ACTA ORTHOPAEDICA et TRAUMATOLOGICA TURCICA
www.aott.org.tr

Case Report

Medial patellofemoral ligament reconstruction in osteogenesis imperfecta using quadriceps tendon graft: a rare case report

Tayfun Özel[1], Mehmet Ali Tokgöz[2]

[1]*Department of Orthopedics and Traumatology, Ankara Training and Research Hospital, Ankara, Türkiye*
[2]*Department of Orthopedics and Traumatology, Gazi University Hospital, Ankara, Türkiye*

ARTICLE INFO

Article history:
Submitted December 29, 2025
Received in revised form
February 2, 2026
Last revision received from
May 18, 2026
Accepted July 28, 2026
Publication Date
September 21, 2026

Keywords:
Medial patellofemoral ligament reconstruction
Osteogenesis imperfecta
Patellar dislocation
Quadriceps tendon graft

ORCID iDs of the authors:
T.O. 0000-0003-1049-609X;
M.A.T. 0000-0002-4056-3743

Corresponding author:
Tayfun Özel,
dr.tayfunozel@gmail.com

Content of this journal is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

ABSTRACT

Osteogenesis imperfecta (OI) is a rare connective tissue disorder associated with bone fragility and ligamentous laxity, predisposing patients to recurrent patellar instability. Surgical treatment of recurrent patellar instability is challenging because standard medial patellofemoral ligament (MPFL) reconstruction techniques involving patellar tunneling may increase the risk of patellar fracture. We present a 15-year-old male patient with OI type V and recurrent patellar dislocation treated with a minimally invasive MPFL reconstruction using a pedicled quadriceps tendon graft. This patella-sparing technique was selected to reduce stress on fragile patellar bone. At the 3-year follow-up, the patient demonstrated marked clinical improvement with reduced pain and improved knee function. No patellar fracture, fixation failure, or recurrent instability was observed. This case suggests that patella-sparing MPFL reconstruction may be a safe surgical option for managing patellar instability in patients with OI.

Introduction

Osteogenesis imperfecta (OI) is a genetically heterogeneous connective tissue disorder characterized primarily by bone fragility and increased fracture risk. Although many forms are associated with mutations affecting type I collagen, additional subtypes have been identified that are related to defects in other genes involved in bone formation. One of these variants, OI type V, is associated with mutations in the IFITM5 gene rather than type I collagen.[1] Patients with OI frequently present with bone fragility, skeletal deformities, and ligamentous laxity, which may contribute to joint instability.[2]

Patellar maltracking and joint hyperlaxity may be observed more frequently in cases of OI and increase the risk of patellofemoral instability.[3] At the molecular level, the inherent qualitative or quantitative defects in type I collagen synthesis impair the structural integrity of joint capsules and tendons, particularly weakening the medial patellofemoral ligament (MPFL) which acts as the primary static restrainer against lateral patellar displacement.[4] This generalized ligamentous laxity alters the physiological loading of the patellofemoral joint during skeletal growth, subsequently leading to trochlear dysplasia due to inadequate mechanical stimulation of the trochlear groove.[5] Furthermore, progressive long-bone deformities and rotational alignments (such as femoral anteversion or external tibial torsion) common in OI patients secondary to recurrent microfractures mechanically increase the Q-angle.[6] Together with sagittal plane abnormalities like patella alta/baja, these compounding soft-tissue and bony deformities severely disrupt the quadriceps vector, creating an excessive lateralization force. Consequently, this complex pathophysiological cascade predisposes the patella to lateral maltracking and recurrent subluxation or dislocation.[7] Various MPFL reconstruction techniques are used in the treatment of recurrent lateral patellar dislocations and can generally be classified as suture or tunnel techniques.[8,9] Complications such as patella fracture, recurrent instability, and anchor pull-out may develop after reconstruction with these MPFL techniques.[9] However, published data on MPFL reconstruction in patients with OI is limited; the existing literature reports several case presentations indicating the need for specific evaluation of patellar fracture risk and graft/fixation preferences.[10,11] This article will discuss MPFL reconstruction using a minimally invasive pedicled quadriceps graft in an adolescent diagnosed with OI due to recurrent patellar dislocation.

Case Presentation

The patient and his family were informed that the case data would be sent for publication, and they gave their consent. A 15-year-old male patient presented to the outpatient clinic complaining of frequent popping sensations in his knee, anterior knee pain, and difficulty squatting. The patient's history revealed that he first experienced patellar dislocation at age 7 and had experienced numerous episodes since then, to the point where he could no longer recall the exact number. He reported that patellar dislocation now occurred frequently during daily activities and that he was able to reduce it himself. The patient had previously been diagnosed with OI type V, had a history of multiple long-bone fractures during childhood, and was

Cite this article as: *Özel T, Tokgöz MA. Medial patellofemoral ligament reconstruction in osteogenesis imperfecta using quadriceps tendon graft: A rare case report. Acta Orthop Traumatol Turc., 2026;60(5), 0829, doi: 10.5152/j.aott.2026.25829.*

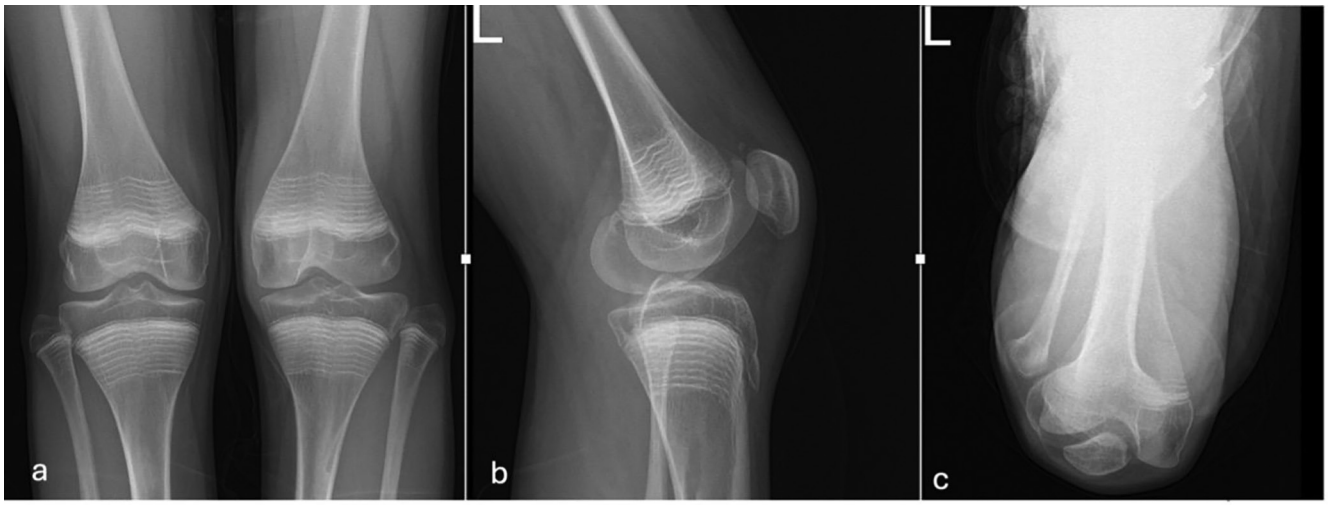

Figure 1. Preoperative (a) anteroposterior knee radiograph, (b) lateral knee radiograph, (c) sunrise knee radiograph.

receiving cyclic pamidronate therapy every 3 months. Preoperatively, the patient had no functional limitations and was classified as GMFCS level I. The patient's preoperative joint range of motion was normal in flexion and extension, but the apprehension test was positive. X-rays showed a zebra stripe sign associated with bisphosphonate treatment (Figure 1).[12] Preoperative imaging revealed a Caton–Deschamps index of 1.25 and a TT–TG distance of 18 mm. Lower extremity rotational alignment was clinically assessed preoperatively, and no significant rotational malalignment or limb-length discrepancy was detected. Magnetic resonance imaging (MRI) revealed disruption of the continuity of the MPFL at the patellar attachment site (Figure 2). The patient's preoperative Lysholm score was 53, Kujala score was 46, and Visual Analog Scale (VAS) pain score was 7.

After general anesthesia was administered, the patient was placed in a supine position and the diagnosis was clinically confirmed. Prophylactic antibiotics were administered before the thigh tourniquet was applied. A pneumatic tourniquet was applied to the proximal thigh, and the inflation pressure was set approximately 100 mm Hg above the patient's systolic blood pressure. Diagnostic arthroscopy was performed after preparation and draping, and no meniscal, cruciate ligament, or chondral pathology was identified, and patellar tracking abnormalities were confirmed arthroscopically. As described by Fink et al[13] a 2.5-3 cm transverse incision was made at the superomedial patella, aligned with Langer's lines. The prepatellar bursa was split longitudinally to expose the tendon, and a graft (1 cm wide, 8 cm long, and 3 mm thick) was harvested from the superior patella using a double-edged knife (KARL STORZ, Tuttlingen, Germany), leaving the distal attachment intact. The distal incision was extended to the anterior patella (2 cm laterally and 1 cm medially). The free end of the graft was prepared using No.2 absorbable braided sutures (Vicryl®, Ethicon, USA) in a whipstitch pattern to facilitate graft handling and fixation, rotated 90° inward, and passed beneath the prepatellar tissue. It was secured at the medial patellar border and the lateral tendon edge with additional absorbable sutures. A 2-3 cm longitudinal incision was then created from the medial epicondyle to the adductor tubercle. Under fluoroscopic guidance, a guidewire was placed at the Schöttle point,[14] and the femoral tunnel, sized 1 mm larger than the graft, was then drilled from medial to lateral, slightly anterior and proximal, in line with the anatomical course of the native MPFL, ensuring anatomic reconstruction and optimal graft positioning. The graft was shuttled through the medial retinaculum and capsule into the femoral tunnel and then tensioned while cycling the knee through flexion-extension. Once proper tension was achieved and patellar alignment was confirmed, fixation was completed at 30° of knee flexion using a 6-8 × 25 mm interference screw. The donor site was closed with absorbable sutures (Figure 3).

Postoperatively, a 0°-30° locked knee brace was applied, and passive and active-assisted range of motion exercises were initiated from the first postoperative day and gradually increased to 120° by the

HIGHLIGHTS

- We report a rare case of recurrent patellar instability in a patient with osteogenesis imperfecta type V.
- A patella-sparing medial patellofemoral ligament reconstruction using a pedicled quadriceps tendon graft was successfully performed.
- This technique avoids patellar drilling and may reduce fracture risk in patients with fragile bone.
- Excellent clinical and functional outcomes were achieved at 3-year follow-up without complications.
- This case contributes to the limited literature and highlights a safe surgical option for this challenging patient population.

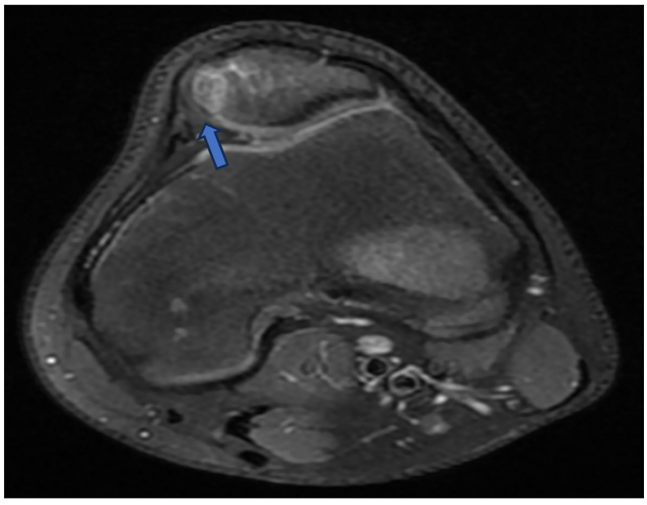

Figure 2. MRI axial section shows MPFL injury. MPFL, medial patellofemoral ligament; MRI, magnetic resonance imaging.

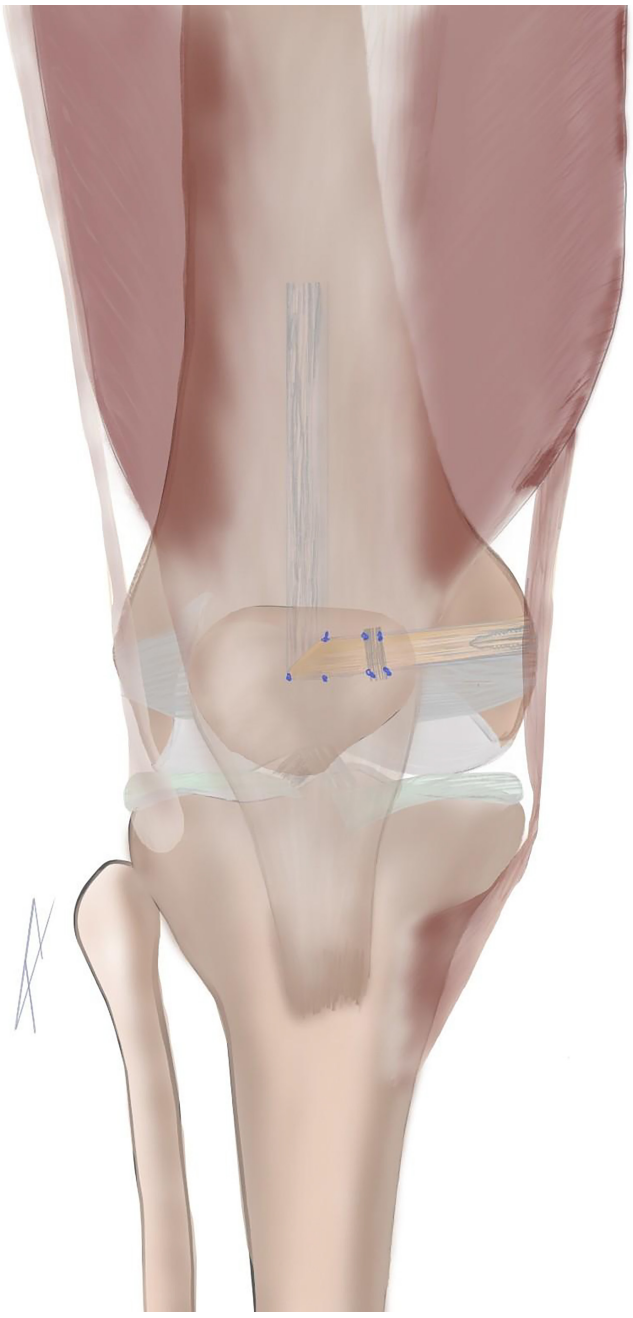

Figure 3. Schematic illustration of MPFL reconstruction using a pedicled quadriceps tendon graft. A partial-thickness quadriceps tendon graft measuring approximately 1 cm in width, 8-10 cm in length, and 3 mm in thickness is harvested from the superior patella while preserving its distal attachment. The graft is then rotated 90° medially and secured at the medial patellar border and the lateral tendon edge using additional absorbable sutures. The blue dots indicate additional sutures placed for reinforcement, serving as safety augmentation to enhance fixation stability. MPFL, medial patellofemoral ligament.

end of 6 weeks. In-bed quadriceps activation exercises were also started on the first day, while progressive strengthening exercises with increased intensity were introduced after the eighth week. Weight bearing as tolerated was allowed from the first operative day and gradually increased during the first month, followed by full weight bearing thereafter. Return to sports was permitted after 6 months, once adequate strength and joint mobility were achieved. At the 3-year follow-up, the Lysholm score was 100, the Kujala score was 99, and the VAS pain score was 1. No recurrent patellar dislocation or subjective instability was reported. While the patient was in a sitting position, extension and flexion forces were measured using a hand dynamometer. Compared to the unaffected side, a 20% loss in extension strength was found, whereas no loss in flexion strength was detected. The patient's joint range of motion was full (Figure 4,5).

Discussion

In the surgical management of recurrent patellar instability, one of the most common surgical procedures involves the use of a semitendinosus tendon graft using a single or double patellar tunnel technique.[15] Recently, techniques that do not require tunneling of the patella, such as anchor techniques or quadriceps graft techniques, have also gained popularity.[16] The procedure to be selected should be decided based on the patient's age and underlying pathologies.

Although OI was historically considered a disorder related to abnormalities of type I collagen according to the Sillence classification, recent advances have shown that OI represents a heterogeneous group of disorders with different genetic mechanisms. Type V OI, which is associated with mutations in the *IFITM5* gene, is characterized by features such as hyperplastic callus formation and calcification of the interosseous membrane. Despite this different molecular mechanism, patients with type V OI still demonstrate increased bone fragility and a higher risk of fractures, which should be considered during surgical treatment and postoperative management.[3,17]

One of the most serious complications after MPFL reconstruction is patellar fracture, which is usually observed after techniques that create a tunnel in the patella.[9] Given the increased risk of fracture in OI patients, the likelihood of patellar fracture may increase with techniques that create a tunnel into the patella. Carrol et al[4] detected a patellar fracture in a patient with OI who was performing a single-leg squat exercise to 45° at 6 weeks postoperatively after undergoing MPFL reconstruction by creating a transverse double tunnel in the patella, which required revision surgery on the patient. The authors suggest that other MPFL reconstruction techniques may be more suitable for patients with OI, and that a slower pace of physical therapy may be required afterward. However, carefully supervised early rehabilitation may be beneficial for preserving bone density in patients with OI. Fano et al[5] performed MPFL reconstruction in their patients with excessive lateral patellar tilt using lateral retinacular release, vastus lateral release, quadriceps tendon Z-lengthening, and semitendinosus graft with basket-weave technique. They reported that the patient gained 0°-90° of flexion in the first 8 weeks and achieved full range of motion with centralized patella at 7 months postoperatively. The authors stated that this technique can also be applied in patients with poor bone density and in patients with congenital patellar dislocation accompanied by patellar osteopenia and hypoplasia.

Although the TT–TG distance and Caton–Deschamps index were within borderline ranges, no additional bony procedure was performed. Recent studies have shown that isolated MPFL reconstruction can yield satisfactory outcomes regardless of these parameters, and that such measurements should not be considered absolute indications for tibial tubercle osteotomy.[18,19]

Various graft choices and fixation techniques have been described for MPFL reconstruction. Comparative studies have demonstrated that both quadriceps and hamstring tendon grafts yield similar clinical

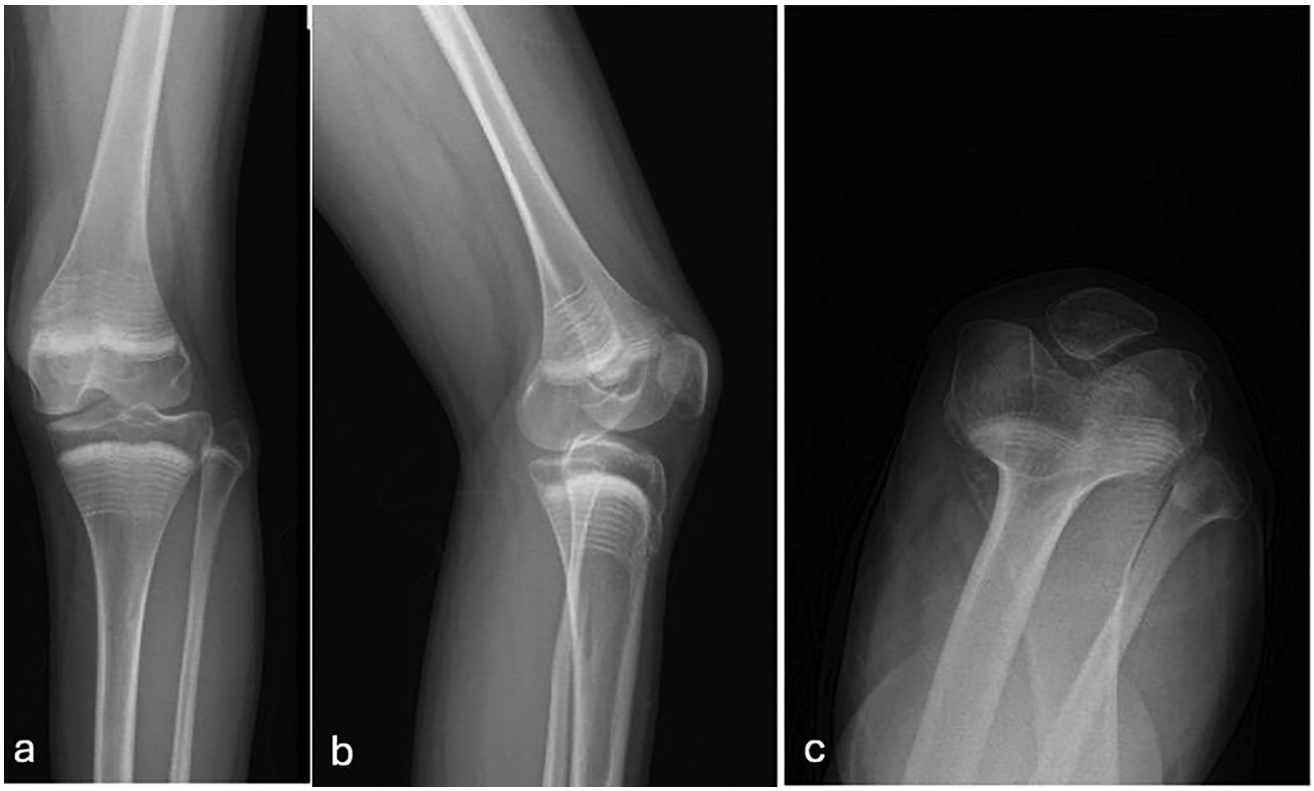

Figure 4. Postoperative (a) anteroposterior knee radiograph, (b) lateral knee radiograph, (c) sunrise knee radiograph.

and functional outcomes, with no significant differences in patient-reported scores or redislocation rates. Similarly, different fixation strategies, including tunnel and non-tunnel techniques, have shown comparable results, with technique selection largely depending on surgeon preference and efforts to minimize complications such as patellar fracture or donor-site morbidity.[20-22]

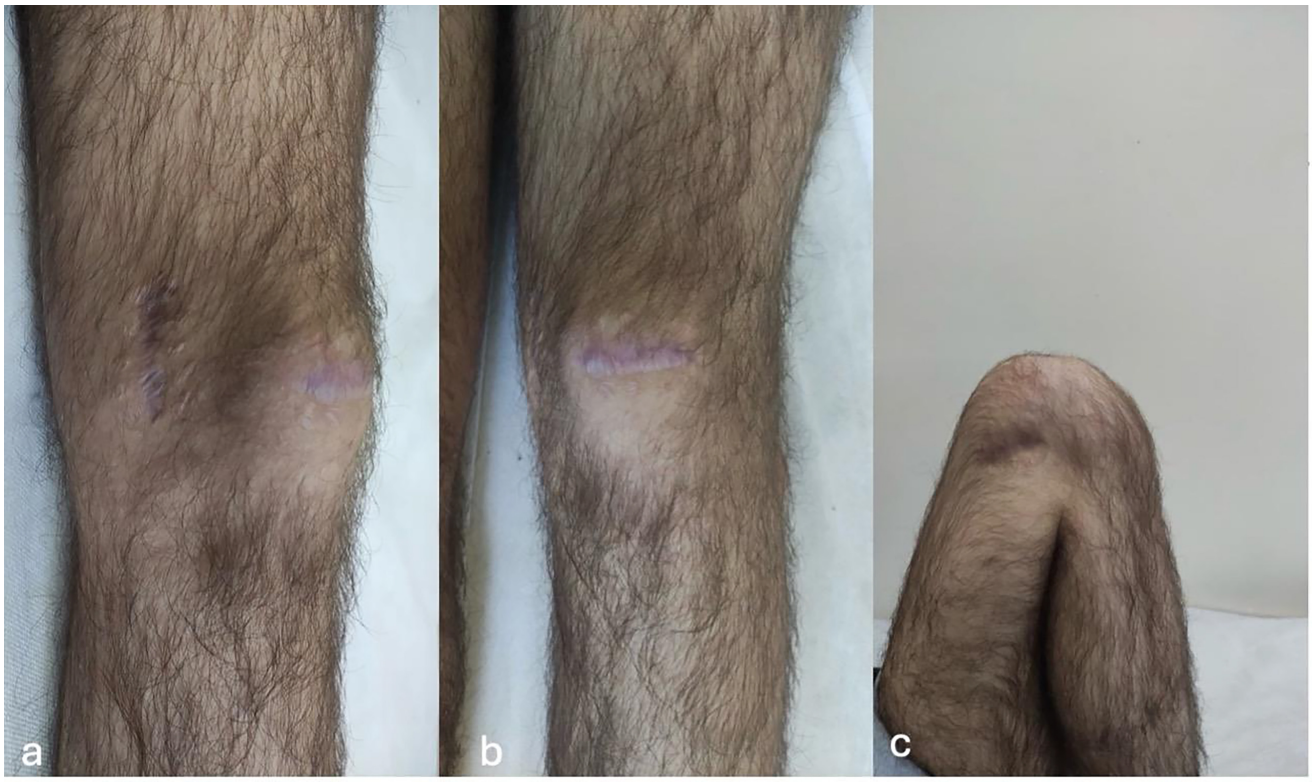

Figure 5. Postoperative (a) medial view of knee in extension, (b) anteroposterior view of the knee in extension, (c) medial view of the knee in full flexion.

At the 3-year postoperative follow-up, the Kujala score improved from 46 to 99 and the Lysholm score from 53 to 100, accompanied by a reduction in the VAS pain score from 7 to 1. These findings suggest that the procedure resulted in favorable mid-term clinical and functional outcomes in this patient. Importantly, no patellar fracture, fixation failure, or recurrent instability was observed during the 3-year follow-up period. Although a 20% reduction in knee extension strength was detected on the operated side, this finding did not appear to adversely affect clinical function or patient-reported outcomes. This deficit may reflect a combination of preexisting weakness due to recurrent patellofemoral instability and donor-site–related changes following quadriceps tendon harvesting rather than graft failure or persistent instability. Rhatomy et al [23] reported that quadriceps muscle strength was measured using a hand-held dynamometer and that there was no difference in mean quadriceps muscle strength between the donor and contralateral knees 6 months after MPFL reconstruction using a quadriceps tendon autograft. Another study found a 20% difference in extensor strength between extremities in the low-activity sports group 1 year postoperatively after quadriceps tendon and MPFL reconstruction, similar to this study.[24]

When a pedicled quadriceps graft is used, the risk of patellar complications such as fracture and anchor dislocation can be reduced in patients with fragile bones because there is no need for a tunnel or anchor in the patella. This allows the patient to begin rehabilitation early and, by allowing partial weight-bearing during the first 3 weeks post-operatively, presents a significant theoretical advantage in minimizing immobilization-induced bone loss, as guided by established biomechanical principles of early mobilization. This case suggests that minimally invasive MPFL reconstruction using a pedicled quadriceps tendon graft may represent a safe and effective option for managing recurrent patellar instability in patients with OI, particularly by avoiding patellar tunnels in fragile bone. Further studies with larger cohorts are warranted to confirm these findings.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Artificial Intelligence Usage Statement: The authors declared that no Artificial Intelligence Tool was used in the preparation of the manuscript.

Informed Consent: Written informed consent was obtained from the parents' of the patient who agreed to take part in the study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – T.Ö., M.A.T.; Design – T.Ö., M.A.T.; Supervision – T.Ö., M.A.T.; Resources – T.Ö., M.A.T.; Materials – T.Ö., M.A.T.; Data Collection and/or Processing – T.Ö., M.A.T.; Analysis and/or Interpretation – T.Ö., M.A.T.; Literature Search – T.Ö., M.A.T.; Writing – T.Ö., M.A.T.; Critical Review – T.Ö., M.A.T.

Declaration of Interests: The authors have no conflict of interest to declare.

Funding: The authors declare that this study received no financial support.

References

1. Marom R, Song IW, Busse EC, et al. The IFITM5 mutation in osteogenesis imperfecta type V is associated with an ERK/SOX9-dependent osteoprogenitor differentiation defect. *J Clin Invest*. 2024;134(15):e170369. [CrossRef]
2. Marini JC, Forlino A, Bächinger HP, et al. Osteogenesis imperfecta. *Nat Rev Dis Primers*. 2017;3:17052. Published 2017 Aug 18. [CrossRef]
3. Forlino A, Marini JC. Osteogenesis imperfecta. *Lancet*. 2016;387(10028):1657-1671. [CrossRef]
4. Engelbert RH, Uiterwaal CS, van de Putte E, et al. Pediatric generalized joint hypomobility and musculoskeletal complaints: a new entity? Clinical, biochemical, and osseal characteristics. *Pediatrics*. 2004;113(4):714-719. [CrossRef]
5. Biedert RM, Bachmann M. Anterior–posterior trochlear measurements of normal and dysplastic trochlea by axial magnetic resonance imaging. *Knee Surg Sports Traumatol Arthrosc*. 2009;17(10):1225-1230. [CrossRef]
6. Zeitlin L, Fassier F, Glorieux FH. Modern approach to children with osteogenesis imperfecta. *J Pediatr Orthop B*. 2003;12(2):77-87. [CrossRef]
7. Amis AA. Current concepts on anatomy and biomechanics of patellar stability. *Sports Med Arthrosc*. 2007;15(2):48-56. [CrossRef]
8. Castagno C, Kneedler S, Fares A, Maier M, Gontre G, Weiss WM. Isolated medial patellofemoral reconstruction outcomes: a systematic review and meta-analysis. *Knee*. 2023;44:59-71. [CrossRef]
9. Shah JN, Howard JS, Flanigan DC, Brophy RH, Carey JL, Lattermann C. A systematic review of complications and failures associated with medial patellofemoral ligament reconstruction for recurrent patellar dislocation. *Am J Sports Med*. 2012;40(8):1916-1923. [CrossRef]
10. Carroll CJ, Nammour M, Reese J, Lavie L, Warren M, Waldron S. Patellar dislocation and fracture after medial patellofemoral ligament reconstruction in a patient with osteogenesis imperfecta. *Ochsner J*. 2022;22(1):80-84. [CrossRef]
11. Fano AN, Hadley M, Shannon BA, Franzone JM. Medial patellofemoral ligament reconstruction in osteogenesis imperfecta using modified basket-weave technique: a case report. *JBJS Case Connect*. 2025;15(3). [CrossRef]
12. Chakraborty PP, Biswas SN, Patra S, Santra G. "Zebra stripe" sign and "bone in bone" sign in cyclical bisphosphonate therapy. *J Clin Diagn Res*. 2017;11(2):RJ01-RJ02. [CrossRef]
13. Fink C, Veselko M, Herbort M, Hoser C. MPFL reconstruction using a quadriceps tendon graft: part 2: Operative technique and short term clinical results. *Knee*. 2014;21(6):1175-1179. [CrossRef]
14. Schöttle PB, Schmeling A, Rosenstiel N, Weiler A. Radiographic landmarks for femoral tunnel placement in medial patellofemoral ligament reconstruction. *Am J Sports Med*. 2007;35(5):801-804. [CrossRef]
15. Lee DY, Park YJ, Song SY, Hwang SC, Park JS, Kang DG. Which technique is better for treating patellar dislocation? A systematic review and meta-analysis. *Arthroscopy*. 2018;34(11):3082-3093.e1. [CrossRef]
16. Lee DY, Kang DG, Jo HS, Heo SJ, Bae JH, Hwang SC. A systematic review and meta-analysis comparing conservative and surgical treatments for acute patellar dislocation in children and adolescents. *Knee Surg Relat Res*. 2023;35(1):18. [CrossRef]
17. Sillence DO, Senn A, Danks DM. Genetic heterogeneity in osteogenesis imperfecta. *J Med Genet*. 1979;16(2):101-116. [CrossRef]
18. Erickson BJ, Nguyen J, Gasik K, Gruber S, Brady J, Shubin Stein BE. Isolated medial patellofemoral ligament reconstruction for patellar instability regardless of tibial tubercle-trochlear groove distance and patellar height: outcomes at 1 and 2 years. *Am J Sports Med*. 2019;47(6):1331-1337. [CrossRef]
19. Feller JA, Magnussen RA, Sillanpää P, et al. Acceptable outcomes for isolated medial patellofemoral ligament reconstruction despite using higher thresholds for patella alta and regardless the value of tibial tubercle-trochlear groove distance and the degree of trochlear dysplasia-An international multicenter study. *J ISAKOS*. 2025;15:101028. [CrossRef]
20. Özel T, Yaş S, Türkoğlu HH, Ahmadov A, Ataoğlu MB, Kanatlı U. Comparison of double bundle semitendinosus technique and pedicled quadriceps technique in patellar instability. *Knee Surg Sports Traumatol Arthrosc*. 2025;33(11):3762-3771. [CrossRef]
21. Runer A, Klotz S, Schneider F, et al. Medial patellofemoral ligament reconstruction using pedicled quadriceps tendon autograft yields similar clinical and patient-reported outcomes but less donor-site morbidity compared with gracilis tendon autograft. *Arthroscopy*. 2024;40(2):438-445. [CrossRef]
22. Sanguanjit P, Rujiraphum P, Apivatgaroon A, Chernchujit B. Medium to long-term outcomes of medial patellofemoral ligament reconstruction using the superficial quadriceps versus a hamstring autograft in patellar instability patients. *Sci Rep*. 2023;13(1):13353. [CrossRef]
23. Rhatomy S, Lisang R, Soekarno NR, Kisworo B. Evaluation of quadriceps strength post-medial patellofemoral ligament reconstruction using quadriceps tendon autografts. *Open Access Maced J Med Sci*. 2020;8(A):943-946. [CrossRef]
24. Inoue C, Aoki Y, Yasuda K, et al. Postoperative knee extensor strength after medial patellofemoral ligament reconstruction using superficial slip of the quadriceps tendon and the factors that affect strength recovery. *Orthop J Sports Med*. 2025;13(4):23259671251325748. [CrossRef]