

Patellar Instability: Medial Patellofemoral Ligament Reefing Versus Medial Patellofemoral Ligament Reconstruction

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Abstract

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Although more than 100 operative procedures have been described for the treatment of patellar instability, there is no single universally successful procedure. Careful physical and imaging examination should be performed before the most appropriate operative treatment is chosen. For the patients with patellar instability, who have normal tibial tubercle-trochlear groove (TT-TG) distance, normal patellar height and no marked trochlear dysplasia medial patellofemoral ligament (MPFL) reefing or reconstruction is recommended. In patients who have an increased TT-TG distance or patella alta, distal realignment procedures are used. Because studies have shown that MPFL is the most significant passive stabilizer of the patella, and because they have shown that MPFL is disrupted in majority of patellar dislocation cases most of the authors recommend reefing or reconstruction of the MPFL for the treatment of patellar instability. The purpose of this review is to give an overview of the etiology, diagnosis and treatment of patellar instability determining whether MPFL reefing or MPFL reconstruction is a suitable procedure for the most patients with patellar instability.

Introduction

Patellar instability is a common problem affecting young active population. Usually patients are between 13 - 20 years of age. Although most of the studies show that patellar instability mostly occurs in females, in our practise we have equal number of male and female patients with patellar instability. Instability is mostly in lateral direction, though medial instability can occur as a

result of trauma or overaggressive operative treatment. It can be traumatic recurrent with a history of major trauma before, or habitual without that. Because no single operative procedure is universally successful for treating patellar instability, careful physical and imaging examination of the patient should be done before the right operative treatment is chosen.

The aim of this review is to introduce the physical

and imaging examinations that should be performed for diagnosis of patellar instability, and to introduce the recently used proximal realignment operative procedures for the treatment of patellar instability.

Method

Because patellar instability is a complex problem for orthopaedics according to its diagnosis and treatment options, there are a lot of studies for patellar instability. There are not dilemmas according to the etiology and diagnosis of the patellar instability, but there are dilemmas when the right operative treatment should be chosen. When we electronically searched for studies, we paid attention to those studies that describe the latest operative procedures for the treatment of patellar instability. In the last years there is great dilemma when one should decide to use reefing or reconstruction of the medial patellofemoral ligament (MPFL) for the treatment of patellar instability. There are some surgeons like Prof. Jeffrey Halbrecht who propose that MPFL reefing is the best procedure for treating patellar instability [1]. According to them, MPFL reefing is indicated for the most cases of patellar instability. It gives good clinical and radiographic stability, complications are rare, it is easy to perform and does not cost much, writes Prof. Halbrecht [1]. Other surgeons like Prof. Anthony Schepsis say that their results are better when they treat patellar instability with MPFL reconstruction. Prof. Schepsis in his article, published on 29th Annual Meeting of AANA, gives 10 reasons why one should do MPFL reconstruction rather than MPFL reefing [2]. In our practice MPFL reefing has shown as a good procedure for the treatment of patellar instability. In some cases (rare) MPFL reconstruction should be done. Further studies are needed to show what is the best operative treatment for treating patellar instability.

Discussion

Patellar instability is a common problem that forms 3-5% of acute knee injuries. Etiology of patellar instability is multifactorial. Generally, causes of patellar instability can be divided in three groups (Table 1).

Proximal soft tissue insufficiency means disruption of the medial static and dynamic patellar stabilizers, that maintain the physiologic positioning of the patella within the trochlea and provide for patellar stability and its proper tracking. Although Vastus medialis obliquus muscle (VMO), has a role for providing patellar

Table 1: Etiology of patellar instability.

Proximal soft tissue insufficiency (MPFL injury)
Structural dysplasia
<ul style="list-style-type: none"> • Trochlea dysplasia • Patella alta • Patella dysplasia • External tibial torsion • Genu valgum • Laterally positioned tibial tubercle
Generalized ligamentous laxity

stability as a dynamic stabilizer, the most important is the medial patellofemoral ligament which is the static patellar stabilizer. MPFL is a ligamentous structure 5-6 cm long, attached near medial epicondyle on the femur, and on the proximal half of the medial patellar margin (see Fig. 1). It plays a primary role in patellar stabilization during the first 20-30 degrees of knee flexion when the patellar instability mostly occurs. The cadaver study from Hautamaa et Fithian shows that MPFL gives 50-70 % restraining force to lateral patellar dislocation [3].

Trochlea dysplasia means that trochlea has flat or dome shape and there is no congruity between patella and trochlea. Particularly the dysplasia of the lateral femoral condyle is important because of the bony

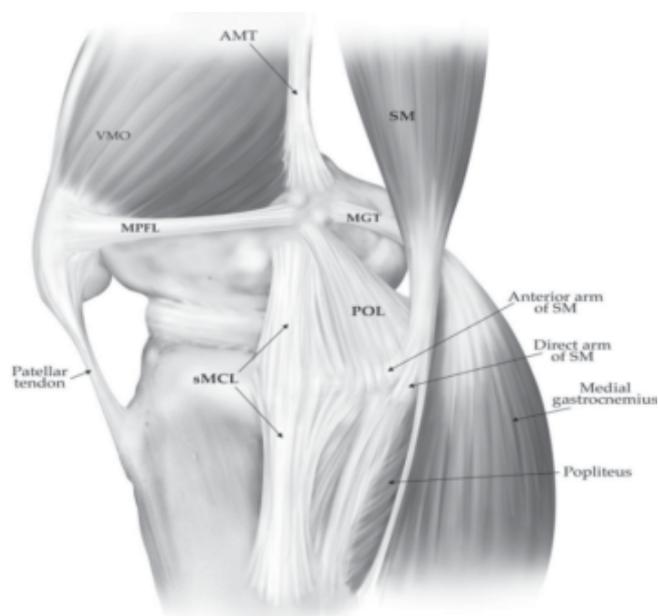


Figure 1: Illustration of the main medial knee structures. VMO = Vastus medialis obliquus muscle; MPFL = Medial patellofemoral ligament (by Robert F. LaPrade, Anders Hauge Engebretsen, Thuan V. Ly, Steinar Johansen, Fred A. Wentorf and Lars. *The Anatomy of the Medial Part of the Knee*. J Bone Joint Surg Am. 2007;89:2000-2010).

support that prevents lateral patellar dislocation.

Patella alta is an abnormally high riding patella and is associated with a long patella tendon. It delays patella's engagement with trochlea until the knee flexion is increased, which greatly increases the risk of patellar dislocation.

Patella dysplasia means that the patella has lost its normal shape. Because of that the congruity between patella and trochlea is lost and that leads to patellar instability.

External tibial torsion, Genu valgum and Laterally positioned tibial tubercle. All these factors increase the Q angle, which is an angle formed by the line of pull of the quadriceps mechanism and that of the patellar tendon, as they intersect at the center of patella. Increased Q angle gives lateral force vector to the patellofemoral joint which leads to lateral patellar dislocation [4].

Generalized ligamentous laxity gives habitual patellar dislocations and other joints are also affected with hyperlaxity.

Diagnosis of patellar instability

An accurate **history** is still one of the most important tools for diagnosis of patellar instability. Patients usually give information how many previous patellar dislocations they had. They also report that they have pain in their knees that gets worse by going up and down stairs or report that they have feeling of insecurity or giving way in the knee.

Physical examination starts with **inspection**. Swelling of the knee or limb malalignment should be



Figure 2: Patella apprehension test. Apprehension and reactive contraction of the quadriceps muscles by the patient is noticed when the test is positive.

noticed. It is important to notice if there is genu valgum, external tibial torsion or laterally positioned tibial tubercle. On **palpation** examiner should find if there is tenderness or a palpable defect along the course of MPFL.

Patella apprehension test. The knee is in 10-20 degrees of flexion and the examiner pulls the patella laterally. If the test is positive the patient complains of pain and stops any further motion of patella (Fig. 2).

Patella tilt test. The knee is in extension and the examiner wants to raise the lateral or medial patellar



Figure 3: Patella tilt test. It is useful for the evaluation of MPFL injury or lateral retinacular tightness.

facet to horizontal plane or slightly past. Raising the medial patellar facet past horizontal plane indicates injury of the MPFL. Inability to raise the lateral patellar facet to the horizontal plane or slightly past indicates excessive lateral retinacular tightness (Fig 3).



Figure 4: Patella glide test. By determining the medial and lateral patellar mobility, tightness or insufficiency of MPFL and lateral retinaculum can be estimated.

Patella glide test. The knee is in 0-20 degrees of flexion and the examiner pulls the patella medially and laterally and measures patellar mobility. Normally patella glides laterally, but not more than two quadrants of patellar width. If there is increased mobility laterally, injury of MPFL is suspected. Excessive lateral retinacular tightness is indicated by limited medial patellar glide (Fig. 4).

“J sign” test. It is useful for evaluation of the dynamic patellar tracking. The knee is first in flexion and then in full extension. When the knee is near full extension the patella notably subluxates laterally and its movement shows inverted J sign. Normally the patella should move more superiorly than laterally (Fig. 5).

Q angle. It is an angle between line that connects anterosuperior iliac spine and center of patella and line from the center of patella to the tibial tubercle. Increased Q angle of more than 16 degrees is abnormal and leads to patellar instability (Fig. 6).

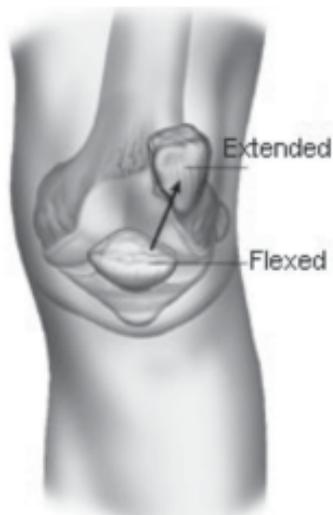


Figure 5: “J sign” test. A positive J sign indicates abnormal lateral patellar tracking.

Determining generalized ligamentous laxity. For that purpose other joints should be examined. Hyperextension of the knees or elbows over 10 degrees and ability to touch the forearm with the thumb shows that generalized ligamentous laxity is present.

Imaging studies include:

Plain roentgenograms:

- **AP view** is useful to reveal an osteochondral fracture of the medial patellar edge or some osteochondral fractures in the knee.

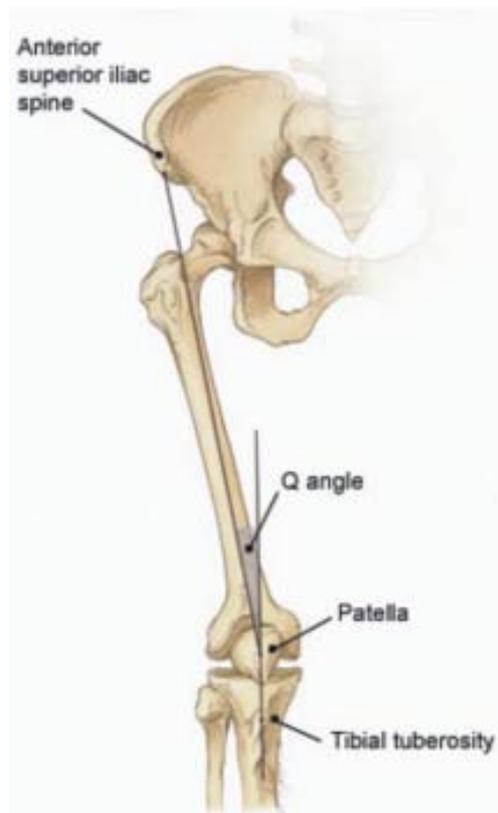


Figure 6: Quadriceps angle (Q angle). Reprinted from Juhn MS. Patellofemoral pain syndrome: a review and guidelines for treatment. *Am Fam Physician* 1999;60:2014.

- **Lateral view** is important for determining patellar height. For that purpose a lateral view with 30 degrees of knee flexion is made and the **Insall-Salvati index** (ratio between the length of patella tendon and the diagonal length of patella) is determined (Fig. 7). If the Insall- Salvati index is more than 1.2 the patient has patella alta and if it is less than 0.8 the patient has patella baja.

- **Merchant view** is an axial view with the knee in 20 - 40 degrees of flexion. On that view patellar tilt and translation, as well as patella and trochlea dysplasia can be determined. For that purpose sulcus angle, congruence angle and lateral patellofemoral angle should be measured.

Sulcus angle is the angle formed by the lines which connect the highest points of the medial and lateral femoral condyles (B and C) and the lowest point of the intercondylar sulcus (see Fig. 8). A sulcus angle of more than 145 degrees indicates a trochlear dysplasia.

Congruence angle is the angle formed by the

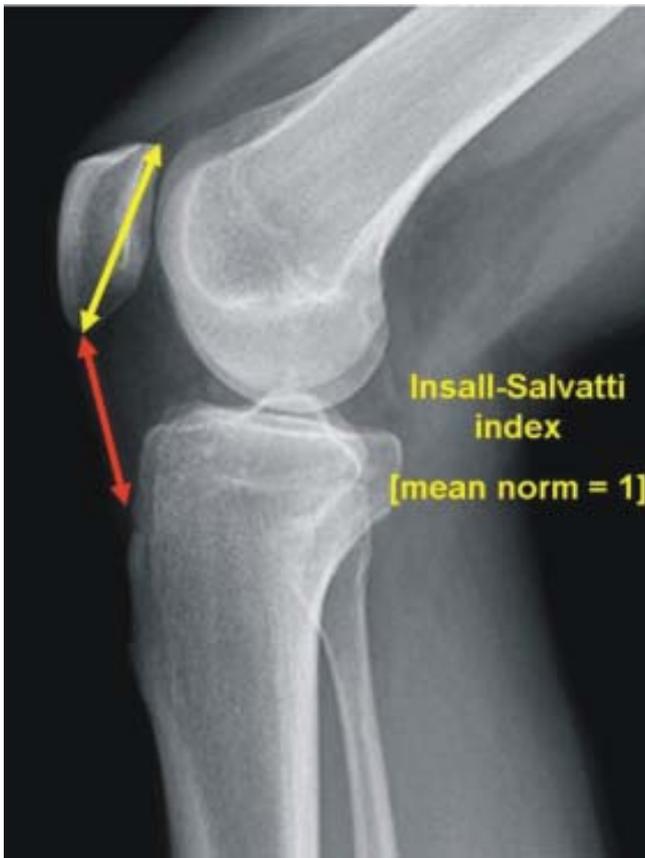


Figure 7: Lateral radiograph with 30 degrees of knee flexion. Insal – Salvati index (red line/ yellow line).

line which connects the lowest point of patella (D) and the lowest point of intercondylar sulcus and the line that bisects the sulcus angle (Fig. 8). A congruence angle of more than 16 degrees indicated patellar instability.

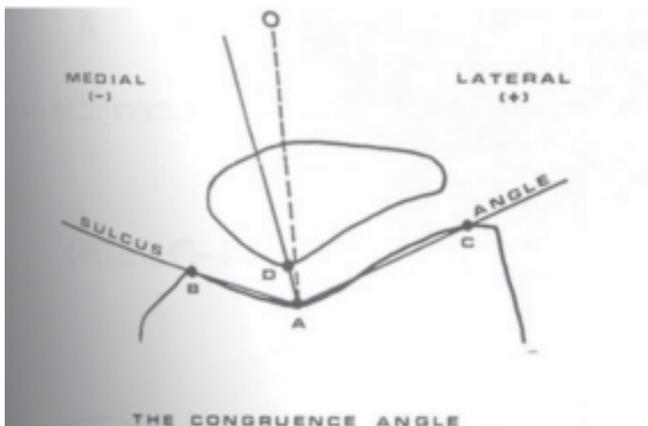


Figure 8: Sulcus angle and Congruence angle on Merchant view. (from R.L. Sahu, S.K. lunawat, D.K. Taneja: The patellar compression syndrome: Treatment by miniopen lateral retinacular release results and review of literature. The Internet Journal of Orthopedic Surgery. 2009;14(2).

Lateral patellofemoral angle is the angle formed by the line drawn through the lateral patellar facet (B-B1) and line drawn through the highest points of each femoral condyle (A-A1, Fig. 9). Normally this angle is open laterally. In patients with patellar tilt this angle is 0 degrees or it is open medially.

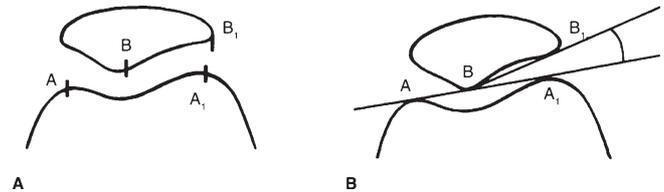


Figure 9: Measurement of the lateral patellofemoral angle on Merchant view.

Computed Tomography (CT) is a more sensitive imaging to determine patellar instability. It is made with the knee in 0, 15, 30 and 45 degrees of flexion. On CT scan lateralization of the tibial tubercle can be identified by measuring the **tibial tubercle-trochlear groove distance (TT-TG distance, Fig. 10).**

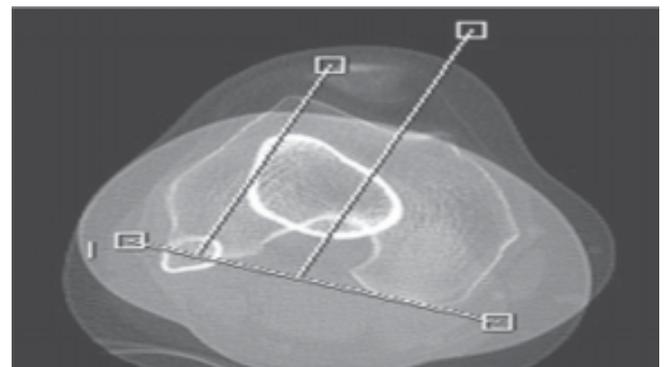


Figure 10: CT scan measurement of the tibial tubercle to trochlear groove distance.

An axial CT image of the femoral groove is superimposed on an axial image of the tibial tubercle. Two lines are drawn perpendicular to the line that connects the posterior points of each femoral condyle.

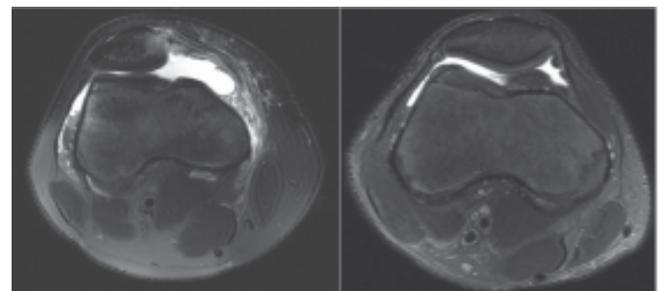


Figure 11: Axial T2 image shows tear of the MPFL; b) Axial T2 image shows normal MPFL.

The first line bisects the tibial tubercle and the second line bisects the trochlear groove. If the distance between these two lines (**TT-TG distance**) is more than 20 mm, lateralization of the tibial tubercle is identified.

Magnetic Resonance imaging (MRI) is important to identify cartilage and soft tissue injuries in the knee (MPFL, VMO or other soft tissue injuries).

Treatment

Immobilisation of 3 weeks is necessary after an acute patellar dislocation. Immobilisation in extension helps in healing the medial knee structures. Cast, posterior splint or knee brace can be used for immobilisation. Although the study from Maenapaa and Lehto shows that the patients with patellar dislocation, who were immobilised with knee brace, had higher risk of patellar redislocation than those treated with cast, in practise knee brace is more commonly used because of the lower risk of knee stiffness after its use [5]. If a large haemartrosis in the knee is present, aspiration under sterile conditions is indicated before the immobilisation.

Physical therapy includes exercises for strenghtening of Vastus medialis obliquus (VMO) and Gluteal muscles, as well as exercises that regain normal knee motion and proprioception. Patellar taping may help to control excessive patellar motion during the therapy. Closed chain exercises are more efficient than open chain exercises. Escamilla et all. found that closed chain exercises are more efficient because they promote more Vastus and Gluteal muscles activity than Rectus femoris muscle activity [6].

Operative treatment is recommended when conservative treatment fails. Although more than 100 operations for the treatment of patellar instability are described, still the gold standard treatment is not found. Generally, if the cause of patellar instability is proximal soft tissue insufficiency, proximal soft tissue realignment is recommended. It includes repair, reefing or reconstruction of the MPFL or VMO transposition. If the cause of instability is external tibial torsion, genu valgum or laterally positioned tibial tubercle, anteromedialisation of tibial tubercle or corrective osteotomy is recommended. Trochleoplasty is rarely indicated in patients with severe trochlear dysplasia. In patients with patella alta only small number of orthopaedic surgeons do distalisation of patella.

MPFL reefing and MPFL reconstruction combined with release of the lateral retinaculum are

mostly used operative procedures for treating patellar instability in the last years. Primary repair of the medial knee structures after an acute patellar dislocation should be considered only if there is an associated osteochondral fracture that needs fixation, or if there is residual lateral displacement of patella on post reduction Merchant view, which means massive injury of the medial knee structures. Studies from Nikku et all. [7] and Palmu et all. [8] show that there is no significant difference between the rates of redislocation in patients with acute patellar dislocation who had been treated with repair of the medial knee structures and those who had conservative treatment.

The appropriate patient for MPFL reefing or MPFL reconstruction should have Q angle less than 15 degrees, TT-TG distance less than 20 mm, and should not have marked trochlear dysplasia. MPFL reefing and MPFL reconstruction usually are combined with release of the lateral retinaculum (lateral release).

Lateral release is an operative procedure performed to release the tight lateral retinaculum. It can be done open or arthroscopically assisted (Fig. 12). This procedure has been shown to be the most effective in conjunction with other proximal and distal patella realignment procedures, but never for treating patellar instability as an isolated procedure. The study from Aglietti et all. shows that there was 35% patellar redislocation rate after isolated lateral release in their study [9]. The poor results after isolated lateral release for treating patellar instability can be attributed to the inability of the procedure to align the patella more medially [10]. When lateral release is performed, care must be taken not to release more superior than the

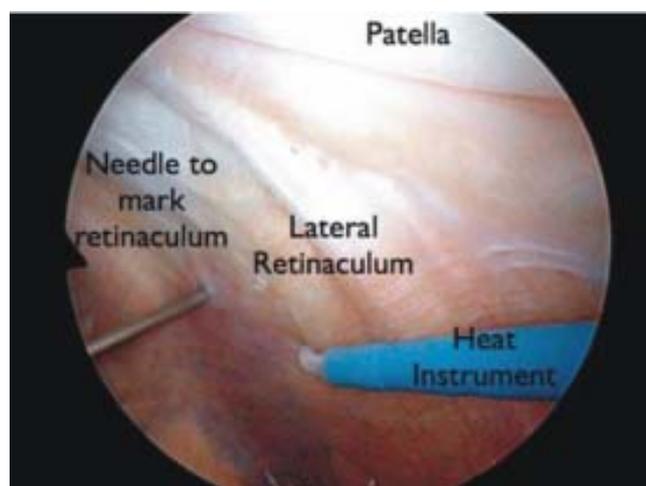


Figure 12: Arthroscopic technique for release of the lateral retinaculum with cautery knife (arthroscopic view).

proximal pole of patella because of the danger to get medial patellar instability.

MPFL reefing is one of the most used operative procedures for the treatment of patellar instability in the last years. With this procedure, similar to capsuloraphy for treating shoulder instability, plication of the redundant tissue of the elongated medial patellofemoral ligament is done. The procedure is performed by placing 3-5 PDS

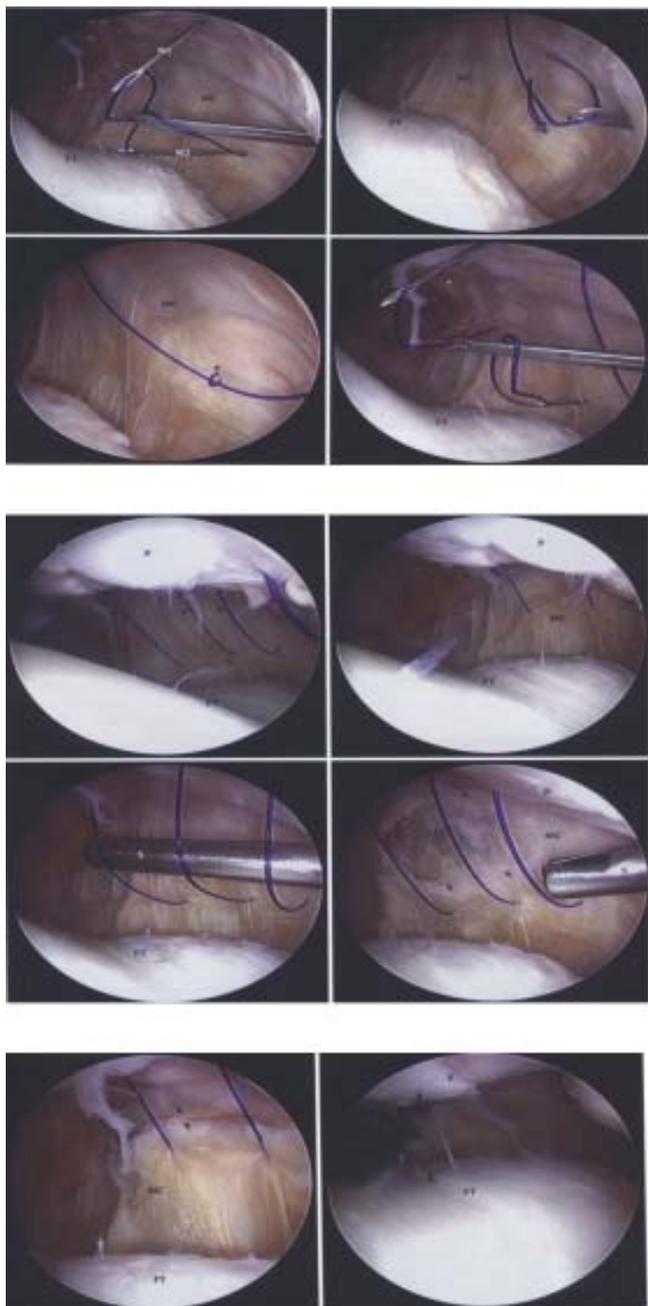


Figure 13: Technique for mini open arthroscopically assisted MPFL reefing (arthroscopic view).

sutures under arthroscopic control (Fig. 13) and tying them subcutaneously through the small (1-1.5 cm) skin incision. Tying of the sutures can be done inside the joint with sliding knots when all arthroscopic MPFL reefing is performed.

The result of this procedure is tightening of the MPFL which is the primary patellar stabilizer during the first degrees of flexion when the instability mostly occurs. The cadaver study from Hautamaa et Fithian shows that MPFL gives 50-60 % restraining force to lateral patellar dislocation [3]. The studies of Nomura and Sallay show that MPFL is the essential lesion after patellar dislocation. They found that 94-96% of their patients with patellar dislocation had MPFL injury [11,12]. The study from Tom Fulkerson shows that MPFL heals even with avulsion on MRI [13]. He made open exploration of the MPFL in 13 consecutive cases after patellar dislocation and in all of them MPFL was identified as a healed but elongated structure with an intact anatomically correct femoral insertion. All these studies show that MPFL is essential lesion after patellar dislocation and that MPFL heals, but it is elongated and that is why MPFL reefing can be an effective procedure for treating patellar instability. It is important to do this procedure after more than 6 weeks after acute patellar dislocation because of the time necessary MPFL to heal, and to follow the right postoperative protocol.

MPFL reconstruction is another recently used operative procedure for the treatment of patellar instability. MPFL reconstruction means anatomic reconstruction of the medial patellofemoral ligament with free graft. Although variety of grafts can be used, the Semitendinosus et Gracilis muscle tendons are used for the most number of cases. During this procedure the graft is fixed on two fixation points on the medial patellar margin (one 6.1 mm from the superior pole of patella, and other on the midpoint of the medial patellar margin), and on one fixation point on the femur 1.3 mm anterior to the posterior femoral cortex near medial epicondyle (Figures 14a,14b). Although multiple techniques have been described for MPFL reconstruction, all of them have the same purpose: to fix the graft in proper position obtaining the appropriate amount of tension, so it will be tight in the first 30 degrees of flexion and will become lax in further flexion. It means that the graft should act as a restraint to prevent abnormal lateral displacement, not to pull the patella medially.

In the last years there is a controversy when MPFL reefing or MPFL reconstruction should be performed. According to Prof. Jeffrey Halbrecht MPFL

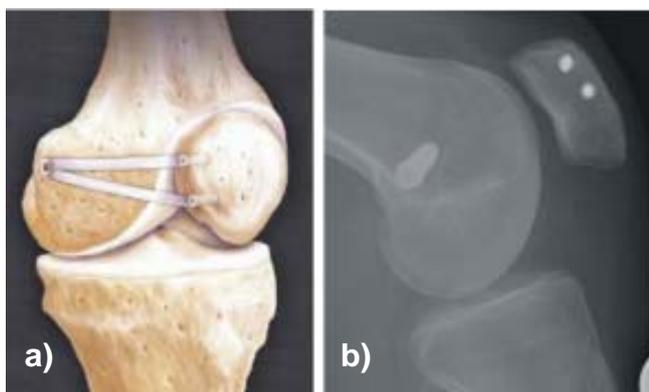


Figure 14: a) Illustration of MPFL reconstruction; b) Post-operative lateral radiograph of a patient operated with MPFL reconstruction.

reefing is the best procedure for the treatment of patellar instability for the most cases [1]. It gives good clinical and radiographic stability, rare complications, it is easy to perform and does not cost much. His attitude about MPFL reconstruction is that although MPFL reconstruction is a procedure that restores patellar tracking to near normal and it is not dependent on tissue quality like MPFL reefing, there are some problems when it is performed. First, because the graft is many magnitudes stiffer and stronger than MPFL, only small malpositioning of the graft causes dramatic increase in patellofemoral loads. When the femoral fixation point is too proximal, the medial patellar facet becomes overloaded when the flexion is increased, or when the femoral fixation point is too distal, the graft becomes unappropriately tight in extension and prevents the patella from engaging the trochlea correctly causing stiffness. The study from Matthews JJ and Schranz P shows that 20 % of their operated patients with MPFL reconstruction required manipulation under anaesthetic [14]. Second problem can sometimes occur because even slight overtensioning of the graft during MPFL reconstruction severely restricts patellar motion and increases medial patellofemoral loads. The study from Beck et al shows that tension of more than 2 N applied to the graft during MPFL reconstruction restricts lateral patellar translation and increases medial patellofemoral contact pressures [15].

According to Prof Anthony Schepesis MPFL reconstruction is the best procedure for the treatment of patellar instability. In his article he gives some reasons why it is better to do MPFL reconstruction than MPFL reefing [2]. One reason for that, according to him, is because we do not know the quality and strenght of the tissue of the MPFL when we do MPFL reefing. In the presence of reccurent traumatic patellar instability, this

relatively frail structure can be torn many times. Another reason is because MPFL reconstruction has shown good results in patients with trochlear dysplasia, and because it allows an aggressive rehabilitation program. The third reason, according to Prof Schepesis [2], is because opposite to MPFL reefing, MPFL reconstruction gives much better control over tensioning and tracking since the surgeon can place the origin and incertion on its anatomic points and reproduce the normal role of the MPFL to be tight in the first 30 degrees of flexion and to become lax in higher degrees of flexion.

In our practice MPFL reefing has shown as a good procedure for the treatment of patellar instability. It can be performed for the most number of cases with good results. In some cases MPFL reconstruction is indicated to be done. It is usually indicated in patients with more than 10 patellar dislocations who have severe deficiency of the tissue of the medial knee restraints, in patients with trochlea dysplasia or in revision cases after failed MPFL reefing or VMO transposition. More experience with these operative procedures is needed, so we can decide what is the best operative treatment for patellar instability.

Acknowledgements

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