


Complications of medial patellofemoral ligament reconstruction using two transverse patellar tunnels

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Abstract

Purpose The aim of this study was to report the complication rate after a medial patellofemoral ligament (MPFL) reconstruction using transverse patellar tunnels in a retrospective case series performed in a single institution.

Methods Case series of 179 patients (192 knees) that had an MPFL reconstruction, with or without additional bony realignment procedures, between January 2009 and March 2015. Data were obtained from available patient charts.

Results Thirty-nine complications (20.3 %) were registered. Twenty-seven of these (14.7 %) were minor. Seven patients (3.6 %) sustained a patellar fracture without adequate trauma. Male gender was a risk factor for patellar fracture ($p < 0.001$). Sixteen (8.1 %) reported recurrence of instability, of whom 10 (5.1 %) were defined as objective instability (reported dislocation and positive apprehension test).

Conclusion This is largest patient series to date in which the complications after a two tunnel MPFL reconstruction are described. The use of transverse patellar tunnels increases the risk of sustaining a patellar fracture.

Level of evidence IV.

Keywords Medial patellofemoral ligament · MPFL · Patellar instability · MPFL reconstruction · Complications

Introduction

The medial patellofemoral ligament (MPFL) is a soft tissue restraint to lateral dislocation of the patella [1, 23]. It is nearly always disrupted after an initial dislocation [9, 22]. After sustaining a primary dislocation, the risk of recurrence is relatively high. Reported percentages differ greatly, but approximately half of all patients have recurrent dislocations [8, 17, 29]. In case of persistent instability, surgical management is the best option [29]. There are several anatomical factors associated with instability [30]. Surgery is aimed at addressing these abnormalities. Soft tissue repairs were introduced two decades ago. These soft tissue approaches seem to be safer than the osseous techniques, which were the keystone of patellar stabilization in the previous decades.

Since the introduction of MPFL reconstruction, numerous techniques have been described. All techniques employ fixation of a graft to the femur and the patella with sutures, bone tunnels or anchors. Overall results have been favourable so far in terms of functional outcome and recurrence of instability [19, 28, 31]. As with all new techniques, the early success of the procedure has outshone the potential risks of the procedure. Post-operative complications are rarely reported, and the use of different definitions of complications, heterogeneity in surgical techniques and small sample sizes make it practically impossible to give a realistic comparison between studies and techniques. The incidence of reported complication is highly variable and ranges from 3 to 85 % [7, 12, 25, 27], ranging from wound infections to patellar fractures. A large systematic

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review on complications of MPFL reconstructions by Shah et al. [27] reported a mean complication rate of 26 ± 21 % among included studies. Overall recurrence of dislocations and subluxations was 3.7 %; there was significant post-operative pain in 5.4 % and patellar fractures occurred in studies using tunnel fixation in 0.9 %. However, these numbers are mere averages and do not represent the complication rates of specific surgical techniques. Large studies reporting complication rates of specific surgical techniques are needed to give a clearer view on this. These studies can help determine what the safest technique is.

This retrospective study reports the complications and recurrence rates of patellofemoral instability in a large group of patients after an MPFL reconstruction using two transverse patellar tunnels performed in a single institution. The aim of this study was to give a clear view on the complication rates of this technique.

Materials and methods

Data collection

All patients who were operated between January 2009 and March 2015 for recurrent patellar dislocations using a double-bundle dynamic MPFL reconstruction were included. Patient charts were reviewed for data collection. If the procedure was not complicated, patients were asked to visit the outpatient clinic at 6 weeks and 6 months post-operatively.

Patients

One hundred and ninety-two knees in 171 patients with persistent patellar instability were included. Patellar instability was defined as a history of multiple patellar dislocations as reported by the patient and the presence of a hypermobile patella with a positive apprehension test on physical examination. The indications for MPFL surgery were recurrence (2 or more episodes) of patellar instability after failure of conservative management or a first-time patellar dislocation with a concurrent osteochondral fracture. All procedures

were performed by one of the two authors (ST, SK) using a similar surgical technique. If needed, the MPFL reconstruction was combined with other procedures such as a tibial tubercle transfer or a trochlear osteotomy.

The median age at operation was 19 years (range 10–57 years), and 129 of the knees were female (67.2 %). Twenty patients had a history of previous unsuccessful surgery to stabilize the patella. Sixteen of these knees previously had a distal realignment procedure and four knees a soft tissue procedure, such as medial reefing or a lateral release. Preoperatively, patellar height, the degree of trochlear dysplasia, lateralization of the tibial tubercle and patellar tilt were assessed using lateral X-rays and CT or MRI scans. In case of the presence of a patella alta (Caton—Deschamps index >1.2) or a lateralized tubercle (TT-TG distance >15 mm), a tibial tubercle osteotomy (TTO) was performed concurrent with the MPFL reconstruction. In patients with severe trochlear dysplasia, the need for a trochleoplasty (TP) was assessed intraoperatively, based on the presence of a bump and the degree of instability. An overview of which specific procedures each patient had and their surgical history is listed in Table 1. One hundred and fifty-six out of the 197 knees (81.3 %) had at least one additional procedure to the MPFL reconstruction. In 134 knees (69.8 %), an additional TTO was performed; 2 knees (1.0 %) underwent an additional TP and in 21 knees (10.9 %), both procedures were performed. Nine patients had open epiphyseal plates and did not have any additional procedures, despite the presence of a patella alta or lateralized tibial tubercle in six of these patients. In one patient with a previous open lateral release, the lateral retinaculum was closed in addition to the MPFL reconstruction and TTO.

Surgical technique

The MPFL was reconstructed using a hamstring autograft, preferably the gracilis. The graft was harvested from the ipsilateral knee using an incision over the tibial tubercle. For fixation to the patella and the femur, two small separate incisions were used, one at the medial border of the

Table 1 Overview of performed procedures and surgical history

	<i>N</i>	%
Isolated MPFL	35	18.2 %
Previous surgical history	6 (previous TTO)	
Additional TTO	134	69.8 %
Previous surgical history	9 (6 previous TTO, 3 medial reefing)	
Additional TTO and TP	2	1.0 %
Previous surgical history	2 (previous TTO)	
Additional TP	21	10.9 %
Previous surgical history	3 (2 previous TTO, 1 medial reefing)	

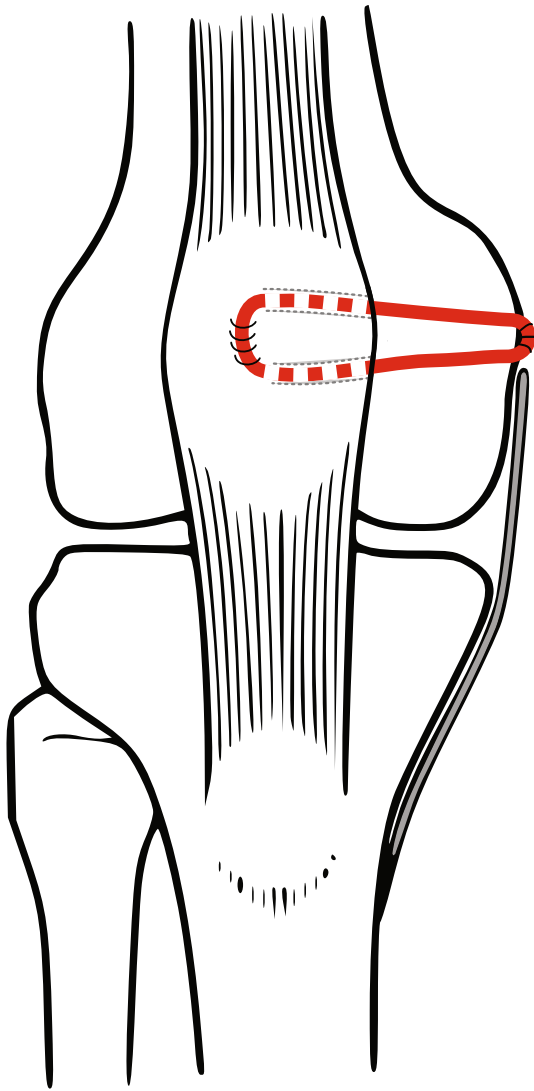


Fig. 1 Schematic drawing of MPFL reconstruction. The graft was looped around the adductor tendon, the free ends of the graft were passed between the retinaculum and capsular layer, and then separately passed through either one of the patellar tunnels and sutured to the periosteum

patella and one at the medial femoral epicondyle. First, the adductor tubercle was located on the femoral condyle. The graft was looped around the tendon, and the two free ends were passed under the superficial retinaculum. The graft was passed between layer 2 (medial retinaculum) and layer 3 (capsule) on the medial side of the knee. Using a 4.5-mm endobutton drill, two transverse tunnels were drilled from the medial border of the patella to the anterior patellar cortex. The free ends of the graft were passed through the tunnels and attached to the patella using absorbable sutures. The isometry of the graft was determined through a complete range of motion. After temporary fixation, a maximum of 5 mm of length change with flexion–extension of

the knee was achieved (see Fig. 1). In patients with a lateralized tubercle or a patella alta, a TTO was performed prior to the MPFL reconstruction, using the same incision that was used for harvesting the graft. The osteotomy was fixed using two small fragment compression screws. The technique and results for this procedure have been described previously [15, 32]. In patients with severe trochlear dysplasia, where an MPFL reconstruction and TTO would be insufficient, a TP was performed. A midline incision was used at the patella instead of the medial incision. The lateral retinaculum was opened with a z-shaped incision, and the shape of the trochlea was assessed. In case of a trochlear bump without significant cartilage damage, the proximal cartilage was liberated from the subchondral bone and a bur was used to deepen the trochlea. The cartilage was reattached to the trochlea using absorbable sutures at the proximal edge. If the lateral side of the trochlea was insufficient, an anterior lateral open wedge osteotomy was performed. The opening was filled with a small bone block that was harvested from either the tibial tubercle or the iliac crest. This technique and its results have also been described previously [16]. All patients followed the same rehabilitation protocol: full weight bearing in a removable Velcro splint or plaster cast with a restricted knee flexion to 90 degrees for six weeks (Fig. 2).

Data analysis

Both objectives as subjective instability were included in the results, with objective instability defined as a reported episode of instability and the presence of a hypermobile patella and/or a positive apprehension test on physical examination. The complications were stratified into patients undergoing an isolated MPFL reconstruction and patients undergoing an MPFL reconstruction with additional procedures. All complications were categorized as either minor or major. Minor complications include events that are unlikely to have influenced the functional outcome or caused no permanent harm to the patient. Complications were classified as major if they affected outcome or required re-operation. Complications that were specific for the TTO (such as irritation of the screws used for fixation of the osteotomy) were not included in the results.

Statistical analysis

An independent sample *t* test was used to compare the average age of the group with and the group without complications. A Fisher's exact test was used to detect significant differences in prevalence of complications between the following subgroups: male versus female, isolated MPFL versus combined procedures and skeletally mature versus skeletally immature patients. This test was repeated for

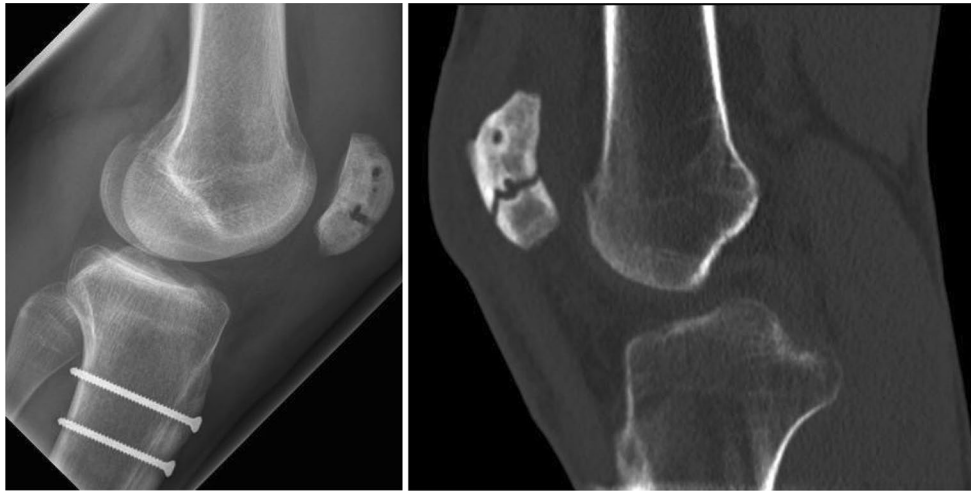


Fig. 2 X-ray and image from a CT scan of a patient with a stable patellar fissure

every individual complication as well. For all datasets, differences with p values <0.05 were considered statistically significant.

Results

Patients were routinely followed up at 6 weeks and at 6 months post-operatively. Thirty-three patients did not come to the clinic at 6 months and had a shorter follow-up. One hundred and thirty-three patients had a follow-up of more than 6 months. Median follow-up was 9 months (range 1–67 months). Most common reasons for longer

follow-up were: recurrent instability, post-operative complications, consultation for contralateral knee issues and request for TTO hardware removal. Out of the 192 operated knees, 39 knees had a registered complication (20.3 %) (Table 2). Of these complications, 12 were considered minor (6.3 %) and 27 major (14.1 %). Two patients had complications in both knees.

The patients in the complication group were younger on average than the patients without a complication (2.4 years, 95 % confidence interval (CI) -4.52 to -0.24 , $p = 0.029$). There were no significant differences in age for the separate complications. There was no difference in recurrence of instability between male and female patients.

Table 2 Occurrence and demographics of complications

	Total (%)	N female	Median age (range)	Median time after surgery (range)	Isolated MPFL (%)	MPFL with additional procedures (%)
<i>Complications</i>	39/192 (20.3 %)	21/39 (53.8 %)	19 (9–42)	8 (2–41)	9/35 (25.7 %)	30/157 (19 %)
Minor	12 (6.3 %)	5	20 (15–24)	N.A.	0 (0 %)	12 (7.6 %)
Wound infection	11 (5.7 %)	5	19 (15–24)	N.A.	0 (0 %)	11 (7.0 %)
Wound dehiscence	1 (0.5 %)	0	24 (N.A.)	N.A.	0 (0 %)	1 (0.6 %)
Major	27 (14.1 %)	16	18 (9–42)	8 (2–41)	9 (25.7 %)	18 (11.5 %)
Recurrent instability						
Objective	10 (5.2 %)	8	16 (9–42)	9 (3–41)	6 (17.1 %)	4 (2.5 %)
Subjective	6 (3.1 %)	4	19 (14–24)	12 (4–27)	1 (2.9 %)	5 (3.2 %)
Pain	2 (1.0 %)	2	18 (N.A.)	20 (N.A.)	0 (0 %)	2 (1.3 %)
Patellar fracture	7 (3.6 %)	0	19 (15–26)	4 (2–13)	2 (5.7 %)	5 (3.2 %)
Flexion deficit	1 (0.5 %)	1	28 (N.A.)	N.A.	0 (0 %)	1 (0.6 %)
Medial instability	1 (0.5 %)	1	18 (N.A.)	4 (N.A.)	0 (0 %)	1 (0.6 %)

Major complications

Twenty-six major complications were reported. Six patients sustained a patellar fracture, one of them in both knees. Figure 2 shows the x-ray and an image from the CT scan of one of the patients. All patients were male; mean age was 20 years (range 15–27). Mean time of occurrence after surgery was 5.8 months (SD 4.3). There was no significant difference in occurrence between the isolated and combined procedure group. Male patients had a significant higher risk of sustaining a patellar fracture ($p < 0.001$).

Ten patients (5.2 %) had objective recurrence of instability, of whom 6 in the isolated MPFL group (17.1 %). In patients with open epiphyseal plates, the recurrence was 33.3 % (3 out of 9), which was significantly higher than the recurrence in patients with skeletal maturity (33.3 vs. 3.8 %, $p < 0.01$). There was no significant difference in recurrence between the isolated MPFL and combined group.

Six patients (3.1 %) had subjective recurrence of instability. There was no difference in subjective recurrence between the isolated and combined group.

Other major complications were reported only once: a medial dislocation after failure of a repair of the lateral retinaculum concurrent with the MPFL reconstruction, a locally painful graft in both knees, laxity of the graft without instability and a post-operative flexion deficit of 60°.

Minor complications

There were 12 complications related to the surgical wound: 11 wound infections and 1 dehiscence. All these complications occurred in the group with combined procedures.

Discussion

The most important finding of the present study was the high prevalence of post-operative patellar fractures, which occurred in 3.6 % of patients, usually within 1 year after surgery. All fractures occurred in male patients (7.5 % of all male patients). The results in terms of stability were good, with a recurrence of objective instability in only 5.1 %. Recurrence rate in patients with open epiphyseal plates was high (3 out of 9, 33 %). Patients in the complication group were younger on average, but although this difference is statistically significant, it is small and probably not clinically relevant.

A patellar fracture is a major complication. This complication has been frequently reported [2–6, 10, 11, 13, 14, 18, 20, 21, 24, 25]. The available studies are too heterogeneous and small to determine a reliable prevalence of patellar fractures. An association with tunnels placed too anteriorly, and thus weakening the anterior cortex of the patella,

has been mentioned [4, 11, 25]. The use of two transverse tunnels gives a higher risk, but fractures have also been reported in studies using only one tunnel or sockets [2, 5, 11, 18, 20]. A study on the complications of a similar technique to the one used in this study, employing two transverse patellar tunnels, in patients under 21 years ($N = 179$) reported 6 patellar fractures, only two of whom were male [25]. This contradicts this study's finding of male gender being a risk factor for patellar fractures. Other studies were too small to determine the influence of gender. The time between the MPFL reconstruction and patellar fractures was similar in other studies, mostly occurring within 1 year [3, 5, 14, 18, 21, 24, 25].

Most MPFL techniques employ a static fixation with an interference screw at the femur; the technique in this study reports the results of the adductor sling technique. A cadaver study by Rood et al. [26] on patellofemoral pressures in different MPFL reconstructions shows that there is no increased contact pressure after the adductor sling technique, as was used in this study, while the pressure increases 3–5 times in the static technique from 60 to 110 degrees of flexion. This implies that the femoral fixation method used in this study has no negative influence on the risk of patellar fractures, i.e. by overloading the patellar attachment.

Recurrence of instability in this group was similar to other studies [19, 27]. It should be noted that the recurrence in this group cannot be solely attributed to the MPFL reconstruction, since more than 80 % of patients had a combined procedure, and it was impossible to determine the exact reason of failure retrospectively.

The major strength of this study is the large sample size. Patellofemoral instability is a relatively uncommon disorder, and most other single centre studies have a much smaller population than the one that was reported here, with an average sample size of about 30 [19, 27].

The main limitation of this study is its retrospective nature, using only available patient charts, and the spread in follow-up. Recurrent instability occurred on average after 17 months, so it is possible that the recurrence instability is underreported in this study. The majority of patients (81.3 %) required additional procedures to the MPFL reconstruction, and complication rates of an isolated MPFL reconstruction can be different.

It is possible that (minor) complications are underreported.

Conclusion

This is largest patient series to date in which the complications after a two tunnel MPFL reconstruction are described. The surgical technique that was used in this study gives an unacceptable high risk of patellar fractures due to the use

of transverse patellar tunnels. Alternative patellar fixation methods should be considered. More comparative research is needed to determine which fixation method gives the best functional results and the lowest complication rates.

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