The Medial Patellofemoral Ligament

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9.1 Introduction

The medial patellofemoral complex, consisting of the medial patellofemoral ligament (MPFL) and the medial patellotibial ligament, is the main passive stabiliser of the patellofemoral joint. Since it has been shown that rupture of the MPFL is the main pathological consequence of patellar dislocation and biomechanical studies have demonstrated that the MPFL is the main restraint against lateral patellar displacement, reconstruction of the MPFL has become a widespread technique for restoration of patellofemoral stability.

Different authors have reported on the results of different surgical techniques. The techniques and outcomes vary widely. This ICL aims to provide an overview of the indication for isolated MPFL reconstruction, advantages, and disadvantages of surgical technique and reasons for failure.

9.2 State-of-the-Art Treatment

9.2.1 Biomechanical Considerations: The Normal Anatomy and Biomechanics of the MPFL and of MPFL Reconstruction

Joanna Stephen, Punyawan Lumpaopong, David Deehan, Deiary Kader, and Andrew Amis

The most important anatomical factor is the femoral attachment, which was shown to be midway between the medal epicondyle and the adductor tubercle. If the attachment is too proximal, then it leads to elongation when the knee flexes, and a too distal attachment leads to elongation when the knee extends. In a normal knee, the femoral attachment of the MPFL can be defined by X-ray: if the anterior–posterior size of the femoral condyle is 100 %, then the MPFL attachment is 40 % from the posterior limit, 50 % from the distal limit, and 60 % from the anterior limit [1].

The MPFL is known to be the principal passive soft tissue restraint to patellar lateral displacement. If the MPFL was transacted, it caused significant changes in patellar kinematics, with increased lateral tilt and translation. This change was matched by significant increases in lateral trochlear articular contact stresses and reduction of the medial facet contact stresses. These changes make a case for the desirability to restore MPFL function [2].

When MPFL reconstruction was studied, using a 2-strand gracilis tendon graft from a single femoral tunnel to a groove along the medial edge of the patella, it was found that the best graft tension was only 2 N, that is, only just take out the slackness from the graft, and do not pull the patella medially. Any higher graft tension led to elevated cartilage contact pressures on the medial facet of the PF joint. If a central, anatomical graft tunnel position was found on the femur, the MPFL graft was close to isometry across the range of knee flexion–extension, with approximately 2 mm elongation in the last 15° of knee extension. So the angle where the graft was tensioned did not matter, in the range from 30° to 60° knee flexion, to restore the articular contact pressures to normal across the medial and lateral facets of the PF joint. If the femoral graft tunnel was placed 5 mm proximal or 5 mm distal from the anatomical site, it caused significant joint contact pressure elevation, in line with the length changes of the natural MPFL. That is, 5 mm proximal attachment led to elevated pressures on the medial facet of the PF joint in the flexed knee, and 5 mm distal attachment led to elevated pressures in the extended knee [3].

9.2.2 Indications for Isolated MPFL Reconstruction and the Influence of the Soft Tissue Anatomy on the Diagnosis and Treatment: When Is a Soft Tissue Procedure Sufficient for Patella Stabilisation?

Elizabeth A. Arendt

To describe the ideal patient who would benefit from an MPFL reconstruction to guard against recurrent lateral patella dislocation (LPD) is not a difficult task on paper. What makes this a difficult task in practice is that in the patellofemoral joint, there is not a black and a white answer, but rather numerous shades of grey. This is due to the varied soft tissue and bony dysplasias of the patellofemoral joint that are associated with lateral patella dislocations. Alteration of anatomy, of both soft tissue and bone, can make any one patient a blend of normal, near normal, slightly dysplastic, and highly dysplastic features.

Although we have many measurement schemes to help to objectify our decisions, the type of surgical decision will involve a blend of imaging and physical exam features, combined with patient expectation and surgeon's experience and judgement.

This handout will discuss evidence (Level V) of when a soft tissue procedure sufficient for patella stabilisation against recurrent lateral dislocations. In addition it will assess if current literature helps the clinician in this clinical dilemma.

An ideal candidate for an isolated MPFL reconstruction (without bony work, e.g. tibial tubercle osteotomies/trochleoplasties) might have the following profile of risk factors [4–6]:

- A normal trochlea and a low-grade dysplasia. Low-grade dysplasia can be described as type A (D. Dejour classification) or those patients with normal tracking of the patella through an active arc of motion (no significant J sign or excessive quadriceps pull sign).
- No 'excessive' lateral vector. Though the role of tibial tubercle medialisation as a necessary component of patella stabilisation is being challenged by our current surgical indications, an excessive lateral vector force usually implies a more dysplastic joint.

  A tubercle sulcus angle of 0–5° valgus on physical exam and TT-TG <20 mm (no significant malalignment of the patellofemoral joint) are good candidates for 'isolated' MPFL.

  These patients usually have a reduced patella on axial imaging in early flexion in a non-effused knee.
- No 'excessive' patella height. Though our most common measurement schemes are tibial based, for me it comes down to 'reasonable' overlap of the patella and trochlea surfaces on sagittal MR (functional patella engagement with the trochlea).

In regard to lateral lengthening, the author reviews the following preoperative factors to aid in the decision of how to manage the lateral soft tissue structures.

- Lateral patella tilt less than 20° utilising axial image with posterior femoral condyles as a reference, measured on an image without notable knee effusion (in a non-acute injury setting), usually does not need lateral lengthening.
- If the non-acute axial image in full extension shows increased lateral patella tilt but the tilt corrects in early flexion (20° Laurin's view or a 30° Merchant's view), the patella rarely needs lateral structures lengthened.
- Axial radiographs taken in early flexion reveal excessive lateral tilt on both sides, with no injury to the opposite (non-injured) knee; this is a strong sign that lateral-sided deforming forces are present.
- Patella tilt that has no lateral tightness on physical exam after the patella is relocated does not need lateral side lengthening (This may be necessary to evaluate intra-operatively.)

9.2.3 Surgical Technique

9.2.3.1 MPFL Reconstruction Using the Superficial Quad Technique

Deepak Goyal and Christian Fink

Introduction

MPFL reconstruction using hamstring grafts is quite popular but carries an important inherent risk of complications associated with patellar bony procedure. Patella fracture, violation of anterior cortex or chondral surface of patella, irritation due to hardware, gradually rising stress-riser effect, etc. are commonly reported problems [7–13]. Improper point of isometry at the femur and failure to keep optimum length of the graft are other important reasons for development of complications like patellofemoral overload [14], medial patellofemoral arthritis [15], persistent lateral instability [16], and loss of postoperative movement [11].

Superficial slip of quadriceps tendon is a broad and thin graft similar to native MPFL and has biomechanical properties similar to MPFL. Its use eliminates hardware fixation at the patella. Steensen et al. [17] had used a partial thickness graft from quadriceps tendon. Goyal presented a modification called 'the superficial quad technique' during 14th ESSKA congress, Oslo, 2010, and later reported midterm results of his series in 2013 [18]. The modifications involved providing anatomical fixation points at the patella without use of any hardware, passage of graft through anatomical subvastus space, and isometric fixation at femur and keeping optimum length of the graft instead of tensioning it. As there was no patellar bony procedure required with the superficial quad technique, there were no patellar complications. Fink developed a further modification by developing a technique for the close harvest of the graft.

Surgical Technique

MPFL reconstruction should always be preceded by arthroscopic joint assessment and management of intra-articular pathologies. The superficial slip of quadriceps tendon is actually the anterior most lamina of the three-layered quadriceps tendon structure. It is best dissected few centimetres above the upper pole of patella. A surgical plane of separation exists a few centimetres above the upper pole of patella, from where a broad strip of tendon, around 10 mm wide, can be dissected as far as tendino-muscular junction proximally. Distally one must take care to avoid the penetration of the joint, and thin/broad anterior lamina dissection is carried as an oblique dissection on the anterior surface of patella. The lateral subperiosteal dissection is carried out till midpoint of supero-inferior length of patella on lateral side, while medial dissection ends at the level of superomedial corner of patella. Now the graft is rotated medially and is passed through subvastus space. While Steensen et al. [17] leaves the graft attached on anterior surface of patella, Goyal [18] fixes the graft at superior half of medial border of patella at its anatomical attachment. Fink recommends forming a subperiosteal sleeve of tissue on the medial part of anterior surface and passing the graft underneath the sleeve to have more secured fixation.

There are various methods of fixation of superficial slip of the graft on femoral side. While Goyal uses Farr and Schepsis technique to fix the graft on isometric point, others use Redfern's technique [19] or Schoettle's technique [20]. The superficial quad technique described by Goyal stresses importance of keeping optimum length of the graft instead of tensioning the graft. Any undue tension can lead to immediate postoperative stiffness, pain, loss of motion, and late onset of medial patellofemoral arthritis.

As there are secure fixations on both the sides using the superficial quad technique, there is no need to immobilise the joint. A simple brace for comfort of the patient is enough. Patient is encouraged to start ROM exercises on the same day or as soon as pain is under control. Walking is also allowed once patient regains a good quadriceps control.

Discussion and Anatomical Considerations

Literature confirms that MPFL is a thin, broad, sheetlike ligament with length varying from 45 to 65 mm and width varying from 10 to 32 mm (Smirk and Morris [21], Nomura et al. [22], Tuxøe et al. [13]). Average length of semitendinosus and gracilis is 250 and 220 mm, respectively, and these are cordlike grafts. According to Andrikoula et al. [23], the mean length of superficial slip of quadriceps tendon is 68 mm (range, 50–85) with knee flexed and distance measured from superior border of patella to myoaponeurotic junction of rectus femoris. The average width is 41 mm at superior aspect of patella and 22 mm at middle of tendon. Hence superficial slip of quadriceps tendon is more anatomical match of native MPFL.

Wide area of attachment at patella will have better rotational control on the patella, during flexion–extension movement. Also, it will avoid abnormal biomechanical stresses at the graft–patella junction. Hamstrings tendons, being cordlike structures, can only provide a single-point (or two point) fixation, while superficial slip of quadriceps tendon, being broad in structure, can provide continuous attachment on the medial border of the patella.

Biomechanical Considerations

Mountney et al. [24] studied strength of various fixation methods in MPFL reconstruction along with strength of native MPFL itself. While strength of sutures alone was average 37 N, that of bone anchors combined with sutures was 142 N. Both were remarkably less than strength of MPFL itself that is mean 208 N. When using blind-tunnel tendon graft, it was 126 N, and with through-tunnel graft, it was mean 195 N. The strength of various fixation methods in MPFL reconstructions is remarkably less than the strength of MPFL itself. That means a graft that is fixed at patella using any means is more likely to fail at the patella fixation point rather than at mid-substance, even if its strength and stiffness is similar to native MPFL. On the other hand, a reconstruct which is stronger and stiffer than original MPFL will put more loads on patella when subjected to a severe stress. The loads will be much higher in presence of other persistent anatomical abnormalities like trochlea dysplasia, patella alta, abnormal TTTG distance, etc. To avoid such overload and overstress at patella, stiffness and strength of an ideal graft should be as near to the native MPFL as possible.

Mean strength of the MPFL is 208 N with a mean stiffness of 24 N/mm. Hamner et al. [25] found that the mean strength and stiffness of single-strand gracilis was 402 and 666 % higher, respectively, than the native MPFL. Similarly mean strength and stiffness of double-strand gracilis was 745 and 1,400 % higher, respectively, than the native MPFL. On the similar considerations, it was found that mean strength and stiffness of single-strand semitendinosus was 509 and 887 % higher, respectively, than native MPFL. Similarly mean strength and stiffness of double-strand semitendinosus was 1,120 and 1,954 % higher, respectively, than native MPFL. Herbort et al. [26] found out the mean strength of superficial slip of quadriceps is 204 N, compared to that of MPFL being 190 in his study. The mean stiffness value for the superficial slip of quadriceps was 33 N, compared to that of MPFL being 29 in his study. Studies of Hamner and Herbort confirm that superficial slip of quadriceps tendon is much better biomechanical match of native MPFL.

Patellar Complications Due to Bony Fixation

Patella fracture is the most devastating complication reported after MPFL reconstruction with a hamstring graft. According to one study, up to 90 % strength reduction in the bone can occur depending on the geometry and the size of the bony defects [27]. A weak medial patellar ridge has a potential for late patella fracture. As discussed previously, a stronger and a stiffer graft puts more load on patellofemoral joint as against a native MPFL. The extra load put on the graft–patella junction by a stronger graft will have further deteriorating effect on weak medial patellar ridge. This continuous load over a period can cause stress-riser effect and lead to late patella fractures after many years [12]. Patella fracture is a complication that cannot be accepted from a surgery that was aimed to treat patella instability.

Other complications can be accidental damage of the anterior or the chondral surface while creating the bone tunnels. Fixation devices such as suture anchors or buttons may lead to foreign-body reaction or other hardware-related intraoperative or postoperative problems [11]. This can lead to poor postoperative result and early onset of patellofemoral arthritis. A graft that can eliminate bony fixation at patella indirectly eliminates all associated complications.

Conclusion

The superfi.cial slip of quadriceps tendon is a better anatomical and biomechanical match to the native MPFL. It provides anatomical patellar fixation without any requirement of patellar hardware and thus avoids hardware/bony procedure related to patellar complications.

9.2.3.2 Surgical Technique: MPFL Reconstruction Using a Double-Bundle Gracilis Tendon with Swivel Lock Fixation

Philip Schoetlle

Reconstruction of the MPFL has become a widespread technique for restoration of patellofemoral stability. The main reason that MPFL reconstruction became popular is the fact that distal realignment procedures such as transfer of the tibial tuberosity or release at the lateral patellar retinaculum/capsule have provided inadequate restoration of patellofemoral stability in every patient, frequently leading to increased mediolateral instability, increased patellofemoral pressure, or arthritic degeneration.

Therefore, numerous techniques for reconstruction of the medial patellofemoral complex have been described with promising clinical results. However, since it is known that a nonanatomical reconstruction of the MPFL can lead to non-physiological patellofemoral loads and kinematics, the goal of a surgical intervention must be an anatomical reconstruction. Since the femoral insertion of the MPFL has been evaluated anatomically, biomechanically, and radiologically, the complications of increased patellofemoral pressure in flexion associated with nonanatomical femoral graft fixation that is too anterior/proximal can be avoided. Upon careful observation of the anatomical shape of the original MPFL, it is apparent that the patellar insertion is much wider than the femoral one. Additionally, Amis et al. have proven double-bundle structure provides a more stable proximal and distal ligamentous structure. Respecting this anatomical condition, a double-bundle reconstruction at the patellar side is reasonable to restore native ligamentous morphologic and biomechanical properties; moreover, this method lessens the patellar rotation during flexion–extension movement that may occur during single-bundle reconstruction. Under these conditions, the double-bundle reconstruction, described earlier shows very satisfying clinical results. As we know from ACL reconstruction, direct anatomical/aperture fixation provides the highest time-zero fixation by avoiding elongation of the graft or 'bungee' effect, resulting in the possibility of early rehabilitation with a full range of motion. In a similar manner, these concepts may be applied to MPFL reconstruction.

Although most of the actual surgical techniques utilise a free tendon graft to reconstruct the MPFL as the only method for anatomical double-bundle graft fixation, an all aperture fixation has not yet been described.

Recent studies have described an anatomical double-bundle reconstruction, using an aperture fixation at the femoral insertion, while the patellar fixation remains relatively indirect resulting in the eventual risk of postoperative micromotion and subsequent loosening. Patellar graft fixation has been described either with an anchor system, attaching the graft into a bony rim, or by tying the attached graft sutures to each other at the lateral patellar edge; however, this method may potentially result in graft slippage by degloving.

Until today, only one technique described anatomical patellar fixation by looping graft through bone tunnels without any additional fixation device. This technique appears to produce stable fixation at the patella. However, in soft bone, a widening of the tunnel could occur in the long term; moreover, in patients with a short gracilis graft, the tendon length may not be long enough to reach the anatomical femoral insertion.

The double-bundle technique described here offers an aperture fixation at the patella and the femur, providing a high initial stability on both insertions, resulting in improved bony ingrowth and, consequently, an earlier return to full range of motion.

Harvesting and Preparing of the Gracilis Tendon

After completion of the arthroscopy, a 2 cm long oblique incision is performed at the pes anserinus. After incising the sartorius aponeurosis, the gracilis tendon is harvested and used as an autograft. The load to failure force of the Gracilis graft – even as a single bundle – exceeds the failure to load of the MPFL (208 N.) The usable part of the tendon should be at least 18 cm long. After harvesting the tendon with the stripper and removing the muscle tissue, the doubled tendon diameter is determined, and both ends are whipstitched with an absorbable braided suture over a length of 15 mm.

Preparing the Soft Tissue Layer

A 2 cm skin incision is performed from the superomedial corner to the end of the medial margin of the patella, where the patellar MPFL insertion is located. As the MPFL is situated central to the vastus medialis obliquus (VMO) in the second layer of the medial patellofemoral complex, the central part of the VMO is identified, and a scissor is brought along to the medial femoral epicondyle in between the VMO and the joint capsule, cautiously avoiding any injury to the joint. After the opened scissors are removed, a right-angle clamp is brought into the separated layer, and the tip is directed towards the skin in the area of the adductor tubercle, where the femoral MPFL insertion is located. Then a small longitudinal skin incision is performed over the tip in 30° knee flexion, the position where the graft will be finally fixed. Finally, in preparation for passing the final graft, a suture loop is inserted in between the second and the third layer using the right-angle clamp.

Preparing the Femoral Insertion Site

To avoid non-physiological patellofemoral forces, the femoral MPFL insertion has to be very accurate. Therefore, a guide wire with an eyelet is placed slightly posterior to the midpoint of the medial epicondyle and the adductor tubercle, and the entering point into the bone is marked with a clamp. Then the guide wire placement is controlled by a picture intensifier on a straight lateral view to obtain the correct anatomical femoral insertion; if the graft is placed too anterior or proximal, abnormal graft tensioning will lead to increased patellofemoral pressures during flexion. Therefore, we use the radiographic landmark of the anatomical MPFL insertion which has been shown to be located slightly anterior to an elongation of the posterior femoral cortex in between the proximal origin of the medial condyle and the most posterior point of Blumensaat's line. If necessary, the guide wire entry point is corrected before overdrilling to the contralateral cortex with a drill diameter 1 mm larger than that of the graft loop.

Preparing the Patellar Tendon Insertion Site

To achieve aperture fixation at the patellar side, the free graft ends have to be fixated directly to the patella. Therefore, the medial patellar margin is prepared, and two guide wires are drilled tangentially into the patella at the proximal and distal end of the medial edge. The guide wires are subsequently overdrilled with a cannulated 4 mm drill to a depth of 20 mm.

Graft Fixation

The two free-sutured graft ends are fixed into the patellar holes one after each other, using a 4.75 × 15 mm Swivel Lock (Fa. Arthrex), achieving a direct anatomical graft fixation. To accomplish this, the graft sutures are pulled through the PEEK eyelet of the Swivel Lock and pushed into the drill holes. Keeping the suture under tension, the graft ends are fixed with the 4.75 × 15 mm Swivel Lock screw. In this way, a double-bundle aperture fixation at the patellar side is achieved, leaving the graft loop free.

The suture loop is then used to pull the graft in between layer 2 and 3 to the femoral insertion. Next, a nitinol wire is inserted into the femoral drill hole, and the suture loop of the graft is pulled laterally using the guide wire. Finally, while maintaining equal tension on both bundles, the graft is pulled into the femoral socket. Since biomechanical studies have shown that the MPFL has its maximal length and restraint against patella lateralisation in 30° of flexion, femoral fixation is performed in 30° of flexion with the lateral patellar edge positioned in line with the lateral trochlear border using a bioresorbable interference screw. An anatomical femoral insertion avoids an overcorrection, since an overtension of the graft can only occur if the femoral tunnel is placed too far anterior or proximal. In this case, the insertion point would move towards posterior in flexion, leading to a lengthening of the distance between patellar and femoral insertion, increasing the load onto the graft and, consequently, onto the patellofemoral joint.

If adequate medial restraint has been restored, lateral patellar dislocation should no longer be possible, and routine skin closure is performed after reattaching the aponeurosis of the VMO back to the medial edge of the patella with resorbable sutures.

Postoperative Treatment

Compared to other techniques, this aperture fixation with a biotenodesis screw at the patellar insertion provides an immediate stable tendon to bone fixation with an ultimate load to failure force at the patellar side higher than the 208 N needed to rupture an intact MPFL. Weight bearing is allowed, however, no more than 20 kg until wound healing, while leg raising and quadriceps setting exercises can be started immediately with a free range of motion as tolerated.

Low-impact activities such as running or cycling are allowed at 6 weeks post-op; full activity is permitted at 3 months.

9.2.3.3 Surgical Technique Using a Double-Bundle Dynamic MPFL Reconstruction with a Free Gracilis Tendon Autograft

A. Rood, K. Groenen, A. Lentinga,
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Why Reconstruct the MPFL?

The medial patellofemoral ligament (MPFL) is the most frequently injured soft tissue structure following acute lateral patellar dislocation. MPFL reconstruction has become a popular option to restore patellar stability following lateral patellar dislocation. The goal is to reconstruct the MPFL in a way that mimics the pre-traumatic condition of the patellofemoral joint in safe and reproducible way with minimal change of complications. In some papers complication rate can be as high a 25 %, with stiffness of the knee and patellofemoral pain being the most common. Some complications are influenced by the operative technique chosen.

Why Use the Gracilis Tendon?

Graft choice depends on graft length, graft stiffness, graft strength, and graft fixation possibilities. The ideal graft has qualities that resemble the native MPFL in strength, elasticity, and length. An advantage of using the gracilis is that the mechanical properties resemble the native MPFL more than those of the quadriceps. The tensile strength of the MPFL is 208 N (SD 90) at 26 mm (SD 7) of displacement. The gracilis has a tensile strength of 800 N, while the quadriceps tendon graft has a thicker cross-sectional area and a much higher tensile strength of 2,352 N to failure. The stiffness of the native MPFL is 8 N/mm, the stiffness of the gracilis is 171 N/mm and that of the quadriceps is even greater. Another advantage of gracilis tendon harvest is that the extensor mechanism is not violated with a hamstring harvest which causes less initial quadriceps atrophy. This advantage may not be clinically relevant, since extensor mechanism wasting is usually more caused by the postoperative treatment.

Which Fixation Technique?

Fixation of the graft can be with bone anchors, interference screws, or sutures. The optimal fixation is rigid enough to prevent dislocation but allows full range of motion and does not influence the patellofemoral pressure.

To evaluate which fixation technique of the MPFL approaches the original situation best in terms of patellofemoral pressure, we performed a biomechanical in vitro study. We measured the patellofemoral pressure at different angles of knee flexion in normal, undamaged cadaveric knees and compared this to the pressure after cutting the MPFL and after three reconstructive techniques of the MPFL (a fully dynamic reconstruction, a partial dynamic fixation through bone tunnels in the patella, and a static fixation on both the femoral and patellar side). Seven fresh frozen knee specimens were tested in an in vitro simulation using a knee joint motion and loading apparatus. We harvested a gracilis tendon to use as a graft for reconstruction of the MPFL later on. We divided the quadriceps muscles into three groups. A total load of 50 N was applied to the three muscle groups. We created a constant 20 N force on the hamstrings. The knee joint was opened by a small medial arthrotomy. A pressure-sensitive film was fixed to the retropatellar cartilage with skin glue, covering the whole surface of the patella, where after the knee joint was closed using sutures to restore intact conditions. The knee was inserted into the knee loading and motion apparatus. We started the pressure and orientation measurements in fixed flexion angles from 0 to 110 in the following five conditions: A, normal knee condition; B, transected MPFL; C, complete dynamic MPFL reconstruction where we attached the graft only to soft tissues on both femoral and patellar side; D, partial dynamic reconstruction where the patellar attachment was altered by fixing the graft through bony tunnels; and E, static MPFL reconstruction, stapling the graft onto the femur at the location of the isometric point. As primary outcome measurement we looked at patellofemoral mean pressure and peak pressure. As secondary outcome measurements we evaluated centre of force (COF) and contact area. We compared all different reconstructions and the situation where the MPFL was cut (group B–E) to baseline conditions (group A). Mean patellofemoral pressure increased slightly with deeper flexion in all conditions, but it was highest after static reconstruction (E). The pressures in condition B and C looked most similar to baseline condition (A). The peak pressure also differed the most in condition E. In this static reconstruction the peak pressure in deep flexion was much higher than in the other situations. The dynamic reconstruction (C) showed the most similar peak pressure compared to the original situation. In all conditions the contact area increased when the knees were more flexed. There were no significant differences between the groups.

This study shows that after a dynamic reconstruction patellofemoral pressures return to the normal situation. Rigid fixation causes higher peak and mean pressures. This could suggest that after a dynamical method, the risk of pressure-related complications is lowest.

Which Operative Technique?

We use a gracilis tendon through bone tunnel in patella. The bone tunnels do not completely transverse the patella to minimise the risk of fracture. The MPFL is not a genuine ligament (like the ACL) but rather a thicker part of the medial retinaculum. Please see Fig. 9.1 for more details.

What Are the Results?

We retrospectively evaluated the results. Between 2009 and 2013, 117 patients were operated. Redislocation was seen in two patients; in both cases patients were treated with a trochlea osteotomy. No clinical significant decrease in ROM was noted. A patella fracture was seen in two cases, in both cases after a fall (during field hockey at 8 weeks post-op and during physical therapy at 3 months post-op). One patient was treated conservatively; the other was operated.

Conclusion

This is one of the many techniques for reconstructing the MPFL. Advantages of this technique include its biomechanical advantages; it is not technically demanding and seems relatively safe.

9.2.3.4 Surgical Technique for MPFL Reconstruction After TKA

S. van Gennip, J.J. Schimmel, G.G. van Hellemondt, K.C. Defoort, and A.B. Wymenga

Maltracking of the patella after total knee arthroplasty (TKA) remains a well-recognised problem. The medial patellofemoral ligament (MPFL) has shown to be important for patellar stabilisation, and reconstructions of the MPFL have already shown excellent functional outcomes for patellar instability of the native knee. Nevertheless, there is only limited literature on using an MPFL reconstruction for correction of patellar maltracking after TKA. In this retrospective study, a consecutive case series was evaluated.

Between 2007 and 2010, nine patients (nine knees) with anterior knee pain and symptomatic (sub)luxations of the patella after primary or revision TKA were treated by reconstruction of the MPFL in combination with a lateral release. In two cases, an additional tibial tuberosity transfer was performed, due to insufficient preoperative correction. Preoperative workup included a CT scan to rule out component malrotation and disorders in limb alignment. Pre- and postoperative patellar displacement and lateral patellar tilt were measured on axial radiographs. Clinical outcome was evaluated using the visual analogue scale (VAS) satisfaction, VAS pain, dislocation rate, and Bartlett patella score.

Median patellar displacement improved from 29 mm (0–44) to 0 mm (0–9) postoperatively. Median lateral patellar tilt was 45° (23–62) preoperative and changed to a median 15° (−3 to 21)

Fig. 9.1 Anatomic double bundle MPFL reconstruction. The MPFL is a thicker part of the retinaculum and its attachment is close to the adductor insertion (at the scissors). A gracilis tendon is prepared. A separate incision is made at the patella and at the medial epicondyle. If necessary avulsion fragments can be removed. The adductor tubercle is prepared. Two patellar tunnels are made. The graft is fixed using resorbable sutures

postoperative. Median VAS satisfaction was 8 (5–9), and only one patient reported a subluxing feeling afterwards. The Bartlett patella score displayed a diverse picture.

Patellar maltracking after primary or revision TKA without malrotation can effectively be treated by MPFL reconstruction in combination with a lateral release. Only in limited cases, an additional tibial tuberosity transfer is needed.

9.2.4 The Failed MPFL

D. Dejour

There are various reasons for failure of the reconstructed MPFL. Before revision procedures you should evaluate the reason for failure. Reasons can be underlying bony pathology and technical problems. This session will address management of the failed MPFL.

9.3 Future Directions for Research and Clinical Decision-Making Based on Literature Review

Elizabeth A. Arendt

In regard to understanding in what clinical setting is an isolated MPFL reconstruction of value, one would hope to be able to turn to the literature for some answer. A recent systematic review of PubMed on MPFL reconstructions was performed at the University of Minnesota.

Inclusion criteria were ‘isolated’ MPFL reconstructions without any bony procedure, at least ten patients in the cohort and in a journal with an impact factor >2.

We found 24 articles that fit these criteria. The main points of the systematic review are outlined below.

What kind of outcomes were reported? $n = 24$

- Rate of redislocation – nearly all
- Kujala score (pain scale) – nearly all
- VAS (pain) – few
- Return to activity – most commented on this but without a metric
- QOL scale – few (KOS, IKDC, Cincin.)
- PF instability scale – none

What kind of preoperative variables were reported? $n = 24$

- # of patients in study (range 12–193) 5>45 patients
- Age M 23, range 10–52
- ‘Children’: variably reported as either open physis or <18 y/o

Preoperative variables recorded in M & M (% of all studies, $n = 24$)

Mechanism of injury (A vs T)	71 %
Cartilage status	71 %
Activity level (1° Tegner)	50 %
Prior procedures	71 %

Preoperative variables recorded in M & M

Physical exam	
(+) Apprehension sign and/or quad. translation	56 %
Hyper laxity syndrome	21 %
Version	25 %

Preoperative variables recorded in M & M Imaging measurements

Patella height	72 % C/D and/or I/S methods
Trochlear dysplasia (TD)	80 %
Most studies used sulcus angle to determine TD	
TT-TG	80 %
Tilt (variably measured)	54 %

MPFL Reconstruction: In what population was ‘isolated’ procedures performed?

Were anatomical instability factors accounted for in the patient selection?

Increased Q Angle: patients were excluded if TT-TG was elevated:

Wang et al. [28]	>15 mm
Howell et al. [29]	>18 mm
Kang et al. [30]	>20 mm

Patella alta and selection criteria were discussed:

- Steiner et al. [31]
  - 'Significant alta' excluded
  - M I/S 1.16
- Nomura et al. [32]
  - I/S: M 1.08
  - Range (.98–1.23)
- Thaunat/Erasmus [33]
  - 'Severe' patella alta with extensor lag
- Patella alta: excluded if >1.2 (I/S)
  - Ronga et al. [34]
  - Kang et al. [30]
  - Goyal [18]
  - Wang et al. [35]

9.3.1 Gaps of Knowledge in Current Literature and Possible Recommendations for Future Research

- Current literature on MPFL reconstruction contains variable selection bias in the patients that they are reporting on that influences the results.
- Current literature on MPFL reconstructions contains non-uniform methods of reporting preoperative variables and outcomes.
- More clarity in reporting methodology is needed to be useful for the treating clinician.

9.4 Take-Home Message

- The MPFL is nearly always damaged after patellar dislocation.
- MPFL reconstruction seems a valuable technique in case of recurrent dislocation.
- There is no consensus regarding the exact indication for isolated MPFL reconstruction in literature.
- There are various operative techniques available, all with their different advantages and disadvantages (with regard to stability, ease of conduct, specific complications, and costs).

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