# Patellofemoral instability: surgical treatment of soft tissues

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**Summary**

Instability of the patella is a relatively frequent occurrence in adolescents. Its pathogenesis, which is multifactorial, is still much debated. Stability of the patella is guaranteed by a delicate balance of a series of factors (osteo-cartilaginous, ligamentous and muscular), and it is not surprising that alteration of one or more of these can lead to pathological conditions that can range from simple anterior pain associated with a hypermobile patella to recurrent dislocation. The aim of surgical treatment is to correct these anatomical abnormalities. Surgical procedures on the soft tissues comprise reefing, realignment and reconstruction of the medial stabilizing structures, and release of the lateral structures. These procedures, although having precise indications, provide the surgeon with the instruments necessary to deal with almost all these anatomo-pathological conditions. Furthermore, preserving the osteo-cartilaginous components results in less morbidity than is associated with traditional surgical procedures, such as trochleoplasty and transposition of the anterior tibial tuberosity.

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***Key words:*** *patellofemoral instability, medial patellofemoral ligament, lateral retinacular release, patella dislocation, medial retinacular reefing.*

## Introduction

Patellofemoral (PF) disorders are frequently encountered in clinical practice and their etiology varies greatly. We encounter pain syndromes (very common in adolescents and less so in adults) and different forms of patellar instability. The stability of the patella, of course, depends on the maintenance of a delicate balance between the geometry of the bone-cartilage surfaces, the integrity of the ligamentous structures, and the active action of the muscle components. For this reason, each of these three aspects has, in recent years, been the focus of in-depth anatomical and biomechanical studies conducted in order to clarify their respective roles and influence on PF kinematics. From the pathophysiologic perspective, bone and cartilage abnormalities can be classified as: trochlear dysplasia, excessive tibial tubercle to trochlear groove distance (TT-TG), abnormal patellar morphology, and excessive patellar height. Each of these alterations can affect PF tracking and thus result in the onset of pathological conditions. For this reason, over the years, numerous surgical procedures have been proposed, designed to correct anatomical abnormalities and restore a physiological relationship between the femur and the patella. These include the trochleoplasty procedures proposed by Albee and Masse, transposition (medialization and/or lowering) of the anterior tibial tuberosity, and patelloplasty.

Anatomical alterations of the soft tissues are more frequent, often associated with bone dysplasia, and sometimes more difficult to diagnose and treat. Schematically, the following can be identified: extensor mechanism dysfunction with dysplasia of the vastus medialis obliquus (VMO), sometimes associated with disorders of the vastus lateralis with retraction of the lateral capsule, and disorders of the ligamentous structures with avulsion of, or damage to, the medial patellofemoral ligament (MPFL) and other passive stabilizing structures, such as the medial meniscopatellar ligament (MMPL) and the medial patellotibial ligament (MPTL).

## Reconstruction of the medial patellofemoral ligament

The MPFL extends from the medial margin of the upper 2/3 of the patella (even though some of its fibers attach to the undersurface of the VMO, the aponeurosis of the vastus intermedius, and the lower part of the medial patella) to the femur, where it inserts in an area slightly distal to the adductor tubercle and proximal to the posterior portion of the medial epicondyle (1). Steensen et al. (2) found the patellar attachment of the MPFL to be slightly wider than the femoral one (17 mm versus 15.4 mm).

The MPFL plays a crucial role in guaranteeing the medio-lateral stability of the patella. Sandmaier et al. (3) evaluated the relative contribution of the different structures of the medial retinaculum to patellar stability and showed that the most important role is played by the MPFL, which contributes 60%. Furthermore, Panagiotopoulos et al. (4) looked, in detail, at the relationship between the VMO and the MPFL. The role of the first is not limited to active control of patellar tilt; indeed, thanks to the connections between the MPFL and the VMO, contraction of the VMO tensions the MPFL, increasing the stabilizing action exerted on the patella. This fundamental role is confirmed in clinical practice. Fithian et al. (5) showed that dislocation of the patella does not occur in the presence of an intact MPFL, even if the subject presents one or more predisposing factors (patella alta, excessive patellar tilt, throchlear dysplasia and excessive TT-TG). Furthermore, Sallay et al. (6) found MPFL lesions in 94% of cases following a first dislocation of the patella, and noted that the rate tended to increase with the number of dislocations.

**Figure 1:** Photograph of surgical reconstruction of the MPFL. The two tunnels drilled in the patella must be parallel or diverge medially slightly and the size of the bone bridge must be sufficient to reduce the risk of patellar fracture.

It seems clear, therefore, that following one or more dislocations, it is necessary to reconstruct this ligament, possibly intervening surgically on the osteo-cartilaginous structures. The procedure most often performed is ligament reconstruction by means of a semitendinosus or gracilis tendon autograft. The original patellar attachment of the MPFL is reconstructed, according to the different techniques, drilling one or two horizontal holes (tunnels) in the patella (these are parallel or diverge medially slightly), through which the graft is passed (Fig. 1). To avoid the risk of patellar fracture, some authors suggest fixing the new ligament with anchors, thereby avoiding the need to drill tun-


**Figure 2:** Magnetic resonance image showing the femoral tunnel after reconstruction of the MPFL. It is crucial to position the tunnel correctly, in such a way as to reproduce the biomechanical behavior of the original ligament.

nels in the patella (7). The graft is then passed deep into the soft tissues, following the course of the medial retinaculum, and sutured in a blind-ended femoral tunnel at the level of its anatomical origin.

Many variants of the technique have been proposed, but to date no "gold standard" has been established (8-10). The success of the procedure depends on several critical aspects that must be carefully considered, namely: the positioning of the femoral tunnel, the tensioning of the new ligament, and the chosen degree of knee flexion at the time of fixation. Although the ligament exhibits non-isometric behavior, the best results are obtained by positioning the femoral tunnel close to the original femoral attachment of the ligament (11) (Fig. 2). Positioning it too proximally causes excessive tension of the ligament which can result in pain and cartilage damage (12). Conversely, if new ligament is too loose, the instability will inevitably recur (13). However, the lack of a uniform protocol means that, ultimately, this choice depends solely on the experience and ability of the surgeon. Similarly, there is no optimal degree of knee flexion for fixing of the new ligament, even though most surgeons opt for 30-40° (10, 14, 15). The clinical results of this surgery, regardless of the variations of technique used, are very favorable (16); however, a recent meta-analysis highlighted the possibility of intra- and post-operative complications which can reach a rate of 26% (17).

## Medial retinacular reefing

Anatomically, the anterior region of the knee is comprised of different layers: the subcutaneous layer, the superficial fascia (arciform layer), the intermediate oblique layer, the deep longitudinal layer, the deep transverse layer, and finally the capsular layer (18). The medial retinaculum, also defined transverse, is formed by fibers of the deep transverse layer and is a capsular structure in which the MPFL, MPTL and MMPL can be identified. Reefing of the medial retinaculum, arthroscopically assisted or in open surgery, has, in the past, been proposed for various conditions, such as hypermobile patella, patellar pain and patellar dislocation. However, in our view, this surgical procedure is not advisable in the presence of previous dislocations because of the high risk of failure, due to the fact that the MPFL lesion that is always present in dislocations cannot be treated exclusively with capsular reefing. Accordingly, this surgery can be recommended in patients with excessive external patellar tilt and/or painful hypermobile patella in whom conservative treatment has failed (19). Therefore, the procedure is most indicated in the presence of intrinsic hyperlaxity of the medial capsule, possibly associated with atrophy of the vastus medialis. The surgery can be performed as an entirely arthroscopic (all-inside) technique and/or as a mini-open technique (20, 21). As a result of the cosmetic advantages of entirely arthroscopic surgery, this option tends to preferred by young women. The synovial membrane and capsule are gently abraded at the point of reefing in order to stimulate bleeding and thus promote healing of the retinaculum. Reefing is performed with percutaneous sutures using a spinal needle and the *out-in* technique.

Three sutures are normally sufficient; the lowest suture, at the level of the distal third of the patella, is placed first, taking care to ensure that the needle emerges adjacent to the medial margin of the patella. A monofilament suture (PDS #1) is then passed through the needle into the joint and retrieved using an arthroscopic grasper through a portal situated posterior to the previous one. The other two sutures are then placed, more proximally to the first, at intervals of around 1.5 cm (Fig. 3). The two ends of each suture are retrieved through the posterior portal and tied under athroscopic visualization with the knee flexed to 60-70° to avoid over-tensioning the repair. We never perform lateral release in medial retinacular reefing or MPFL reconstruction, as it does not make for better quality results and, furthermore, it increases the mobility of the patella (20). The literature contains several studies of case series with different indications. Nam and Karzel (22) reported the results they obtained using mini-open medial reefing together with arthroscopic lateral release for the treatment of recurrent patellar dislocation: 91% of knees were rated as good or excellent, while postoperative dislocation and recurrent subluxation were each reported in 4% of cases. Miller et al. (19) described the use of an arthroscopically assisted technique in patients with subluxations and dislocations of the patella and reported that 96% were satisfied with their results, and that there were no recurrent dislocations or subluxations. The authors documented, radiographically, improvements in the following parameters: congruence angle, lateral patellofemoral angle and lateral patellar displacement. Halbrecht (21) instead described the use of an all-inside technique, which resulted in subjective improvement in 93% of patients. He, too, reported an improvement in radiographic parameters and no complications. Although the literature contains reports of favorable results in quite a wide range of applications, we prefer to reserve medial retinacular reefing for patients presenting painful patellar instability, no previous dislocations and no or only mild predisposing factors.

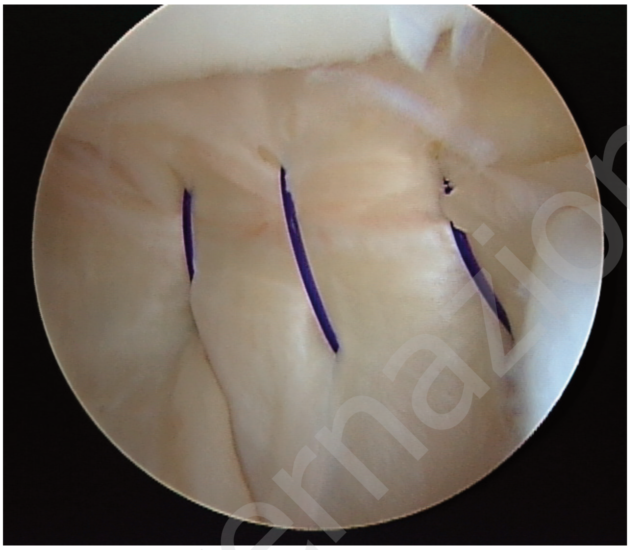

**Figure 3:** Photograph of arthroscopically assisted medial retinacular reefing. The three absorbable sutures are spaced at intervals of 1.5 cm in order to exert homogeneous traction on the medial retinaculum.

## Lateral retinacular release

The lateral retinaculum (LR), like the medial one, contributes to the stability of the patella; however, its role is more limited, given that it provides only 10% of the lateral stability (23). Despite this, lateral retinacular release is a surgical technique frequently used, often inappropriately, in different types of patellar dysfunction (instability, subluxation, dislocation, chondromalacia, osteoarthritis, retraction of the LR). Its main purpose is to reduce the compressive and lateralizing forces on the patella, which result in abnormal contact and "tracking" between the joint surfaces. The technique was originally proposed by Merchant and Mercer (24), who were the first to describe isolated lateral release. Over time, this surgical technique has evolved from an open to an arthroscopic procedure. The procedure involves cutting the retinaculum, the joint capsule and synovial tissue longitudinally as far as the distal fibers of the vastus lateralis, approximately 2 cm proximal to the superior patellar pole. The incision must follow the lateral margin of the patella as closely as possible in order to avoid cutting the lateral geniculate artery. In the past, the release was deemed to be sufficient when the lateral border of the patella could be raised to a point at which the medial margin of the patella made contact with the intercondylar notch. Analysis of the literature, however, shows that the results obtained using this method are highly variable. This can be attributed partly to the excessively, and not always sufficiently precise, surgical indications. Furthermore, it has been shown that clinical outcomes tend to deteriorate rapidly over time in patients affected by patellar instability (25). On the basis of these data, we feel that this procedure should be reserved for patients with retraction of the LR and lateral patellar tilt. It has indeed been shown that lateral release corrects lateral patellar tilt more than it corrects lateral subluxation (26). By contrast, biomechanical studies have shown that lateral release reduces patellar stability, and thus exacerbates any pre-existing patellar hypermobility (27). In the light of these findings, we feel that the use of this procedure should be considered very carefully. In any case, we no longer consider isolated lateral release an option in the treatment of patellar hypermobility, with or without dislocation (28).

## Proximal realignment

Proximal realignment techniques have been proposed since the last century, although they really began to gain momentum from the 1960s on. The rationale behind these techniques is that of rebalancing the force vectors of the knee extensor mechanism through muscle/tendon transpositions. Certain interventions, such as those of Krogius, Campbell, and Madigan now have purely historical significance.

The most widely used procedure described by Insall (29), involves advancement of the VMO, which is detached and sutured onto the middle and distal aspects of the patella. The aim of the procedure is to compensate for the presence of VMO dysplasia (proximal insertion) in patients with patellar instability (29). Compared with other procedures, Insall's undoubtedly has the advantage of being simpler and less invasive.

The results reported in the literature are generally good. However, as reported in a recent study, the recurrence rate can reach 20% (30).

## Conclusions

Surgical techniques for use on soft tissues are a crucial aspect of the treatment of instability of the patella and patellar pain. Although many techniques have been proposed over the years, MPFL reconstruction and medial retinacular reefing are currently the ones most widely used. Reconstruction of the MPFL is a reliable technique for treating recurrent patellar dislocations. The possibility of combining it with interventions on the bone-cartilage structures considerably increases its versatility. Medial retinacular reefing is not an adequate technique for the treatment of patellar dislocation, whereas it is very effective in cases of patellar hypermobility. In this condition, a loose medial capsule and a partially incompetent VMO can be almost completely corrected using this mini-invasive technique. Lateral retinacular release and Insall's proximal realignment technique have become less and less used over time. With regard to the former, biomechanical studies and long-term clinical follow-ups have confirmed its negative effects in cases of patellar instability/dislocation; therefore, lateral retinacular release is to be considered indicated only in cases of chondromalacia associated with lateral retinacular retraction. As regards proximal realignment, on the other hand, the excessive invasiveness of this surgery has led surgeons to prefer procedures that, based on the same rationale, can be performed arthroscopically.

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