

Clinical outcome in MPFL reconstruction with and without tuberositas transposition

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Abstract

Purpose There are several surgical options for recurrent patella dislocations. As the reconstruction of the medial patellofemoral ligament (MPFL) has been proven to restore stability, it has become more accepted. **Aim of this study** was to investigate the clinical outcome after MPFL reconstruction as an isolated procedure or in association with a transposition of the tibial tubercle (in case of patella alta or an excessive TT–TG) in a large prospective cohort study. Additionally, the effect on patellar height was analysed radiographically using the Caton–Deschamps index.

Methods In a large prospective cohort study of 129 knees in 124 patients (81 females, 48 males, mean age 22.8 ± 7.7 years), 91 knees received primary MPFL reconstruction (group 1) and 38 were a combination with a transposition of the tibial tubercle (group 2). The clinical follow-up was evaluated using KOOS and Kujala scores preoperatively and 1 year postoperatively. Patient satisfaction, complications and revision surgery were recorded.

Results Overall, Kujala improved significantly from 53.5 (SD 22.7) preoperatively to 74.7 (SD 20.5) postoperatively ($p < 0.01$). All KOOS subdomains improved significantly ($p < 0.01$). No significant difference for Kujala score between groups was noticed. Revision rate was (5/129) 3.9 %. Reconstruction was supplemented with a transfer of the tibial tuberosity in (38/129) 29.4 % of the cases and shows a comparable outcome.

Conclusion MPFL reconstruction is a viable treatment option for episodic patellar dislocation. A concomitant tuberositas transposition is useful in selected patients.

Level of evidence I.

Keywords Medial patellofemoral ligament · MPFL · Patellar instability · Tibial tuberosity transfer

Introduction

Patellofemoral instability can be a disabling condition and most commonly affects young patients [10]. As the reconstruction of the medial patellofemoral ligament (MPFL) has been proven to restore stability [4, 7, 19, 22, 32], it has received increased attention over the past few years.

Numerous surgical techniques have been described to address patellar instability. Some of these techniques involve the soft tissues, whereas others primarily address a bony correction [25]. The goal of surgery is to stabilize the patella, restore normal kinematics and optimize load transmission through the joint in case of failed conservative treatment.

Different factors are relevant in knees with symptomatic patellar instability: (1) trochlear dysplasia, (2) quadriceps dysplasia (defined as patellar tilt in extension more than 20 % on the CT scans), (3) patella alta with a

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Caton–Deschamps index higher than or equal to 1.2), (4) tibial tuberosity–trochlear groove (TT–TG) (pathological when higher than or equal to 20 mm) and (5) soft tissue incompetence such as a torn MPFL or generalized hyperlaxity. In summary, the aetiology of patellar instability is multifactorial [5].

The purpose of this study is to investigate the clinical outcome after MPFL reconstruction as an isolated procedure or in association with a transposition of the tibial tubercle (in case of patella alta or an excessive TT–TG) with a large consecutive cohort study. Additionally, the effect on patellar height was analysed radiographically with the Caton–Deschamps index.

To date, there is limited evidence on clinical outcome between both entities. Only a limited number of studies have examined the difference in clinical outcome between patients with an isolated MPFL reconstruction (group 1) versus patients with a concomitant operation [MPFL + tibial tuberosity transfer (TTT)] (group 2). There might be a trend towards performing more solitary MPFL reconstructions versus TTT since they are less invasive and might have a faster recovery because there is no harm to the extensor mechanism. In this study, we objectified the clinical outcome. This might be a step towards performing MPFL reconstructions for all patellar dislocations.

Materials and methods

From 2007 to 2013, 129 patients were operated for primary MPFL reconstruction of which five were bilateral. Fifty-four right knees and 75 left knees were included. All patients were documented with recurrent patellar dislocation or had a constant feeling of patellar instability. All patients failed an intensive 6-month rehabilitation programme, before surgery was proposed. Patients with associated diseases or a need for trochleoplasty were excluded. Patients older than 45 years were also excluded because of possible degeneration of the articular surfaces. Cartilage damage because of dislocation was not considered a reason for exclusion.

Eight patients were unwilling to take further part in this study protocol. In five patients, no further clinical follow-up was performed because of revision; 120 of 129 patients (93.0 %) were available for clinical follow-up. The mean age at the time of operation was 22.8 years (range 11.0–43.0; SD 7.7 year). Eighty-one (62.8 %) were females and 48 (37.2 %) males. The mean follow-up period was 34.5 months (SD 15.3 months) with a minimum of 12.0 months and a maximum of 87.0 months (7 years and 3 months).

The study was approved by the Ethics Committee of Ghent University Hospital. All patients signed an informed consent.

Surgery

An isolated primary MPFL reconstruction was performed on 91 knees in 86 patients (group 1). Combined MPFL and TTT surgery was performed on 38 knees in 36 patients (group 2).

MPFL reconstruction was performed using a free autologous gracilis graft (117 cases). If the obtained gracilis tendon seemed insufficient preoperatively, a semitendinosus tendon was harvested (12 knees). The surgery was performed in a standardized fashion making two sockets with a 4.5-mm drill bit in the patella accordingly 1 cm deep. In both sockets, a Twinfix 3.5 mm suture anchor (Smith and Nephew, Andover, USA) was fixated, pulling the tendon into the socket. Afterwards the tendon was tunnelled between layer 2 and 3 medially and fixated in the same fashion at the isometric point near the medial femoral epicondyle as described by earlier studies [23, 33] (Fig. 1a). In case of a patella alta, defined as a Caton–Deschamps index higher than 1.2, a tibial tuberosity distalization with two AO screws was performed. In case of an excessive TT–TG distance (more than 20 mm), an anteromedialization of the tibial tuberosity was performed as described by Fulkerson [11] (Fig. 1b). The technique used for this procedure was as follows: a paramedial skin incision allows to approach the patellar tendon and the tibial tubercle. One vertical (step-cut) and one long longitudinal osteotomy, blending with the anterior cortex of the tibia, permit to elevate a cortico-cancellous bone block including the patellar tendon insertion. Then the bone block is corrected depending on the amount of the expected distal transfer or medialized depending on the TT–TG distance. Finally, the tubercle is fixed with two 4.5 mm-diameter cancellous and cortical screws.

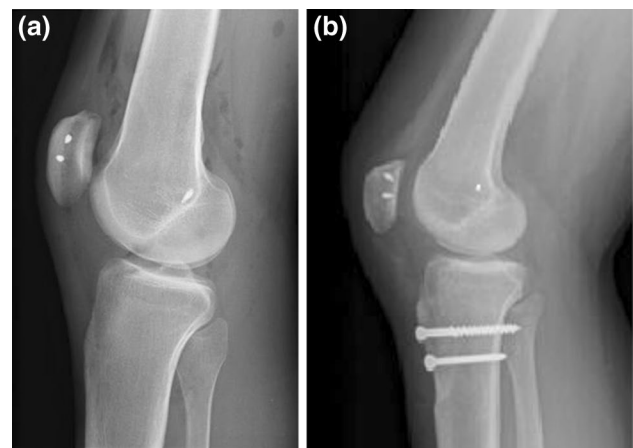


Fig. 1 Postoperative radiograph after MPFL reconstruction (a) and associated with tuberosity transfer (b)

Rehabilitation

A standardized rehabilitation protocol was carried out. Isolated MPFL patients were allowed immediate, progressive weight-bearing. Mobilizations were started after 2 weeks within pain limits. In 6 weeks, full weight-bearing and 90° of flexion would be possible, followed by further quadriceps tonifications in closed chain exercises. Return to sports was allowed after 4 months. **Rehabilitation in MPFL with a TTT included 4 weeks of protected weight-bearing and the use of a brace. Progressive passive flexion was built up first 6 weeks. After 4 weeks, gradually return to full weight-bearing was allowed.** In 6–8 weeks, full passive and active mobility would be possible, followed by training of quadriceps in closed chain exercises and proprioception.

Clinical follow-up

The clinical outcome was measured by means of two subjective questionnaires; the knee injury and osteoarthritis outcome (KOOS) and Kujala questionnaire were analysed preoperatively and at last follow-up. Kujala was set up to assess the function of patients having anterior knee pain from patellofemoral joint conditions. This questionnaire evaluates both impairments such as the presence of limp and the need for ambulatory support and functional limitations related to walking, stair ascending/descending, squatting and running [13]. The KOOS is a self-reported, subjective questionnaire comprising of five dimensions: pain, symptoms, daily life activities, sport and quality of life (QoL). Patient satisfaction was recorded after 1 year (dissatisfied, neutral, satisfied and very satisfied). The minimal follow-up was 1 year. During the follow-up, no other surgery or injuries to the knee were reported. All data were collected and analysed prospectively. Bilateral knees were scored separately.

Radiographical measurement

Radiographic evaluation has been performed preoperatively and 1 day after the surgery on standard antero-posterior (AP) and lateral view by an experienced observer. Position of the patella was determined by the Caton–Deschamps index [3]. Trochleodysplasia was described by the Dejour classification [5].

Statistical analyses

All data were collected in Excel sheets. Statistical tests were performed using the SPSS software package 22.0 (IBM-SPSS Inc., Chicago, Illinois). Research questions were examined with following tests. First, a comparison between preoperative and postoperative results was

performed with nonparametric Wilcoxon signed-rank tests and parametric *t* test for dependent samples. Second, effect in patellar height was analysed with Wilcoxon test. Third question of influence of trochleodysplasia on clinical outcome was examined with Student's *t* test. Normal distribution was checked with the Shapiro–Wilk test. *p* values <0.05 were considered statistically significant.

Results

Clinical outcome

Overall, mean Kujala improved significantly from 53.5 (SD 22.7) preoperatively to 74.7 (SD 20.5) at last follow-up ($p < 0.01$). All KOOS subdomains improved significantly ($p < 0.001$). The highest mean improvement was observed in the subdomain sports (+25.3) and QoL (+23.9), while the symptoms subdomain showed the lowest improvement (+14.7). These results are illustrated in the graphs below. Patient satisfaction was qualified as dissatisfied in 3.1 % (4), neutral in 30.2 % (39), satisfied in 16.3 % (21) and very satisfied in 45 % (58).

Regarding both groups separately, Kujala improvement was significant ($p < 0.001$). Results are specified in Table 1 and represented graphically in Fig. 2a. No significant difference for the Kujala score was observed between group 1 and 2. Also for all subdomains of KOOS, a significant improvement (see Fig. 2b) for both groups was observed (see results in Table 1). Comparing separately the pre- and postoperative state of group 1 and 2, there was no significant difference.

Radiographic outcome

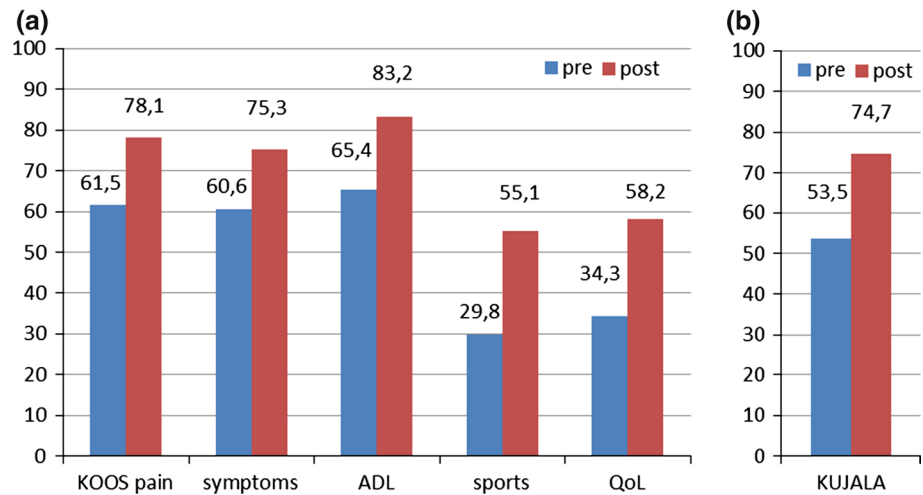
The Caton–Deschamps index was measured on preoperative and postoperative radiograph and rested equally for group 1 (1.2). Results for group 2 decreased significantly, with a mean decrease of 0.1 ($p = 0.02$). Table 2 gives an overview of these results with SD and illustrates the distribution of types of trochleodysplasia for group 1 and 2. There was no significant association between outcome and severity of trochleodysplasia and no difference between group 1 and 2.

Complications

The overall complication rate in our series was 11/129 (8.5 %). Only one clinically objective redislocation was recorded in group 2 (0.8 %). One superficial and one deep wound infection were documented, requiring local wound

Table 1 KOOS and Kujala scores

	All patients			MPFL reconstruction (group 1)			MPFL reconstruction + tuberosity transfer (group 2)		
	Pre	Post	<i>p</i> value	Pre	Post	<i>p</i> value	Pre	Post	<i>p</i> value
KOOS mean (SD)									
Pain	61.5 (24.6)	78.1 (20.6)	<0.001	60.8 (24.1)	78.6 (20.4)	<0.001	63.0 (25.9)	76.9 (21.3)	0.002
Symptoms	60.6 (21.5)	75.3 (20.0)	<0.001	59.1 (19.9)	75.7 (20.2)	<0.001	63.8 (24.8)	74.3 (19.9)	0.029
ADL	65.4 (26.9)	83.2 (20.8)	<0.001	64.9 (25.8)	84.6 (19.2)	<0.001	66.7 (29.6)	79.8 (24.2)	0.009
Sports	29.8 (30.1)	55.1 (31.6)	<0.001	31.6 (30.6)	58.4 (30.4)	<0.001	25.9 (28.9)	46.9 (33.5)	0.002
QoL	34.3 (27.8)	58.2 (27.6)	<0.001	35.6 (27.6)	59.4 (27.5)	<0.001	30.9 (28.6)	55.2 (28.1)	0.001
Kujala mean (SD)									
	53.5 (22.7)	74.7 (20.5)	<0.001	53.7 (23.4)	75.0 (20.4)	<0.001	53.1 (21.5)	73.7 (21.1)	<0.001

Fig. 2 Evolution mean KOOS (a) and Kujala (b) score pre- and postoperative**Table 2** Radiological parameters according to both groups

	All patients		MPFL reconstruction (group 1)		MPFL reconstruction + tuberosity transfer (group 2)	
	Pre	Post	Pre	Post	Pre	Post
Dejour classification <i>N</i> (%)						
a	77 (58.8)		61 (65.6)		16 (42.1)	
b	12 (9.2)		5 (5.4)		7 (18.4)	
c	20 (15.3)		14 (15.1)		6 (15.8)	
d	14 (10.7)		6 (6.5)		8 (21.1)	
Missing	8 (6.1)		7 (7.5)		1 (2.6)	
Caton–Deschamps index mean (SD)						
	1.2 (0.2)	1.1 (0.2)	1.2 (0.2)	1.2 (0.2)	1.2 (0.2)	1.01 (0.2)

care and antibiotics (1.5 %). In one case, a screw had to be revised (0.8 %). Five revisions of an MPFL were performed (3.9 %) of which one because of fracture of the patella, two because of tightness and two because of recurrence patellar instability. Two mobilizations under general anaesthesia were performed (1.5 %).

Discussion

Most important finding of the present study was that MPFL reconstruction with or without TTT has proven to be safe and effective with clinically no significant difference after 2-year follow-up.

Since transposition of the tibial tubercle was described in the late seventies, it was assumed as the gold standard for recurrent patellar dislocations with high TTTG or patella alta. In cases of an excessive lateral position of the tuberosity (TTTG > 20 mm) or excessive patellar height (CD index > 1.2), TTT with medialization, distalization and/or anteriorization could be performed to correct maltracking and/or patellofemoral stress [1, 27]. In the past decade, the reconstruction of the MPFL has been introduced for recurrent patellar dislocations. In different studies, the MPFL is proven to be responsible for 40–80 % of the medial stability [6, 8, 24]. Both entities now coexist for recurrent patellar dislocations.

To date, only limited studies analysed results of an MPFL reconstruction with and without TTT [9, 22]. In the present study, we evaluated clinical outcome of both groups. Secondly, we evaluated the effect on patellar height and the influence of trochleodysplasia on clinical results.

For the total population, MPFL reconstruction with or without TTT has proven to be safe and effective. This was illustrated by statistically significant improvement in clinical outcome (KOOS and Kujala score). These findings were also consistent with previously published studies [9].

In our total population, the increase in Kujala score was significant ($p < 0.001$). Many studies also report a significant improvement [19, 31, 32]; however, our absolute postoperative score was lower than in some other studies. A range of absolute values ranging from 46 to 66 preoperative and from 80.4 to 92.0 postoperative was found [9, 10, 14, 15, 18, 20–22, 28–31]. Possible explanations for these lower results might be the inhomogeneous population from a tertiary referral centre, and the results in other studies were obtained in small groups. The activity level of the patient may also affect the clinical outcome as assessed with the Kujala score.

The overall KOOS questionnaire also showed a significant improvement ($p < 0.001$).

The best improvement was seen in the subdomains sports and QoL, while subdomain symptoms improved the least. This was comparable with results of an MPFL reconstruction study with patellar tendon graft of Witoński et al. [35]; however, results pre- and postoperatively were higher in their study. Other studies showed average results postoperatively of 47.65 [17], 74.4 [28], and a more detailed KOOS profile showed higher values for pain, symptoms, ADL, sports and QoL of, respectively, 97, 93, 97, 70 and 81. Sports and QoL were lowest too [35].

Satisfaction rate showed positive findings of the patients. Schöttle et al. [22] found a comparable overall patient satisfaction rate of over 80 %.

When comparing both groups, our study showed a significant improvement of the Kujala and all subdomains of KOOS scores for both groups (see, respectively, Fig. 1a, b).

This was in line with findings in other studies [9, 10]. They noted that the presence of associated patella alta and the need for an associated TTT did not influence the outcome [10].

Evaluating patellar height, this study confirmed only a significant decrease with associated transposition of tuberositas tubercle. Therefore, we could conclude that there is an additional advantage to associate a TTT in the selected patient group. This conclusion was confirmed in the study of Wagner et al. [34].

In our series, severity of trochleodysplasia was not found to influence the outcome. This was also observed by Howells et al. [10] and previously in small series by Schöttle, Fucentese and Romero [22]. However, no further conclusions could be made because patients with severe dysplasia (grade IV) and a need for trochleoplasty were excluded from our study population.

The overall complication rate varies much in different studies depending on the inclusion criteria. Complication rate of 8.5 % was comparable with other studies. Howells et al. [10] described a low complication rate of 3.3 % of which 5.2 % required further surgery. In the review of Shah et al. [26], an overall cumulative complication rate of 26.1 % was noted.

The revision rate of (5/129) 3.9 % in this study was in line with rates mentioned in previously published case series. Rates below 5 % [2], 3.2 % [9] and 2 % [34] were reported.

Our study included patients that underwent MPFL repair without differentiation in indication (primary traumatic or recurrent atraumatic dislocations) in a tertiary referral centre. This might have an impact on the preoperative scores.

Moreover, questionnaires are only a subjective reproduction of their activity state and require an active participation of patients. Some questionnaires were collected by telephone interview and others by post.

Some shortcomings in our radiographic follow-up were CD measurements on X-rays taken the first postoperative day. The decrease in CD index might be less since a loss of tension after ligament reconstruction. This is also stated by Kita et al. [12]. Measures were executed manually. This must be further explored in future.

The clinical results show benefits of an MPFL reconstruction and associated TTT in selected patient groups. According to Matsushita et al. [16], no significant correlations were observed between TT–TG distance and postoperative Kujala. Maybe it can be considered to avoid two cohorts and to test reliability of a single MPFL reconstruction in case of a patella luxation. Because studies describing both isolated MPFL reconstruction and in association with TTT are very scarce up till now, results of this study are very relevant for the orthopaedic world. Moreover, an important strength of this study is the follow-up of a longer period of time and the big sample size.

Conclusion

There can be concluded that a MPFL reconstruction is a reliable and safe technique with a good clinical outcome, a low complication rate and good patient satisfaction. Between a MPFL reconstruction with or without a tuberositas transposition, there was no significant difference in the subjective clinical follow-up. Associated tuberosity osteotomy has demonstrated additional advantages and can be performed in a selected patient group with patella alta. There was no significant association between outcome and severity of trochleodysplasia according to Dejour classification.

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