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Medial Patellofemoral Ligament Reconstruction with and without Tibial Tubercle Osteotomy in Patellofemoral Instability Surgery: Clinical Outcomes

Patellofemoral İnstabilite Cerrahisinde Tibial Tüberkül Osteotomisi ile ve Osteotomisiz Medial Patellofemoral Ligament Rekonstrüksiyonu: Klinik Sonuçlar

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ABSTRACT

Objective: The aim of this study was to evaluate the clinical outcomes of medial patellofemoral ligament (MPFL) reconstruction with and without tibial tubercle osteotomy (TTO) in patellofemoral instability surgery.

Methods: Between January 2020 and January 2025, 23 patients who underwent surgery for recurrent patellar dislocation due to patellofemoral instability, were retrospectively evaluated. Seventeen patients over 18 years of age, without any additional injuries, who had not undergone any surgery other than MPFL reconstruction ± TTO, with at least 12 months of follow-up, were included in the study. Twelve patients underwent MPFL reconstruction (Group 1), while five patients underwent MPFL reconstruction combined with TTO (Group 2). Demographic data of the patients were recorded. Clinical outcomes were assessed using Kujala, Lysholm, and IKDC 2000 scores, as well as visual analog scale (VAS).

Results: Of the patients included in the study, 11 were female (65%) and 6 were male (35%), with a median age of 22 years (18-39 years), body mass index of 25.3 (18.2-32.5), and follow-up duration of 32 months (15-150 months). Comparison of preoperative and postoperative clinical scores demonstrated significant improvement in Kujala, Lysholm, and IKDC 2000 scores in both groups ($p<0.001$), along with a significant decrease in VAS scores ($p<0.001$).

Conclusion: MPFL reconstruction with or without TTO provides satisfactory outcomes in patellofemoral instability surgery. This reconstructive procedure may be considered an effective treatment option for recurrent patellar dislocation and can be combined with TTO in appropriate cases.

Keywords: Medial patellofemoral ligament, reconstruction, tibial tubercle osteotomy, patellar instability

ÖZ

Amaç: Bu çalışmanın amacı; patellafemoral instabilite nedeniyle tibial tüberkül osteotomisi (TTO) ile birlikte veya osteotomisiz medial patellofemoral ligament (MPFL) rekonstrüksiyonu yapılan hastaların klinik sonuçlarını değerlendirmektir.

Yöntem: Ocak 2020 ile Ocak 2025 yılları arasında patellafemoral instabiliteye bağlı tekrarlayan patella çıkığı nedeniyle ameliyat edilen 23 hasta retrospektif olarak incelendi. En az 12 aylık takibi olan, 18 yaş üstü, ek yaralanması olmayan ve MPFL rekonstrüksiyonu ± TTO harici bir cerrahi uygulanmamış olan 17 hasta çalışmaya dahil edildi. On iki hastaya MPFL rekonstrüksiyonu (Grup 1), 5 hastaya MPFL rekonstrüksiyonu ile birlikte TTO (Grup 2) uygulanmıştı. Hastaların demografik verileri kayıt altına alındı. Klinik sonuçlar Kujala, Lysholm ve IKDC 2000 skorları ile görsel analog skala (VAS) kullanılarak değerlendirildi.

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Bulgular: Çalışmaya dahil edilen hastaların; 11'i kadın (%65), 6'sı erkek (%35), median yaş 22 yıl (aralık;18-39 yıl), vücut kitle indeksi 25,3 (aralık;18,2-32,5), ve takip süresi 32 aydı (aralık;15-150 ay). Hastaların ameliyat öncesi ve sonrası klinik skorları karşılaştırıldığında her iki grubun da Kujala, Lysholm ve IKDC 2000 skorlarında anlamlı yükselme/iyileşme (p<0,001), VAS skorlarında ise anlamlı düşme/düzelme izlendi (p<0,001).

Sonuç: Patellafemoral instabilite cerrahisinde MPFL rekonstrüksiyonu ± TTO tatminkâr sonuçlara sahiptir. Bu rekonstrüksiyon cerrahisi tekrarlayan patellar çıkık olgularında etkin bir tedavi seçeneği olarak değerlendirilebilir ve uygun olgularda TTO ile kombine edilebilir.

Anahtar Kelimeler: Medial patellofemoral ligament, rekonstrüksiyon, tibial tüberkül osteotomisi, patellar instabilite

INTRODUCTION

Recurrent patellar dislocation secondary to patellofemoral instability is common and is associated with medial patellofemoral ligament (MPFL) injury in approximately 90% of cases.[1] The MPFL is the primary restraint preventing lateral displacement of the patella between 0° and 30° of knee flexion; it is compromised in nearly 90% of dislocations.[2] Patients with recurrent patellar dislocation frequently present with underlying pathoanatomical abnormalities that predispose them to patellofemoral instability.[3,4] These abnormalities include lower extremity malalignment syndromes such as trochlear dysplasia and tibial external rotation, as well as osseous anomalies such as patella alta.[5-7] Most patients harbor more than one of these pathoanatomical risk factors.[6-8] The recurrence rate following a primary dislocation ranges from 17% to 69%.[1]

Given its multifactorial etiology, the management of recurrent patellar dislocation due to patellofemoral instability can be challenging. In recent years, there has been a growing interest in MPFL reconstruction for the surgical treatment of recurrent patellar dislocation.[2] Indeed, MPFL reconstruction has increasingly become the surgical technique of first choice for many surgeons.[9] However, in certain cases, concomitant osseous malalignment may render isolated MPFL reconstruction insufficient. In such patients, additional corrective procedures may be required.[10,11] Among these, tibial tubercle osteotomy (TTO) is the most commonly performed.[10]

The aim of this study is to evaluate the clinical outcomes of patients undergoing MPFL reconstruction with and without concomitant TTO for recurrent patellar dislocation.

METHODS

This retrospective study was approved by the İzmir Katip Çelebi University Health Research Institutional Review Board (decision no: 0037, date: 16.01.2025). Due to its retrospective design, informed consent from patients and healthcare providers was not required.

Patient Inclusion

Between January 2020 and January 2025, 23 patients who underwent surgery for recurrent patellar dislocation were retrospectively analyzed. Exclusion criteria were: having undergone other surgical procedures such as isolated medial plication, being under 18 years of age, having a follow-up period of less than 12 months, having concomitant injuries in the ipsilateral lower extremity, or undergoing additional surgical interventions including trochleoplasty, anterior cruciate ligament reconstruction, or meniscus repair. Seventeen patients who did not meet these criteria were included in the study. Twelve patients underwent isolated MPFL reconstruction, while five patients underwent MPFL reconstruction combined with TTO.

Evaluation of Patients

Clinical outcomes were assessed using the Kujala score, Lysholm score, visual analog scale (VAS), and the International Knee Documentation Committee Subjective Knee Form (IKDC 2000).

The IKDC 2000 score is a patient-reported outcome measure that evaluates knee-related symptoms, daily activities, and sports function. As it reflects patients' own experiences, it is considered a reliable and valid tool for both clinical studies and follow-up. Scores range from 0 to 100, with higher scores indicating better knee function.[12]

The Kujala score is a patient-based questionnaire developed to assess patellofemoral disorders and anterior knee pain. It includes parameters related to pain, function, walking, stair climbing, and kneeling. The total score ranges from 0 to 100, with higher scores reflecting better knee function.[13]

The Lysholm score is a questionnaire used to evaluate clinical outcomes after knee surgery. It comprises eight parameters, including pain, instability, locking, swelling, stair climbing, and daily activities. The total score ranges from 0 to 100, with higher scores indicating better knee function and patient satisfaction.[14]

The VAS score is used to assess patients' pain levels. For this purpose, a 10-cm VAS ruler was employed, with the left end marked as "no pain" (0 cm) and the right end marked as "very severe pain" (10 cm). Patients were asked to indicate the point on the ruler that best represented their pain intensity.

In patients who underwent TTO, bone union was evaluated using plain radiographs.

Surgical Technique and Follow-up Protocol

All procedures were initiated with routine arthroscopic examination. In patients with arthroscopically confirmed lateral patellar tightness (9/17), lateral release was performed using radiofrequency ablation. MPFL reconstruction was performed with a free autologous gracilis tendon graft. After graft harvesting, a 2-cm medial mini-incision was made over the patella, and two sockets with a depth of 1 cm were created using a 3.2-mm drill bit. The position of the sockets was verified under fluoroscopy (Figure 1a). The graft was pulled into the sockets and fixed with two 3.5-mm non-absorbable suture anchors. Subsequently, a 2-cm medial incision was made over the medial epicondyle, and a guide wire was advanced under fluoroscopic guidance from the isometric point near the medial femoral epicondyle, as described in previous studies (Figure 1b).[15] If the tibial tubercle-trochlear groove (TT-TG) distance exceeded 20 mm, tibial tubercle anteromedialization was performed as described by Fulkerso [16] (Figure 2a). For TTO, a paramedial skin incision was made to expose the patellar tendon and tibial tubercle. Vertical and longitudinal step-cut osteotomies were performed, blending into the anterior cortex of the tibia. The bone block was then corrected depending on the required distal transfer and medialized according to the TT-TG distance. Finally, the tubercle was fixed with two or three 4.0-mm cancellous screws (Figure 2b).

In patients who underwent isolated MPFL reconstruction, weight-bearing as tolerated was allowed with the knee immobilized at 60° of flexion for the first 3 weeks. After 3 weeks, flexion restriction was removed and strengthening exercises were initiated. In patients who underwent TTO, no weight-bearing was permitted and flexion was limited to 60° for the first 4 weeks. After 4 weeks, partial weight-bearing and mobilization were initiated, and strengthening exercises were started with unrestricted flexion.

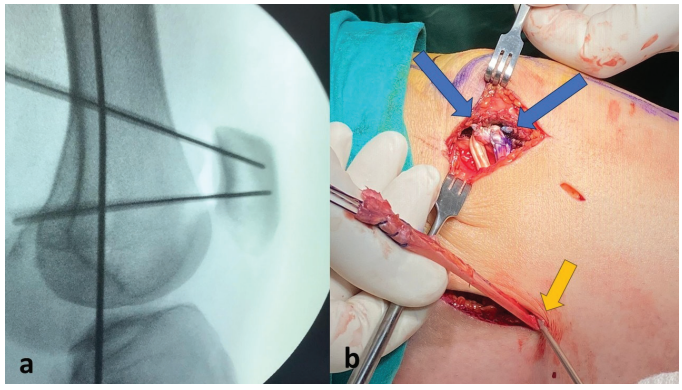

Figure 1. a) Fluoroscopic control of the patellar suture anchor placement using a K-wire. b) Gracilis tendon fixation with two suture anchors (blue arrows) and a guide wire (yellow arrow) for isometric femoral epicondyle fixation of the tendon

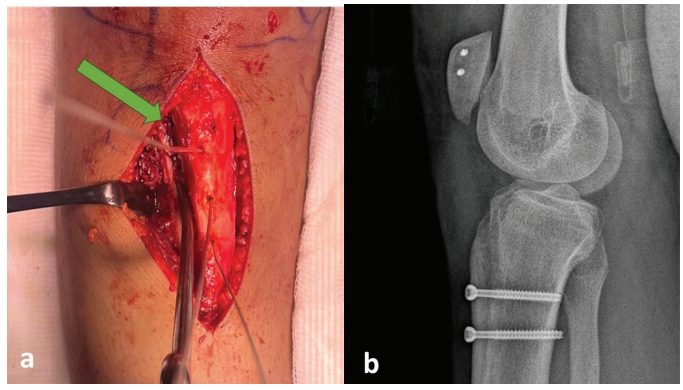

Figure 2. a) Medial and anterior transfer of the tibial tubercle after osteotomy (green arrow) and fixation with guide wires. b) Radiographic image of the tibial tubercle osteotomy line in the second postoperative year

Statistical Analysis

Data analysis was performed using IBM SPSS version 26. The suitability of continuous variables to a normal distribution was tested with the Shapiro-Wilk test. As the data were non-normally distributed, non-parametric tests were used. The Mann-Whitney U test was employed for comparisons between independent groups, while the Wilcoxon signed-rank test was applied for repeated measurements. Distribution of categorical variables was analyzed using Pearson's chi-squared test or Fisher's exact test. A type I error margin of α=0.05 was set, and all tests were performed two-tailed.

RESULTS

The median age of the 17 patients included in the study was 22 years (range: 18-39 years), with a median follow-up period of 32 months (range: 15-150 months). The median body mass index was 25.3 (range: 18.2-32.5). Eleven patients (65%) were female, and six (35%) were male. Nine patients (53%) underwent arthroscopic lateral release (Table 1).

When preoperative and postoperative clinical scores of all patients were evaluated, a significant improvement was observed (Table 2). The median Kujala score improved from 56 (range: 48-64) preoperatively to 84 (range: 78-90) at the final follow-up ($p<0.001$). Similarly, the median IKDC 2000 score increased from 66 (range: 50-78) to 86 (range: 82-92), showing a significant difference ($p<0.001$). The median Lysholm score improved from 50 (range: 48-60) to 90 (range: 80-96), which was statistically significant ($p<0.001$). The median VAS score decreased significantly from 6 (range, 4-8) preoperatively to 0 (range, 0-4) postoperatively ($p<0.001$) (Table 2).

When comparing patients (n=12, Group 1) who underwent isolated MPFL reconstruction with those (n=5, Group 2) who

underwent MPFL reconstruction combined with TTO, both groups demonstrated improvement in knee scores, but no statistically significant difference was detected between the groups (p>0.05). Similarly, VAS scores improved in both groups, with no significant intergroup difference (p>0.05) (Table 2).

All patients who underwent TTO achieved bone union, with a median bone union time of 12 weeks (range: 8-16 weeks). One patient developed screw head irritation, which required hardware removal at 30 weeks, after confirmed bone union. Another patient experienced recurrent dislocation and underwent revision MPFL reconstruction with a palmaris longus tendon autograft at 12 months postoperatively. No cases of infection, wound complications, deep vein thrombosis, or osteotomy union problems were observed.

Table 1. Demographic and clinical data of patients

	Total (n=17)	**Group 1 (n=12)**	**Group 2 (n=5)**	**p**
Age (year), Med. (min; max)	22 (16;39)	21.5 (16;39)	23 (22;24)	0.489[U]
BMI Med. (min;max)	25.3 (18.2;32.5)	23.65 (18.2;32.5)	27.3 (23.7;31.7)	0.065[U]
Follow-up (mounth), Med. (min; max)	32 (15;150)	43 (15;150)	24 (15;32)	**0.020[U]**
Sex, n (%)				
Female	11 (65%)	8 (67%)	3 (60%)	1.000[¥]
Male	6 (35%)	4 (33%)	2 (40%)	
Side, n (%)				
Right	8 (47%)	4 (33%)	4 (80%)	0.131[¥]
Left	9 (53%)	8 (67%)	1 (20%)	
Lateral release, n (%)				
Yes	9 (53%)	4 (33%)	5 (100%)	**0.029[¥]**
No	8 (47%)	8 (67%)	0 (0%)	

[¥]: Fisher's exact test, [U]: Mann-Whitney U test, Med: Median, Min: Minumum, Max: Maximum, BMI: Body mass index

Table 2. Comparison of clinical scores of patients

		Total (n=17)	**Group 1 (n=12)**	**Group 2 (n=5)**	**p[U]**
		Med. (min;max)	**Med. (min;max)**	**Med. (min;max)**	
Kujala	Preop	56 (48;64)	56 (48;64)	52 (50;62)	0.133
	Postop	84 (78;90)	82 (78;90)	86 (78;88)	0.789
	[Δ]Med. (min;max)	26 (16;40)	26 (16;40)	32 (26;36)	0.118
	p[w]	**<0.001**	**0.002**	**0.041**	
Lysholm	Preop	50 (48;60)	54 (48;60)	50 (50;52)	0.162
	Postop	90 (80;96)	90 (80;96)	90 (86;96)	0.872
	[Δ] Med. (min;max)	38 (20;46)	38 (20;46)	40 (36;46)	0.425
	p[w]	**<0.001**	**0.002**	**0.041**	
IKDC 2000	Preop	66 (50;78)	64 (50;72)	66 (56;78)	0.672
	Postop	86 (82;92)	86 (82;92)	86 (84;90)	0.788
	[Δ]Med. (min;max)	22 (12;36)	23 (12;36)	22 (12;30)	0.491
	p[w]	**<0.001**	**0.002**	**0.043**	
VAS	Preop	6 (4;8)	6 (4;8)	4 (4;8)	0.360
	Postop	0 (0;4)	1 (0;4)	0 (0;2)	0.634
	[Δ]Med. (min;max)	-4 (-6;-2)	-5 (-6;-2)	-4 (-6;-4)	0.562
	p[w]	**<0.001**	**0.002**	**0.034**	

[U]: Mann-Whitney U test, [w]: Wilcoxon signed ranks test, [Δ]: The amount of postoperative change in score value, Med: Median, Min: Minumum, Max: Maximum, Preop: Preoperative, Postop: Postoperative, VAS: Visual analog scale, IKDC: International knee documentation committee subjective knee form

DISCUSSION

In this study, satisfactory outcomes were obtained in patients who underwent MPFL reconstruction due to recurrent patellar dislocation associated with patellofemoral instability. Clinical scores significantly improved during the postoperative period, and no statistically significant differences were observed between patients who underwent isolated MPFL reconstruction and those who underwent MPFL reconstruction combined with TTO. Significant improvements were observed in all patients' postoperative Kujala, IKDC 2000, and Lysholm scores, while VAS pain scores showed a notable decrease. These results suggest that this technique is effective in enhancing patellofemoral stability and improving patients' functional capacity.

Systematic reviews and meta-analyses specifically addressing this topic indicate that whether MPFL reconstruction is performed alone or in combination with TTO, functional outcomes are generally favorable, and recurrent instability/dislocation rates are low in both techniques.[17,18] Su et al.[18] reported that although recurrent instability rates were similar in patients undergoing MPFL reconstruction with, and without TTO, the mean Kujala score was slightly higher in the isolated MPFL group. In our study, clinical scores were similar in both groups; however, one patient in the MPFL reconstruction with TTO group required revision surgery due to recurrent dislocation. We attribute this to the higher baseline instability in patients undergoing TTO and the increased complexity of the surgical procedure, which may pose challenges during postoperative rehabilitation. Patients undergoing TTO have an increased TT-TG distance, indicating advanced and more complex instability. Moreover, the addition of TTO renders the surgical procedure more complex, and considerations such as waiting for bone union after osteotomy further complicate postoperative follow-up and rehabilitation. Consequently, these patients may be at a higher risk for recurrent dislocation during the postoperative period. Therefore, both the surgeon and the patient must exercise considerable patience and maintain strict control throughout the follow-up and rehabilitation process to achieve a successful and satisfactory outcome.

When reviewing the relevant literature, some studies have reported that patients undergoing MPFL reconstruction with TTO may experience slightly higher rates of surgical complications, particularly related to TTO, such as joint stiffness, implant irritation, and the need for reoperation.[19] In our study, no patient experienced infection, wound dehiscence, deep vein thrombosis, or osteotomy union problems. However, one patient in the TTO group required implant removal due to screw head irritation. We attribute this to the thin skin and subcutaneous fat over the anterior tibial surface. This weakness is particularly pronounced in lean male patients, making the screw heads easily palpable postoperatively. Therefore, patients of this type should be explicitly warned that they may experience discomfort from implant irritation during activities such as kneeling, which could necessitate a secondary procedure (implant removal). Such complications can lead to patient dissatisfaction. In these cases, the surgeon may also consider the use of headless screws as an alternative. To achieve a successful outcome, the surgeon must select an appropriate surgical technique and manage the postoperative process in a controlled manner, maintaining open communication with the patient and proactively addressing potential risks such as screw head irritation.

Study Limitations

This study has some limitations. The most significant of these are its retrospective design and the relatively small sample size. Another limitation is that the study was not conducted on a homogeneous cohort, and there was no control group. However, despite these limitations, the follow-up period ranging from 15 to 150 months allows for preliminary insights into the mid- to long-term outcomes and this could be considered a major strength of the study. In the future, prospective randomized studies on larger, homogeneous patient groups will provide more concrete data.

CONCLUSION

Both isolated MPFL reconstruction and MPFL reconstruction combined with TTO are effective techniques in the surgical management of recurrent patellofemoral dislocation and instability. Satisfactory clinical and functional outcomes can be achieved with either approach. However, it should be noted that isolated MPFL reconstruction may not always be sufficient without patient-specific patoanatomical evaluation. Therefore, preoperative assessment of bony morphological abnormalities and, when appropriate, combining soft tissue procedures with osteotomy is a critical component of a comprehensive surgical strategy.

Ethics

Ethics Committee Approval: This study was approved by the İzmir Katip Çelebi University Health Research Institutional Review Board (decision number: 0037, date: 16.01.2025).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: M.T., Concept: Y.Ö., M.T., Design: Y.Ö., M.T., T.B., Data Collection or Processing: Y.Ö.,

M.T., Analysis or Interpretation: Y.Ö., M.T., Literature Search Y.Ö., M.T., T.B., Writing: Y.Ö., M.T., T.B.

Conflict of Interest: No conflict of interest was declared by the authors.

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