

Review Article

Excellent Results of Isolated MPFL Reconstruction in Patients with and without High Grade Trochlea Dysplasia

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Abstract

Introduction: Medial patellofemoral ligament (MPFL) reconstruction has become a well-established surgical technique to treat recurrent patellar dislocation. However, no golden standard exists so far to treat a patellofemoral instability. An additive trochleoplasty is recommended for patients with a high-grade trochlear dysplasia, that means a lateral trochlear inclination (LTI) of less than 11°.

The following study was to ascertain if an isolated MPFL reconstruction results in comparable results in patients with and without trochlea dysplasia.

Methods: The study included 43 patients who underwent an MPFL reconstruction with a median age of 25.6 years and a median follow-up of 37.1 months. Patients were assessed by the International Knee Documentation Committee (IKDC), Tegner Activity, Lysholm and the visual analog scale (VAS) scores. On magnetic resonance imaging (MRI) LTI, Caton-Deschamps Index, tibial tuberosity to trochlear groove (TT-TG) distance and tibial tubercle-posterior cruciate ligament (TT-PCL) distance were measured. According to the LTI patients were divided into groups, group 1 with an LTI less than 11° and group 2 above 10°.

Results: The mean LTI of group 1 was 6,1 and 14,4 in group 2. The mean IKDC subjective score was 82 in group 1 and 81.6 in group 2. The mean Lysholm score was 84 in group 1 and 86 in group 2. Comparing the level of activity before and after the operation with the Tegner score showed that it was the same or even higher in 89% of all patients in group 1 and 92% in group 2.

The mean VAS score was 2 (range 0-7) in group 1 and 1.6 (range 0-5) in group 2.

77.8 % in group 1 were satisfied or very satisfied, whereas 92% in group 2 were satisfied or very satisfied. One patient in group 1 had a recurrent dislocation and one patient in group 2 had a subluxation postoperatively.

Conclusion: Patients with patellofemoral instability and a trochlea dysplasia achieved excellent results after an isolated MPFL reconstruction comparable to those without trochlea dysplasia. Thus, it seems that the MPFL can partially compensate the dysplasia. Therefore, the indication for a trochleoplasty should not just be according to radiological measures.

ABBREVIATIONS

MPFL: Medial Patellofemoral Ligament; LTI: Lateral Trochlea Inclination; ROM: Range of motion; IKDC: International Knee Documentation Committee Subjective Knee Evaluation Score; VAS: Visual Analogue Scale; TT-TG distance: Tibial-Tuberosity to Trochlear Groove distance; TT-PCL distance: tibial Tubercle-Posterior Cruciate Ligament distance; MRI: Magnetic Resonance Image

INTRODUCTION

Patella dislocation is a common pathology and tends to affect especially young, active adolescent females [1,2]. Mostly the first patellar dislocation occurs before the second decade of life prevalently under the age of 16 [3].

There are passive, static and dynamic stabilizers of the patella. The main stabilizer (up to 90%) in early extension between 0° to 20° flexion of the patella, is the medial patellofemoral ligament

(MPFL), which is a passive stabilizer [4,5]. At a flexion between 20° to 60°, the lateral trochlear facet provides stability of the patella as a static stabilizer. The more the knee is flexed the steeper becomes the trochlea groove [5].

Acute patellar dislocation is usually associated with a significant trauma such as a fall or an impact injury, which leads to a lateral displacement of the patella [6]. However, atraumatic dislocations are often due to predisposing factors including functional and morphological patellofemoral disorders such as patella alta, trochlea dysplasia, increased patella tilt, increased distance between the trochlear groove and the tibial tuberosity, genu valgum and ligament laxity [7-11].

The recurrence rate following a first-time dislocation is 44% [12]. This is due to the fact that 90% of all first-time patella dislocations have an insufficient or torn MPFL [13,14]. Previous studies have shown that torn or insufficient MPFL results in a lateral riding patella. Even a few millimetres more lateral riding of the patella than normal can cause a significant difference [15].

Several surgical techniques for treating patella tracking disorders including the loosening or tightening of stabilizing ligaments as well as the reconstruction of the medial patellofemoral ligament (MPFL) have been described [5]. Medial patellofemoral ligament (MPFL) reconstruction has become a widely used technique to treat patellofemoral instability. Several studies have shown excellent results of this technique [16,17]. However, in patients with severe dysplasia of the trochlea the results were less favourable and the failure rate was higher [18].

96% of all patients with instability of the patellofemoral joint have a flattened or deformed trochlea, known as a trochlear dysplasia, as an underlying cause [19]. In these patients deepening of the trochlea groove known as trochleoplasty has been advised as an additional procedure to MPFL reconstruction. The lateral trochlea inclination (LTI) angle (Figure 1) seems to be an objective parameter for the evaluation and quantification of trochlea dysplasia [20,14]. Furthermore, the LTI besides the Insall-Salvati ratio has been shown as the best predictor of lateral patella displacement and lateral tilt [21].

Accordingly, the aim of this study was to evaluate the clinical outcomes after an isolated MPFL reconstruction in patients with or without high-grade trochlear dysplasia.

MATERIALS AND METHODS

This study was approved by the medical review board of the University of Witten/ Herdecke (trial number 129/2017) and informed consent was obtained from all subjects.

The present study included 43 patients with objective patellofemoral instability. 25 of these patients had more than two patella re-dislocations and 13 had even more than four patella re-dislocations. 22 patients were female and 21 males, with a median age of 25.6 years. They were all operated by the same surgeon in the same surgical technique.

Surgical technique

MPFL reconstruction included a knee arthroscopy and minimal invasive open approach to the patella. First, a diagnostic arthroscopy was performed to evaluate the patellofemoral joint

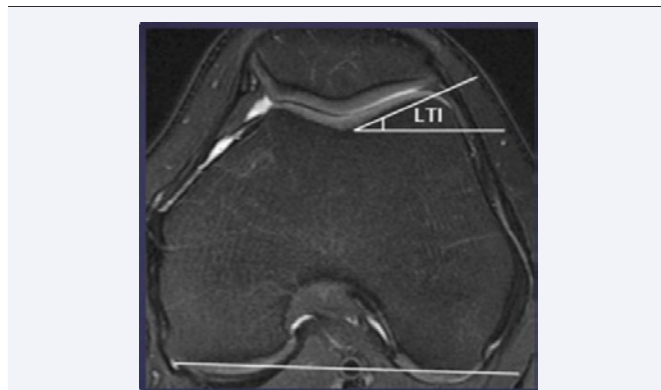


Figure 1 Lateral trochlea inclination (LTI) angle.

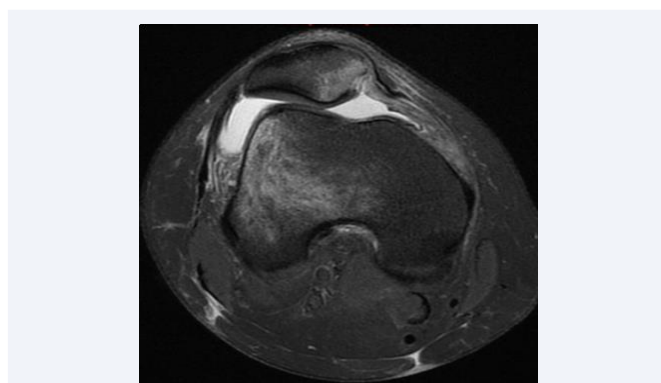


Figure 2 MRI scan showing lateralisation of the patella after patella dislocation.

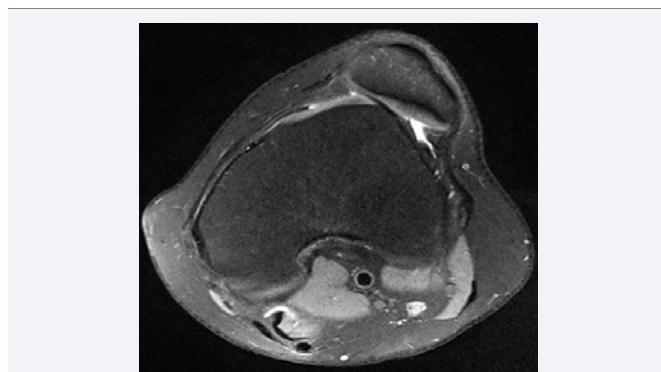


Figure 3 MRI scan showing subluxation of the patella with a trochlea dysplasia.

articulation with respect to a lateralisation or subluxation of the patella (Figures 2,3) or any other joint pathology such as chondral lesions. Patients with a trochlea dysplasia at 30° knee flexion during arthroscopy were regarded as an indication for a trochleoplasty and were not subject of the present study.

Then the MPFL was reconstructed in an anatomic double-bundle technique to replicate the native shape of the ligament and to provide sufficient stability. The gracilis tendon of the ipsilateral side was harvested and sutured at both ends. Both ends of the graft were then fixated with two 4.75mm BioComposite

SwiveLock screws (Arthrex) in the proximal third of the medial side of the patella. The graft was then fixed with a 6mm BioComposite interference screw at the anatomic femoral origin of the MPFL, known as the Schöttle point [28]. The Schöttle point provides a static fixation point that equalizes the tension across the graft in flexion and extension. During the femoral fixation the knee was flexed at 30 degrees and the patella joint articulation was checked arthroscopically (Figures 4-6).

Rehabilitation following MPFL reconstruction

Post-operative care involved partial weight-bearing for 2 weeks and then gradually increasing the weight-load on the operated leg until full weight bearing was reached. The most important criteria were being pain free during weight bearing.

Additionally, all patients wore a posterior extension splint for 1 week, followed by wearing a knee brace with a flexion limitation to 90 degrees for 6 weeks. At the same time, this was supported by a physiotherapy/rehabilitation program to increase strength, improve coordination of the operated leg and achieve a good range of motion. From the 7th postoperative week onwards, free ROM was allowed and cycling on a stationary bike followed by outdoor cycling and slow running.

All patients were followed-up after an average of 37.1 month postoperatively. They completed post-operative outcome scores, including International Knee Documentation Committee Subjective Knee Evaluation Score (IKDC) [22], Tegner activity

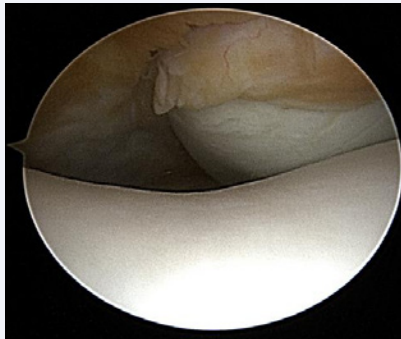


Figure 4 Patella lateralisation from an arthroscopic view.

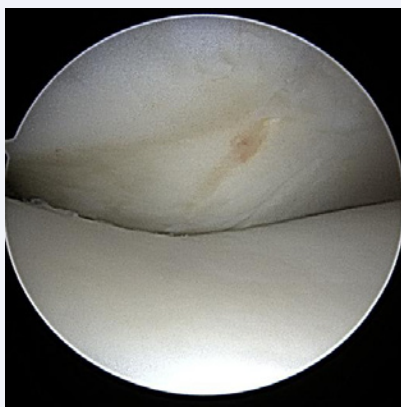


Figure 5 Arthroscopic view after femoral fixation of the MPFL.

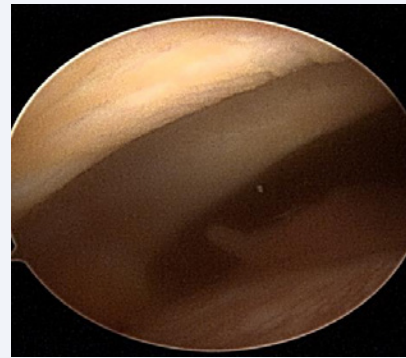


Figure 6 Double bundle technique from an arthroscopic view.

and Lysholm scores [23,24] as well as visual analogue scale (VAS) [25].

Additionally, the Caton-Deschamps Index [26], tibial-tuberosity to trochlear groove distance (TT-TG distance) [27], tibial tubercle-posterior cruciate ligament distance (TT-PCL distance) [28], and LTI [29], were measured on preoperative MRI scans.

The LTI was measured on the most proximal axial magnetic resonance image (MRI) of the trochlear chondral surface with respect to the angle of the posterior condyles (Figure 1) [16].

According to the LTI patients were divided into two groups, group 1 with an LTI below or equal 10° ($\leq 10^\circ$) and group 2 greater than 10° ($>10^\circ$).

Statistical analysis

The two groups were compared semi-quantitatively and statistically. Interval scaled variables were measured on a normal scale and independent random samples were compared using t-test for normally distributed data. The Mann-Whitney-U-Test was used for non-normally distributed data. The groups were compared of the ordinal variables such as the lickert-scale with a Mann-Whitney-U-Test.

The statistical tests to compare both groups used are the chi-square test, at a fourfold schematic stem with the exact Fisher's test. All tests were evaluated at the significance level of 5%.

The Tegner activity score showed normally distributed data and was seen as an interval scaled variable, all three different time points were compared between the two study groups using two-way analysis of variance (ANOVA) with repeat measurements. To account alpha mistakes the Bonferroni-correction was used at the Post-Hoc-Test.

RESULTS

The median follow-up was 3.2 years in group 1 ($LTI \leq 10^\circ$) and 2.8 years in group 2 ($LTI >10^\circ$). In group 1 there were 11 females and 7 males with a median age of 25.3 years. In group 2 there were 11 females and 14 males with a median age of 27.7, years. The mean BMI was 23.7 in group 1 and 24.0 in group 2 ($p= 0.82$). The median LTI in group 1 was 6.1° (range 0.1-9.9) and 14.4° in group 2 (range 10.7-23.0).

One patient in group 1 had a recurrent patellar dislocation and one patient of group 2 had a patellar subluxation after the MPFL reconstruction. This represents a success rate of 95%.

The mean IKDC subjective score was 82 in group 1 (minimum score 49 and maximum score 99) and 81.6 in group 2 (minimum score 46 and maximal score 100) ($p= 0.73$). The mean Lysholm score was 84 in group 1 and 86 in group 2. The difference for both scores was statistically not significant between the two groups ($p= 0.51$) (Figure 7).

In group 1 the mean VAS score was 2, with a range of VASmin 0 to VASmax of 7. In group 2 the mean VAS score was 1.6, with a range of VASmin 0 and VASmax 5 (Figure 8).

Thus, the three most important results of both groups were comparable.

The analysis of the Lysholm score showed that group 2 had more excellent (24%) results than group 1 (5.5%). In group 1, 55.5% had good, 33% fair and 5.5% poor results. Similarly, in group 2 44% had good, 24% fair and 8% poor results.

The Tegner activity score showed a significant difference at the different time periods: preinjury the mean was 6.39 ± 0.28 points; preoperatively the mean was 3.25 ± 0.43 points whereas at the time of examination it was 5.43 ± 0.30 points ($p<0.001$). However, there was no significant difference between both groups (Figure 9). Overall group 1 showed a slightly higher score compared to group 2 at all time periods. In group 1 the Tegner score was 6.8 preoperatively and 5.6 at the time of examination,

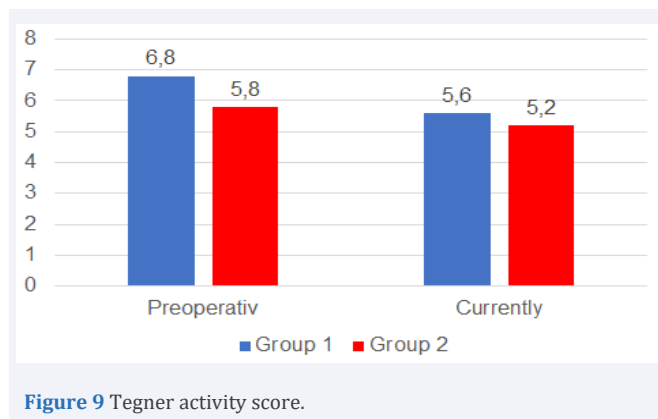


Figure 9 Tegner activity score.

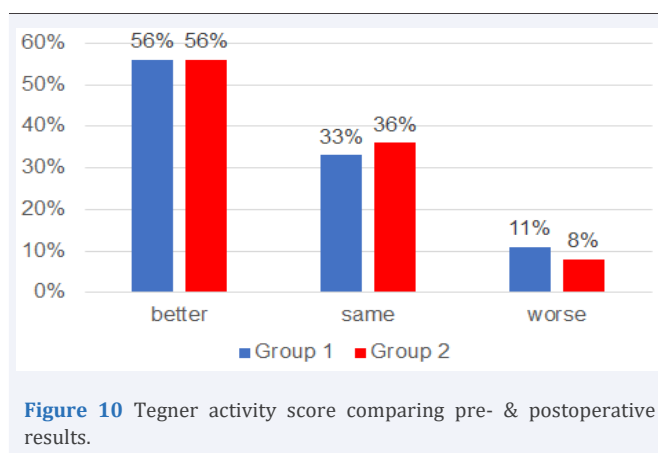


Figure 10 Tegner activity score comparing pre- & postoperative results.

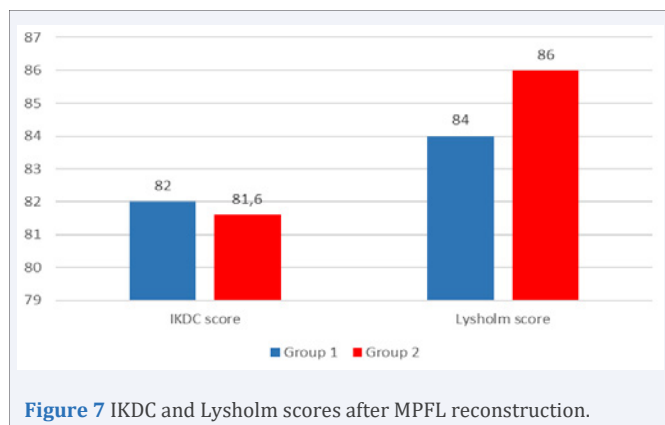


Figure 7 IKDC and Lysholm scores after MPFL reconstruction.

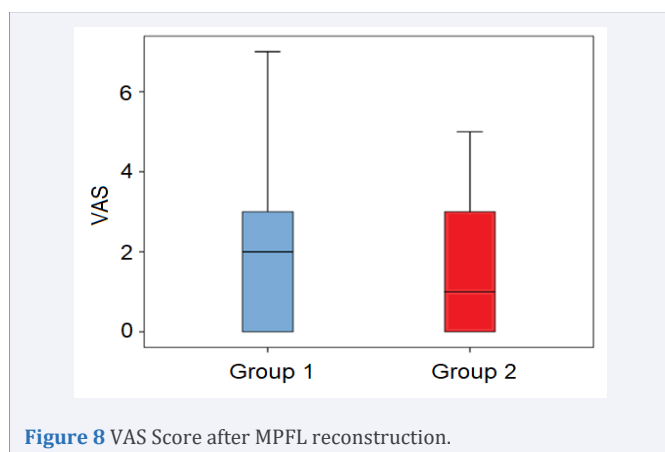


Figure 8 VAS Score after MPFL reconstruction.

whereas in group 2 preoperatively 5.8 and 5.2 at the time of examination (Figure 9).

89% of patients in group 1 and 92% of patients in group 2 had an equal or even better level of activity when comparing the Tegner activity score before and after surgery (Figure 10).

77.8 % in group 1 and 92% in group 2 were satisfied or very satisfied with the operation ($p= 0.3$).

In group 1 there were two patients and in group 2 three patients with a mean TT-TG distance of more than 15mm. Two patients of group 1 had a mean TT-PCL distance higher than 24 mm, whereas only one patient in group 2 exceeded a TT-PCL distance of 24mm ($P 0.03$). Likewise, the mean Carton-Deschamps-Index was significantly higher in group one. In seven MRI scans it was greater than 1.2 in group 1 and in only five MRI scans in group 2 it was greater than 1.2 ($P 0.45$).

DISCUSSION

The most important finding of the current study was that isolated MPFL reconstruction for patello-femoral instability was successful not only in patients without trochlea dysplasia but also in those with significant trochlea dysplasia defined as a lateral trochlea inclination (LTI) of 10° or less. This is in contrast to the current literature.

Isolated MPFL reconstruction has shown excellent results for patients with recurrent patella dislocation [17]. However, in case of trochlea dysplasia the failure rate is increasing. Kita et al.,

found that trochlea dysplasia was the most important predictor of residual instability following isolated MPFL reconstruction [30]. Wagner et al., showed that patients with grade III trochlea dysplasia according to Dejour had a worse outcome than patients with type I and II [31]. Feucht et al., analysed 26 patients who failed after isolated MPFL reconstruction. They found a trochlea dysplasia as the most common anatomical risk factor for failure in 50% of patients [32]. Nelitz et al., found in their study of failed MPFL reconstructions that 5 out of 6 patients with recurrent instability had a trochlea dysplasia [33].

One problem in the indication for surgery is the quantification of trochlea dysplasia and the question which parameter is most appropriate to indicate trochleoplasty. Most of the aforementioned studies used the Dejour classification for the assessment of trochlea dysplasia. Some authors define type B, C and D as severe trochleas dysplasia [34], while in other studies only type C and D are regarded as high grade dysplasia [35,36]. Lippacher et al. found that the Dejour classification has shown a low inter- and intra-observer agreement for the discrimination of the four types [34]. They concluded that it was only useful for the separation of low-grade and high-grade dysplasia. Stefanik et al., examined several parameters to describe the morphology of the trochlea and found that the LTI besides the Insall-Salvati ratio was the best predictor lateral patella displacement and lateral tilt [21]. Nelitz et al., analysed 80 knees and correlated the Dejour classification with objective parameters of trochlea dysplasia (lateral trochlea inclination and others). They found a moderate inter- and intraobserver agreement especially in high grade dysplasia. Patients with dysplasia type A according to Dejour showed an LTI of 15°, type B of 11°, type C of 7° and type D of 1°. 75% of the patients with high grade dysplasia showed an LTI of less than 11°, whereas 84% of patients with a low-grade dysplasia had an LTI of 11° or more [21]. Thus, the cut-off of 11° stated by Carrillon et al., who first described the LTI was confirmed [4].

Due to these results the current study used the LTI with a cut-off value of 11° to objectively quantify trochlea dysplasia. Patients with and without high grade trochlea dysplasia had no difference in the IKDC and Lysholm score and in the pain level (VAS). The Tegner score was even slightly better in patients with trochlea dysplasia (5.6 vs 5.2 in patients without dysplasia). The re-dislocation rate as the most important parameter of success was similar in both groups with one re-dislocation in patients with and one subluxation in the group without trochlea dysplasia. In the study of Hiemsta et al., 61.5% of failed MPFL reconstructions had a high-grade trochlea dysplasia. However also 52.7% of the 243 intact reconstruction had a high-grade dysplasia defined as a type B, C or D dysplasia according to Dejour [12]. Thus, trochlea dysplasia is a common accompanying pathology in patients with patella-femoral instability. We suppose that the MPFL reconstruction can partially compensate a trochlea dysplasia.

In the subgroup analysis of the Lysholm score patients with and without trochlea dysplasia both showed comparable numbers of excellent and good results (61% vs. 68%). However, patients with trochlea dysplasia had less excellent results (5.5%) than those without dysplasia (24%). Although the difference was not statistically significant the number of satisfied or very satisfied patients with trochlea dysplasia was 15% less than in patients without dysplasia (77.5% vs. 92%).

The current study has some limitations. First it is a retrospective case series with no prospective randomisation of the two groups. Second patellofemoral instability is a common pathology, but the sample size is relatively small. Third patellofemoral instability is a multifactorial pathology, but the results were only interpreted in terms of trochlea dysplasia.

CONCLUSION

In summary an isolated MPFL reconstruction can restore stability of the patellofemoral joint and lead to excellent clinical results despite an underlying high grade trochlear dysplasia (LTI $\leq 10^\circ$). In patients with trochlea dysplasia the rate of satisfied or very satisfied patients as well as the rate of patients with an excellent result in the Lysholm score may be slightly lower than in the group without dysplasia with otherwise comparable results between the two groups. Radiological measures like the lateral trochlea inclination are helpful to evaluate trochlea dysplasia but should not be used as the main criterion to indicate trochleoplasty.

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