wires. (B) Illustration indicating the anteromedial orifices of the patellar tunnel.



width of the tendon in single-strand and folded is measured (Table 2 and Video 1).

Debridement of the Knee

Routine anteromedial and anterolateral portals are fabricated. All parts of the knee, especially the popliteal hiatus, the space under the lateral meniscus, and the posteromedial and posterolateral compartments, are examined. Any free body or osteochondral fracture fragment is removed. The deviation and cartilage status of the patella are checked (Fig 1).

Creating the Patella Tunnels

The knee is flexed at 30°. The proximal and distal poles of the patella are detected and marked with needles. The level of the junction of the middle and proximal one third of the patella, which usually corresponds to the widest part of the patella, is defined

with reference to the marking needles. The point on the medial edge of the patella at this level is defined as medial–proximal junction (MPJ). A 1-cm long longitudinal incision, medial patellar incision is made over the MPJ. Two tunnels are created from the medial edge of the patella to the midline of the anterior surface of the patella, at levels respectively 5 mm proximal and distal to the MPJ, sequentially with K wire and a cannulated drill for each tunnel (Fig 2).

Creating the Femoral Tunnel

The knee is flexed at 90°. A longitudinal incision of approximately 2 cm long is made over the medial femoral epicondyle and the adductor tubercle. The medial femoral epicondyle, the adductor tubercle, as well as the gastrocnemius tubercle is defined through this incision. A K-wire is drilled from the midpoint among these 3 tubercles medially in a slight proximal

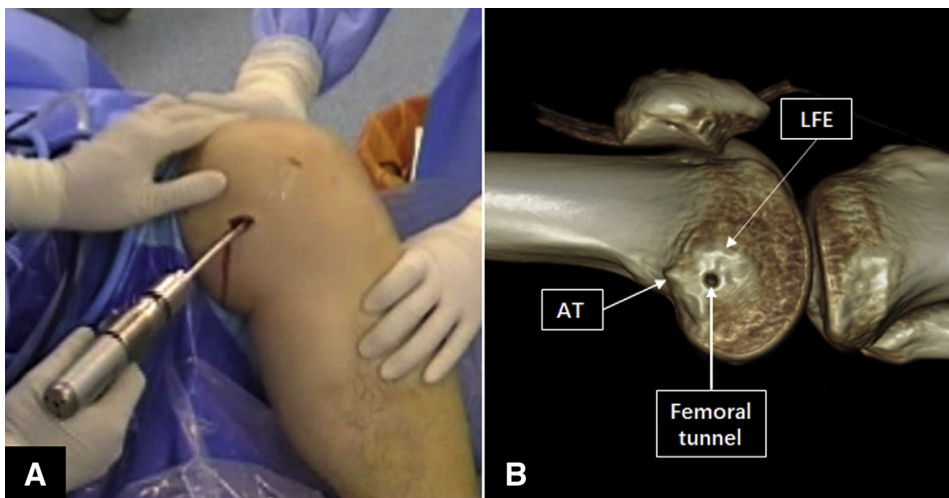


Fig 3. Creating the femoral tunnel. (A) Intraoperative photo. (B) Illustration indicating the location of the femoral tunnel. (AT, adductor tubercle; LFE, lateral femoral epicondyle.)

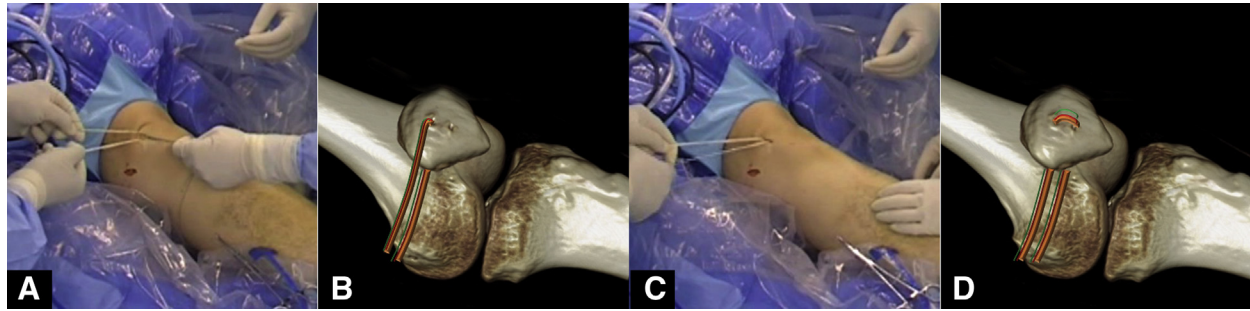


Fig 4. Implantation of the tendon graft and the augmenting sutures through the patellar tunnels. (A) (intraoperative photo) and (B) (Illustration): the tendon and the sutures are passed through the proximal patellar tunnel. (C) (intraoperative photo) and (D) (Illustration): the superior limbs of the tendon and sutures are passed through the distal patellar tunnel back to hang them over the bone bridge.

and anterior deviation across the lateral cortex of the femur. The K-wire is overdrilled to create the femoral tunnel to a size equal to the folded style of the tendon (Fig 3).

Tendon Implantation Through the Patella Tunnels

Two guide sutures are passed through the patellar tunnels with a guide pin through the medial patella incision from medial to lateral side, and the medial limbs of the guide sutures are retrieved subcutaneously back out of the medial patellar incision. The graft tendon along with two No. 2 ultra-high molecular weight polyethylene (UHMWPE) sutures, which are used as internal brace for augmentation is passed through the proximal patella tunnel from medial to lateral side. Then the superior limbs of the tendon and the UHMWPE sutures are pulled through the distal patellar tunnel from the lateral to medial side to hang the graft tendon and the UHMWPE sutures on the bone bridge between the lateral orifices of the patellar tunnels (Fig 4). The tendon ends are leveled abreast.

Lateral Retinaculum Release

Lateral retinaculum release is performed except for patient with medial instability of the patella. With the knee in full extension, the arthroscope is placed in through the anteromedial portal, the radiofrequency probe is placed in through the anterolateral portal. Lateral retinaculum release is performed in the space between the vastus lateralis and the iliotibial band from the level of the anterolateral portal to the tendon-muscle junction of the vastus lateralis.

Tendon Connection to a Cortical Fixation Device

The knee is flexed at 90°. The tendons and the augmenting sutures are pulled subcutaneously out of the medial incision. The guide pin is passed through the femoral tunnel. The traction and adjusting sutures from a cortical suspensory fixation device with an adjustable loop (Arthrex, Naples, FL) are passed through the femoral tunnels from medial to lateral side (Fig 5). Both tendon ends are tied to the adjustable loop. With tensioning of the adjustable loop and the tendons, the augmenting sutures are tied also to the adjustable loop

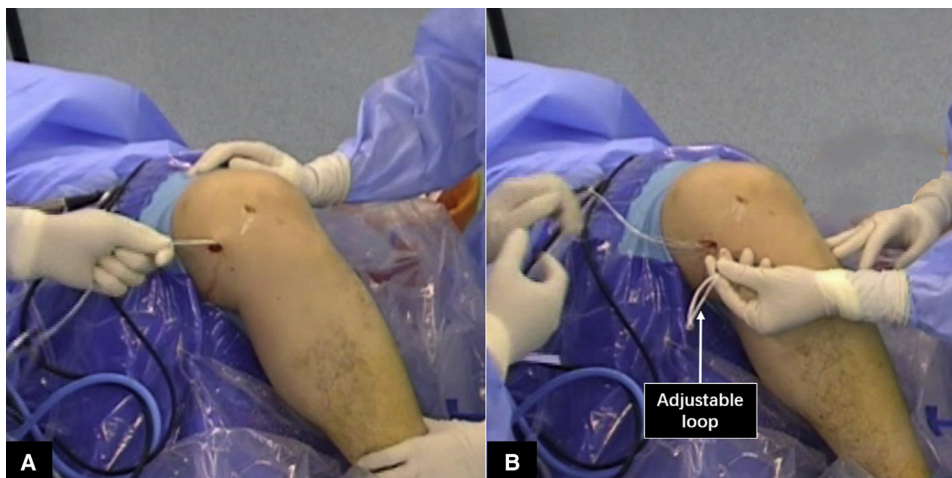


Fig 5. The tendon graft and the augmenting sutures are passed out of the medial incision (A) and sutures from a cortical suspensory fixation device are passed through the femoral tunnel (B).

Fig 6. The tendon ends are tied at the adjustable loop loosely (A) and the augmenting sutures are tied at the adjustable loop with tension on the tendon graft (B) to obtain similar tension on the tendon graft and the augmenting sutures.

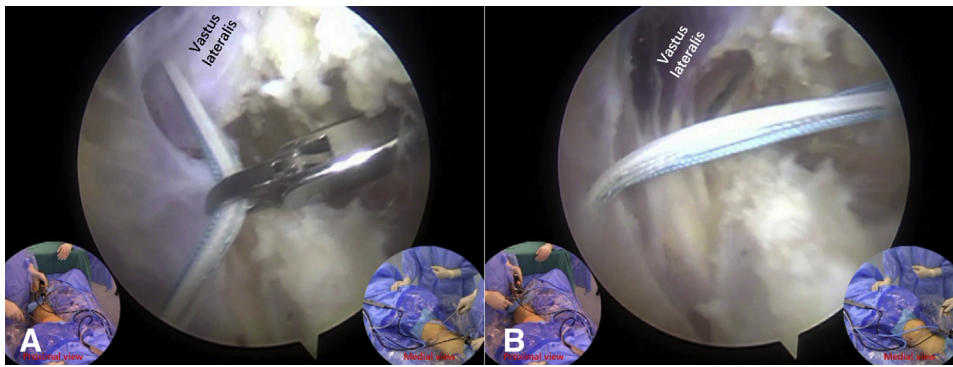
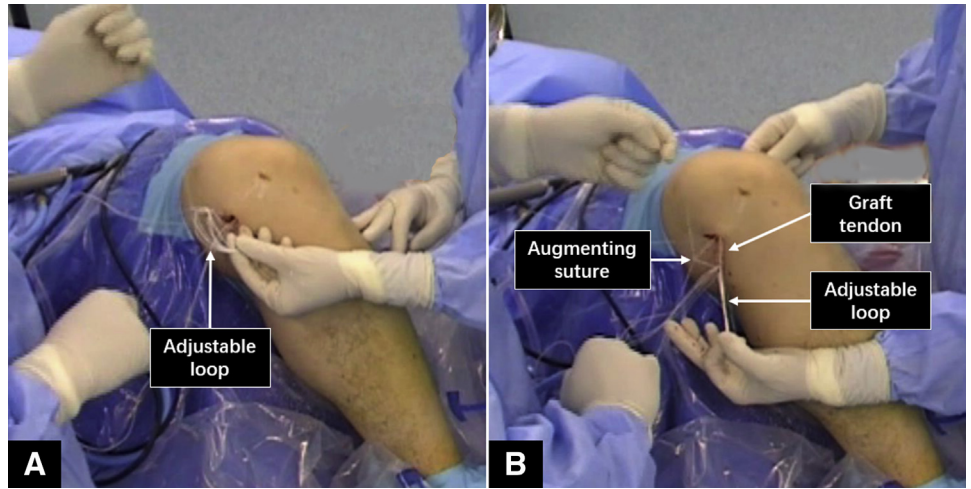
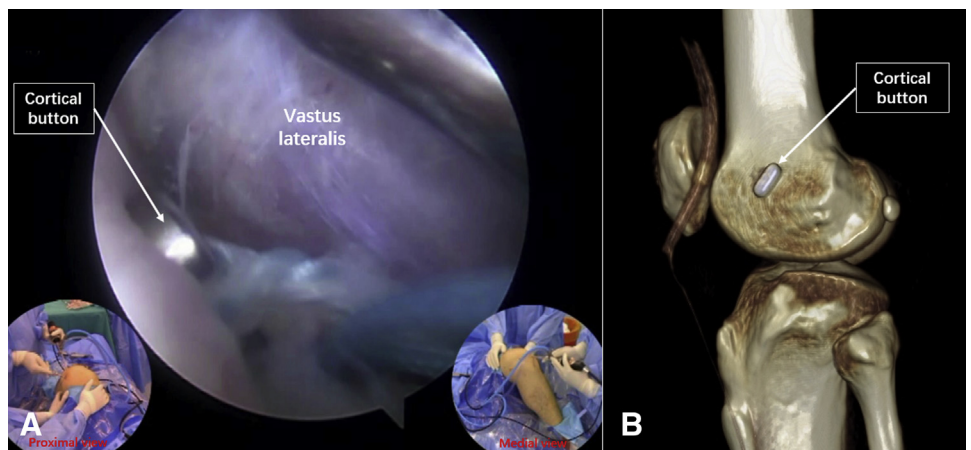


Fig 7. The proximal traction and loop reduction sutures are found (A) and retrieved out through the soft-tissue fissure resulted from lateral retinaculum release and the lateral incision (B).

Fig 8. The cortical fixation button is set against the lateral orifice of the femoral tunnel. (A) Arthroscopic lateral gutter view of left knee through the anterolateral portal. (B) Illustration indicating the position of the cortical button.



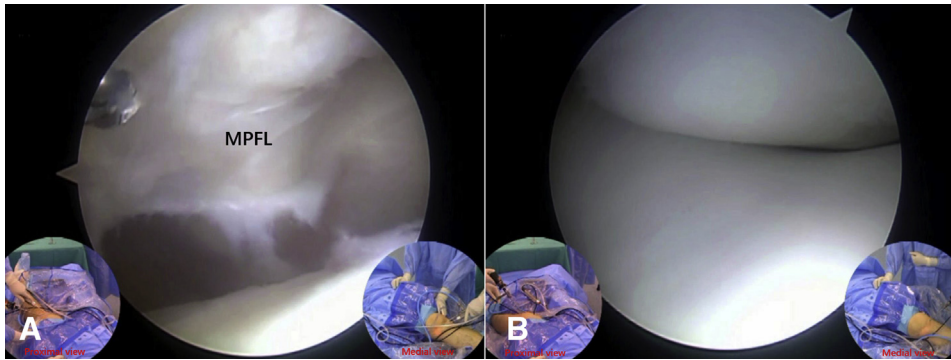


Fig 9. Intra-articular view of the reconstructed medial patellofemoral ligament (A) and the position of the patella after medial patellofemoral ligament reconstruction (B) (arthroscopic view of left knee through the anterolateral portal). (MPFL, medial patellofemoral ligament reconstruction.)

(Fig 6). The length of the adjustable loop is increased to make sure the flipping button can be pulled out of the lateral orifice of the femoral tunnel.

Tendon Implantation Into the Femoral Tunnel

A 2-mm lateral incision is made at the anterior edge of the iliotibial band at a level at the proximal pole of the patella. With the knee in full extension, the sutures from the adjustable loop are pulled through the soft-tissue fissure resulting from the lateral retinaculum release out of the lateral incision (Fig 7).

The knee is flexed at 90°, and the cortical fixation device is pulled through the femoral tunnel until the tendon ends are pulled into the femoral tunnel. While the knee is moved from 60° to 90° of flexion, the tension on the graft is checked within the medial incision. Then, the knee is set at the flexion degree at which the highest tension in the graft is defined, which is usually 90°.

The arthroscope is placed to the lateral gutter of the knee though the anterolateral portal. The adjustable loop is reduced until the flipping button is pulled back

Table 3. Pearls and Pitfalls of Wide Patellar Insertion MPFL Reconstruction With Internal Bracing

1. The purpose of MPFL reconstruction is to prevent recurrence of patellar dislocation or instability and to improve patellofemoral joint matching. Therefore, patients without severe static deviation or dynamic instability should not undergo MPFL reconstruction.
2. On the side of the patella, if the patella is too small and too thin, it is not suitable to build a patella tunnel. It is suggested to use patella pole suspension reconstruction, in which the tendon ends are passed through the quadriceps tendon and the patella tendon respectively to control the patella indirectly.
3. If there is indication to build patella tunnels, it is recommended to use oblique patella tunnels on the transverse plane, which is from the medial edge of the patella to the midline of the anterior surface of the patella, instead of a transverse patella tunnel, which is from the medial to the lateral edge of the patella. Otherwise, the risk of patella fracture will be significantly greater.
4. The force center of ligament reconstruction should be located at the junction of the middle and upper one-third of the patella. Too high or too low may cause abnormal kinematics of the patella.
5. When constructing the femoral tunnel, the 2 anatomical structures of the medial femoral epicondyle and adductor tubercle should be clearly located, and the depression between the two protrusions should be used as a reference for tunnel positioning. This generally does not lead to too obvious location deviation. If the local anatomy is unclear, it is necessary to extend the incision to enlarge the exposure or use X-ray fluoroscopy as an auxiliary positioning.
6. The most common error in positioning the femoral tunnel is that the tunnel is too anterior or proximal. When the MPFL is tightened, the rotating arm is too short, which prevents the patella from sliding to the distal side of the femur, resulting in high pressure on the patellofemoral joint or limited knee flexion.
7. When tying the augmenting sutures at the adjustable loop, the tendon graft is tensioned to obtain similar tension on the graft and the augmenting sutures. Too-slack augmenting sutures have no protective effect, and too-tight augmenting sutures may cause stress shielding effect.
8. The traction and adjustment sutures on the cortical fixation device should be rerouted through the fissure resulted from lateral retinaculum release and the lateral incision. Otherwise, the cortical fixation button is prone to engage the vastus lateralis or the iliotibial band. When lateral retinaculum release is not performed, the capsule and the retinaculum around the lateral incision is removed to expand the soft-tissue tunnel for the rerouting of the traction and adjustment sutures.
9. It is particularly important to adjust the tension and strength of the medial patellar structure during the reconstruction of MPFL, that is, to restore or improve the tension and strength of the medial patellofemoral joint, without overtightening the medial patellofemoral joint and affecting the range of flexion motion.
10. The reconstructed MPFL is not an isometric structure; checking the tension of the reconstructed MPFL and fixing at the knee flexion angle at which the tension in the structure is greatest is preferable

MPFL, medial patellofemoral ligament.

against the lateral orifice of the femoral tunnel (Fig 8). At 30° flexion of the knee, lateral displacement of the patella is checked to make sure the medial stability of the patella is restored.

The arthroscope is placed in the anterolateral portal. The position of the patella is checked from full extension to 45° of flexion to ensure reduction of the patella and preclude overtension of the reconstructed MPFL (Fig 9).

Discussion

There are several main features of the current technique. First, the graft tendon is anchored to the patella through a hang-over mechanism. The disadvantage is that 2 patella tunnels must be created. The advantage is that no special fixation device is needed on the patellar side, and the anchorage of the tendon to the patella depends on mechanical integrating instead of tendon-bone healing. Second, internal bracing with UHMWPE sutures is taken. The advantage of the of internal bracing is that the failure load of the whole MPFL construct is increased. The disadvantage is that once the MPFL construct is overtensioned, it will result in medial patellofemoral osteoarthritis or flexion limitation. Finally, on the femoral side, cortical suspensory fixation device is used. The advantages of this kind of fixation are that the fixation is secure and the tension of the whole MPFL construct can be increased through reduction of the adjustable loop. The disadvantage is that the tension in the MPFL construct cannot be decreased once it is over tensioned.

The pearls and pitfalls of the current technique are listed in Table 3. The most critical points are proper location of the tunnels, especially the femoral tunnel and proper tension of the whole graft complex.

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