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Abstract

Primary traumatic patellar dislocation is a common injury in young active population. The medial patellofemoral ligament (MPFL) is the primary restraint in preventing lateralization of the patella, and it is injured in most cases. Primary patellofemoral dislocation is usually managed nonoperatively, but recurrent dislocations are relatively common. A tear of the MPFL is the essential lesion of recurrent lateral patellar dislocation in patients without any predisposing factors. Many surgical procedures have been commonly used for treatment of recurrent patellar dislocation. MPFL reconstruction using an autogenous gracilis tendon through a double patellar bony tunnel is a safe and reliable technique in patients without predisposing anatomic factors. This technique does not preclude further surgical procedures when failure occurs. However, long-term studies are needed.

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Reconstruction of the Medial Patellofemoral Ligament: A Surgical Technique Perspective from an Orthopedic Surgeon

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Abstract

Primary traumatic patellar dislocation is a common injury in young active population. The medial patellofemoral ligament (MPFL) is the primary restraint in preventing lateralization of the patella, and it is injured in most cases. Primary patellofemoral dislocation is usually managed nonoperatively, but recurrent dislocations are relatively common. A tear of the MPFL is the essential lesion of recurrent lateral patellar dislocation in patients without any predisposing factors. Many surgical procedures have been commonly used for treatment of recurrent patellar dislocation. MPFL reconstruction using an autogenous gracilis tendon through a double patellar bony tunnel is a safe and reliable technique in patients without predisposing anatomic factors. This technique does not preclude further surgical procedures when failure occurs. However, long-term studies are needed.

Introduction

Primary traumatic patellar dislocation is a common injury in young active population, and it accounts for approximately 3 % of all knee injuries (Tsai et al. 2012). It typically results from a sport injury, and its average annual incidence ranges between 5.8 and 7.0 per 100,000 person-years (Sillanpaa et al. 2008). Women are more likely to sustain a patellar dislocation than men.

Patellofemoral stability is provided by both active stabilizers, including active muscle tension, and passive stabilizers such as bony and soft tissue structures. The lateral retinaculum is an important restraint to medial dislocation, while the medial patellofemoral ligament (MPFL), the medial patellomeniscal ligament, the medial patellotibial ligament, and the medial retinaculum provide stability to lateral dislocations (Amis et al. 2003). The MPFL is the primary passive restraint to lateral patellar translation at 0–30° of knee flexion (Senavongse and Amis 2005), the angle at which lateral patellar instability most often occurs. The MPFL is a thin structure with a mean tensile strength of 208 N (Panni et al. 2011), and cadaveric studies reported that it provides 50–60 % of the soft tissue restraint to lateral patellar translation (Conlan et al. 1993; Table 1). The MPFL is located in the second layer of the anteromedial aspect of the knee, and its femoral insertion area at the femur is between the adductor tubercle and the medial epicondyle (Nomura et al. 2005). The MPFL is formed by two bundles, an inferior-straight bundle and a superior oblique bundle (Kang et al. 2010). The angle formed between the two bundles is approximately 15°. This leads to a wide patellar insertion, with the footprint occupying approximately half of the patellar height, on average 22 mm at its proximal medial side (Kang et al. 2010). Although the two bands run in distinct directions, they

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Table 1 Restraint provided by medial static stabilizers to lateral patellar dislocation (Amis et al. 2003)

Ligament	Restraint provided (%)
MPFL	50–60 %
Medial patellomeniscal ligament	22 %
Medial retinaculum	11 %
Medial patellotibial ligament	5 %

Fig. 1 An axial T2-weighted fast-spin-echo magnetic resonance imaging scan illustrates the index lesion in a patient sustaining a primary traumatic lateral dislocation of the patella

are not separated and the MPFL works as a single intact structure with no functional difference between the two bands.

Tears of MPFL are common after lateral patellar dislocations. Magnetic resonance imaging studies and immediate surgical exploration in knees with acute patellar dislocation have demonstrated an MPFL injury in up to 100 % of these patients (Spritzer et al. 1997; Ahmad et al. 2000; Fig. 1). Osteochondral fractures are also common injuries after patellar dislocations, occurring in nearly 25 % of cases (Sillanpaa et al. 2008).

Primary patellofemoral dislocation is usually managed nonoperatively, with acute surgical repair indicated in specific cases such as chondral lesions or fractures (Palmu et al. 2008; Tsai et al. 2012). However, recurrent dislocations are relatively common, and long-term recurrence rates can be up to 45 % (Maenpaa and Lehto 1997). In up to 80 % of patients, recurrent instability is attributed to predisposing factors. Four major predisposing factors have been described: trochlear dysplasia, patella alta, patellar tilt, and increased tibial tuberosity–femoral groove distance (TT–TG) (Dejour et al. 1994). Secondary factors in patellar instability are knee recurvatum, femoral anteversion, valgus alignment, and external tibial torsion, but their absence does not prevent the development of patellar instability (Dejour et al. 1994). After careful clinical and imaging evaluations, all these conditions need to be considered to be corrected to restore the biomechanics of the patellofemoral joint. Many surgical treatments attempt to correct anatomic predisposing factors, others involve a simple repair of pathologic tissue, and some techniques attempt to do both. Lateral retinacular

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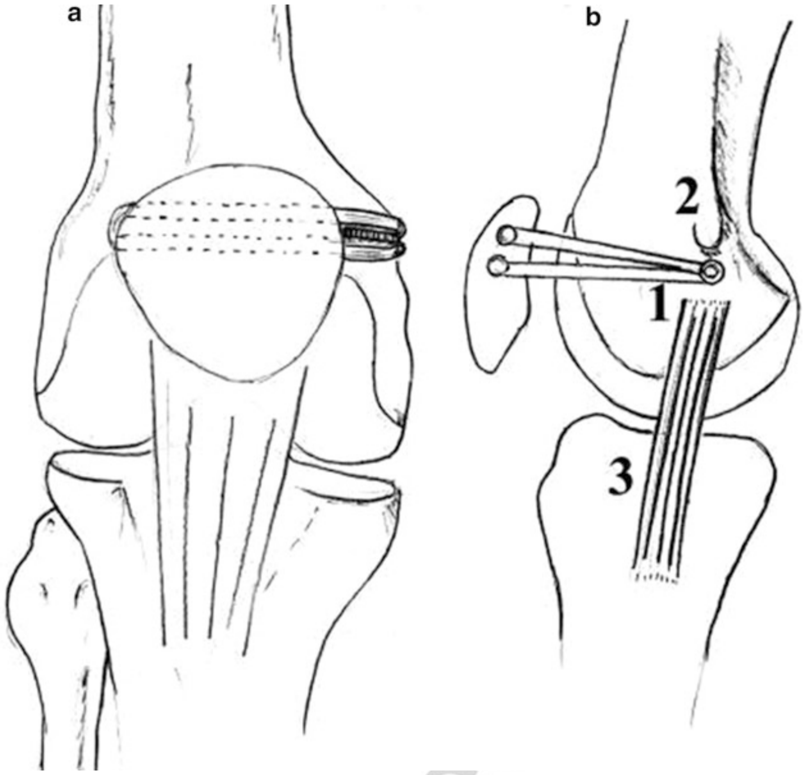

Q3 **Fig. 2** Anatomic reconstruction of the medial patellofemoral ligament with hamstring tendon passed through a double patellar transverse bony tunnel. (**a**) Frontal view. (**b**) Lateral view. The graft is secured with an absorbable interference screw in a tunnel sited on the posterior aspect of the medial epicondyle (1), 1 cm distal to the adductor tubercle (2), and proximal to the medial collateral ligament (3)

release, proximal realignment, and distal realignment, trochleoplasty, purely soft tissue reconstructions, and combinations of these procedures have been purposed with different results (Abraham et al. 1989; Panni et al. 2005). All these nonanatomic surgical procedures have been used also in recurrent patellar dislocation without any predisposing factor altering the patellar tracking (Aglietti et al. 1994; Nakagawa et al. 2002). Several studies reported inconsistent outcomes, recurrent dislocations, patellofemoral pain, and arthritis in up to 40 % of these patients (Muneta et al. 1999; Nakagawa et al. 2002). Since the MPFL has been demonstrated as the primary constraint in preventing lateralization of the patella, this provides biomechanical support for its reconstruction in recurrent patellar dislocation without other predisposing factors. In a cadaveric study, MPFL reconstruction showed a significant reduction in lateral displacement and ligament load compared with medial transfer of the tibial tuberosity (Ostemeier et al. 2006).

Several surgical techniques have been described. Semitendinosus, gracilis, quadriceps tendon, and synthetic grafts have been used to reconstruct the MPFL, all showing good early to midterm results (Deie et al. 2003; Schottle et al. 2005). Clear superiority of only one of these surgical techniques has not been reported to date. The authors' preferred method for an anatomic MPFL reconstruction using autologous ipsilateral gracilis tendon graft is described below (Fig. 2).

Surgical Technique

The patient is placed supine, with an above-knee tourniquet, following the administration of prophylactic antibiotics. A diagnostic arthroscopy is performed to address any intra-articular damage to the knee. The gracilis tendon is harvested and prepared in the usual fashion (Maffulli

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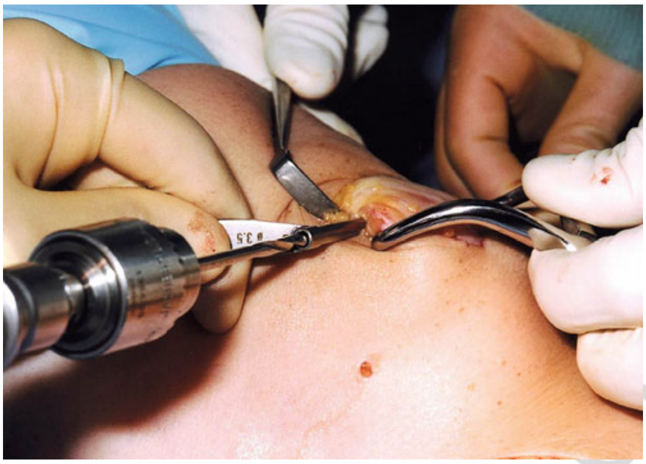

Fig. 3 Following medial and lateral parapatellar incisions, the patella is stabilized using a large clamp on the right of the figure. Tunnels are produced by sequential drill holes in the superior half of the patella, 1 cm apart

and Leadbetter 2005). If the gracilis tendon is insufficient in thickness or length (less than 15 cm), the semitendinosus tendon can be harvested and used to reconstruct the MPFL. The patella is approached through a 4 cm midline incision. The prepatellar fascia is elevated to allow the medial and lateral walls of the patella to be exposed. Two transverse tunnels are made in the upper third of the patella. The diameter of the tunnel depended on the diameter of the tendon and varies between 3.0 and 4.0 mm (Fig. 3). They are drilled parallel to one another and 1 cm apart. The graft is passed through the two transverse tunnels from medial to lateral and then from lateral to medial (Fig. 4), so that the graft forms a loop through the patella. The medial epicondyle is palpated through the skin and exposed using a 2 cm incision, and the graft is passed between the deep fascia and the capsule of the knee joint and out over the medial epicondyle. The two ends of the graft are secured into a 7 mm tunnel about 3 cm long, sited on the posterior aspect of the medial epicondyle, proximal to the medial collateral ligament and 1 cm distal to the adductor tubercle, guided by a transfemoral eyelet pin (Fig. 5). The knee is cycled several times from full flexion to full extension with the graft under tension. In this way, the graft tension is settled. The graft is then secured within the tunnel in the medial epicondyle using a 7 mm diameter and 30 mm long interference with the knee flexed to 20°. The wound is closed in layers, and routine dressings, bandages, and a straight knee splint are applied.

Postoperative mobilization consists of partial weight bearing in a straight knee splint. After 2 weeks, patients are allowed to progress from partial to full weight bearing. At 6 weeks, the straight knee splint is removed, and patients start gentle mobilization of the operated knee. For the first 3 weeks, they are encouraged to undertake cycling on an exercise bicycle, keeping the seat high. The height of the seat is lowered every second day, and normally patients are able to reach 90° of knee flexion by the seventh or eighth postoperative week. In addition, patients undertake gentle concentric training of their thigh muscles and proprioception training. At the eighth postoperative week, gentle on-the-spot jogging on a trampoline is started and gradually progressed over the next 4 weeks. At the 12th postoperative week, sports-specific rehabilitation is started. Progressive return to normal daily activities occurs over the course of the next 3 months, with return to sport normally planned at the sixth postoperative month.

Discussion

When nonoperative management fails, surgical options can be considered to restore patellofemoral stability. Tears of the MPFL are the essential lesion of recurrent lateral patellar dislocation in patients

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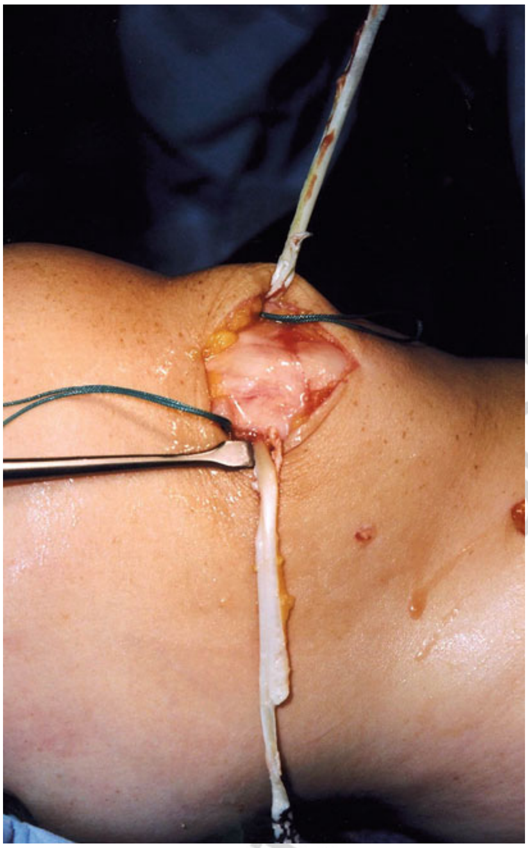

Fig. 4 A Beath pin is used to pass a Vicryl loop through the patella tunnels

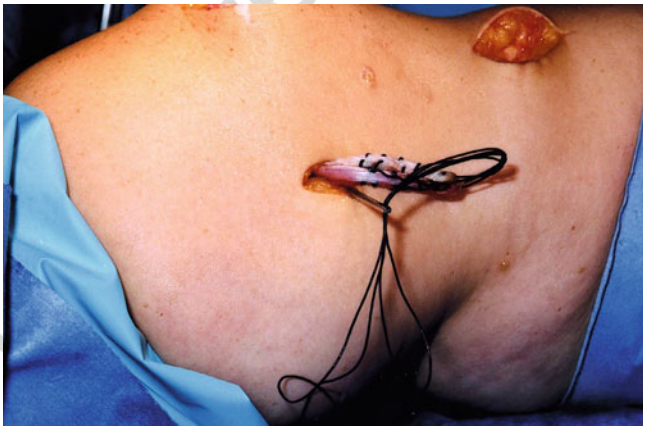

Fig. 5 The medial epicondyle is exposed, and the Beath pin is placed across the transepicondylar axis. A tunnel is drilled to accommodate and secure both ends of the graft. The graft is passed between the second and third layers of the knee. The graft is pulled into the tunnel using Vicryl through the eye of the Beath pin

without any predisposing factors (Amis et al. 2003). Many surgical techniques have been described to reconstruct this ligament, all showing good early to midterm results.

Good results after isolated MPFL reconstruction have been reported in 28 patients with chronic patellar instability without any anatomic predisposing factors at an average follow-up of 3.1 years (Ronga et al. 2009). All patients continued to practice sports, and only four patients retired from their

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sport because of their age and because they were concerned about operated knee, but took part in low-impact recreational sports. Three patients (10.7 %) experienced a recurrent lateral patellar dislocation, and one of these did not return to sport. More recently, Schiavone et al. reviewed 48 active patients who underwent MPFL reconstruction using an autologous semitendinosus graft (Panni et al. 2011). They reported that 89 % were either satisfied or very satisfied with their functional result, and no patients experienced recurrent dislocations.

This technique is a safe and a reliable option for recurrent patellofemoral dislocation. It is technically demanding and requires meticulous positioning of bony tunnels, femoral insertion site, and accurate graft tensioning. Patellar tunnels are usually drilled parallel, but divergent tunnels have been described (Panni et al. 2011). Drilling two diverging bony tunnels may reproduce a more anatomic patellar insertion of the MPFL. But the possible advantages remain to be fully elucidated both in vitro and in vivo and significant differences in outcomes have yet to be reported. However, all authors agree to be careful during tunnels drilling to avoid breaching either the chondral surface or the anterior cortex. In accordance with most anatomic studies, the femoral tunnel should be positioned on the posterior aspect of the medial epicondyle, proximal to the medial collateral ligament, and 1 cm distal to the adductor tubercle (Nomura et al. 2005). Although anatomic reconstruction of the MPFL is important, several studies showed that the femoral attachment of the MPFL is not clearly identifiable, and probably the convergence of various structures and layers toward the medial epicondyle makes it difficult to distinguish the MPFL origin (Elias and Cosgarea 2006). Recent biomechanical data showed significant increases in medial patellofemoral contact pressures when MPFL grafts were misplaced as little as 5 mm. Incorrect graft placement accompanied by a short graft increased medial patellofemoral contact pressures by over 50 % (Elias and Cosgarea 2006). Multiple MPFL reconstruction procedures have been described using semitendinosus, gracilis, or quadriceps tendon and synthetic grafts (Ellera 1992; Hamner et al. 1999), but there is no agreement regarding the best method. Although a semitendinosus tendon graft is stiffer and has a higher ultimate load than the gracilis tendon (Hamner et al. 1999), semitendinosus tendons require larger intraosseous patellar tunnels using a 5.0 mm drill. For this reason, gracilis tendon graft and smaller tunnels (3.0–4.0 mm of diameter) should be preferred to reduce the risks of patellar fractures. Another important aspect to take into account is the tension of the graft. Senavongse and Amis demonstrated that the patella is subluxed laterally most easily at 20° of flexion and that the contribution of the MPFL to resist lateral dislocation of the patella is maximal between 0 and 20°(Senavongse and Amis 2005). This supports the choice to fix the graft at 20° of the flexion. Tensioning and fixing the graft at 60–90° of knee flexion may produce overtightening of the graft and increased loads on the patellofemoral joint, which may result in degenerative joint disease at long-term follow-up.

This technique is not without complications. Recurrent patellar dislocation is a well-known complication. A rate of 10 % of patellar redislocations after MPFL reconstruction has been reported (Drez et al. 2001; Schottle et al. 2005). But one of the advantages of this technique is that it does not preclude further surgical procedures when failure occurs. Patellar fracture is another risk of this procedure. If the two tunnels converge at the lateral edge of the patella, they may produce a figure-of-8 appearance of the exit hole. In these cases, the graft can be sutured to the periosteum. Persistent postoperative anterior knee pain was also reported by some patients. It can be caused by overtightening of the graft or by degenerative disease of patellofemoral joint facet. In fact poorer outcomes have been reported in patients with concurrent patellofemoral chondral damage, particularly in relation to continuing pain and reduced sports participation (Ellera 1992; Christiansen et al. 2008; Panni 2011). Hypoesthesia of the medial or lateral aspect of the knee has also been described, but patients do not report any inconvenience from it.

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Conclusion

MPFL reconstruction using autogenous gracilis tendon through a double patellar bony tunnel is a safe and reliable technique for recurrent patellofemoral dislocation in patients without any predisposing anatomic factors. Correct indications, careful preoperative evaluation, and restoration of normal anatomy are the keys for successful long-term outcome. This technique does not preclude further surgical procedures when failure occurs. However, long-term evaluation is necessary, particularly to monitor the possible development of patellofemoral osteoarthritis and the long-term functional deficit that recurrent patellar dislocation may cause.

Cross-References

▶ MPFL Reconstruction: Current Concepts
▶ Patellar Dislocations: Overview
▶ Return to Play After Acute Patellar Dislocation

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