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Original Article

Implantless patellar fixation in medial patellofemoral ligament reconstruction

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ABSTRACT

Purpose: The medial patellofemoral ligament (MPFL) acts as primary restraint to lateral patellar dislocation and its rupture has been reported in almost all cases of acute patellar dislocation. Various surgical techniques have been described for MPFL reconstruction, using many femoral and patellar fixation techniques and different grafts. This article details our technique for MPFL reconstruction using semitendinosus graft which avoids the use of implant at patellar end.

Methods: Twenty patients (8 males and 12 females) with complaints regarding acute and chronic lateral patellar instability were evaluated and treated by MPFL reconstruction procedure. The mean age of patients was 21 years (range 17–34 years). MPFL reconstruction was performed using semitendinosus graft passing through two parallel, obliquely directed tunnels created in patella. Fixation of graft was done with an interference screw only at the femoral end. Mean follow-up period after intervention was 26.4 months (range 23–30 months). Results were evaluated using Kujala score.

Results: All patients gained adequate patellar stability and full arc of motion. No incidence of patella fracture was noted. There were no postoperative complications related to the procedure. There was no recurrence of instability in patella at final follow-up.

Conclusion: Passing the graft through the tunnels in patella without use of any implant has given excellent functional outcome and moreover has the advantages of less implant-related complications and cost-effectiveness.

Introduction

Patellar subluxation or dislocation due to patellar instability is a common orthopaedic disorder in athletes, leading to pain and functional impairment. The incidence of patellar dislocation is up to 78 in 100,000 and 15%–40% of dislocations for the first time will reoccur after conservative treatment.[1]

Patellofemoral joint is stabilized by static and dynamic structures. Static stabilizers include medial patellofemoral ligament (MPFL) which prevents lateral subluxation of patella. Dynamic stabilizers are muscular components around the knee like vastus medialis obliquus (VMO) muscle fibres which are attached to upper 2/3rd part of medial aspect of patella along with MPFL.[2]

Various factors are involved in the patellar instability which includes trochlear dysplasia (85%–96%), increased lateral patellar tilt (83%), patella alta (24%) and an increase in the distance between tibial tuberosity and centre of the trochlear groove (TT-TG) in 56% of cases, as well as other less frequent problems.[3,4]

In patients with traumatic causes, there is always tearing of the MPFL that leads to loss of static medial stabilization, and thus may require surgical reconstruction of the MPFL for stabilization. Several studies have shown that MPFL is always ruptured or deficient in cases of acute dislocation or chronic patellofemoral instability. According to variable anatomy of MPFL and functional outcomes, several techniques have been described in literature for ligament repair or reconstruction using different femoral and patellar fixation techniques and different grafts (autograft, allograft, synthetic).[2–4] This article describes our technique for MPFL reconstruction with semitendinosus autograft with two transverse obliquely directed parallel tunnels in patella and without the use of any implant for graft fixation at patellar end.

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Methods

Inclusion and exclusion criteria

Twenty symptomatic cases with history of lateral patellar subluxation or dislocation were included in the study. All cases were diagnosed by history and clinical examination, which were further evaluated with radiographs, computed tomography (CT) scans and magnetic resonance imaging (MRI). Various parameters including Q angle, trochlear dysplasia, ligament status and TT-TG distance were measured. Patients meet any of the following criteria were excluded from the study: a Q angle more than 20°; severe patella and trochlear dysplasia or patella alta and baja; TT-TG distance more than 20 mm; and multidirectional knee stability or previous operation on the same knees. MRI was used to assess soft tissue abnormalities including status of MPFL, meniscus, cruciate ligaments, and collateral ligaments. Institutional ethical committee approval was taken.

Surgical treatment

Harvest of semitendinosus graft

All patients underwent surgical intervention after taking informed and written consent for the procedure. The patient was examined under anesthesia to confirm patellar instability. A diagnostic arthroscopy was performed noting trochlear morphology, ligament status, menisci and the ability to displace the patella laterally. Additional arthroscopic procedures were performed like loose body removal, patellar chondromalacia lesion debridement or meniscal debridement, as needed.

The pes anserine was palpated and a 3–4 cm longitudinal incision was made 2 cm medial to the tibial tubercle. The semitendinosus was identified and sartorius fascia was then incised. Blunt dissection was carried out around the semitendinosus tendon to release any adhesion. Harvest of the semitendinosus tendon was conducted with the help of a tendon harvester until the musculotendinous junction.

Transosseous tunnels

A 2–3 cm incision was given along medial side of the patella in the proximal half and deep dissection was carried out up to the bone to expose the medial border and anterior surface subperiosteally. Two parallel transverse transosseous tunnels were made through patella, starting from the posteromedial aspect to exit from the anterior surface of patella, with the help of a 4.5-mm cannulated reamer as shown in Fig. 1A. Looped ethibond sutures were shuttled through the two tunnels (Fig. 1B).

The knee was flexed to 90° and a perfect lateral view of knee can be obtained with the C-arm to identify the Schottle's point (isometric point).[5,6] Schottle's point lies just distal and anterior to the point where a line was drawn as extension of the posterior femoral cortical line and cuts the Blumensaat's line (Fig. 2A). This is the natural anatomic insertion of the MPFL. This site was marked on the skin and a 3–4 cm incision was made. Soft tissue was dissected down to the femur (Fig. 2B). A drill tipped Beath pin was then advanced in the femur directed obliquely starting at Schottle point, to exit from anterolateral femur. Over the wire, appropriate sized reaming was done to make a femoral tunnel for the interference screw. The reamer size was dictated by the thickness of double looped semitendinosus graft (usual size 6–7 mm).

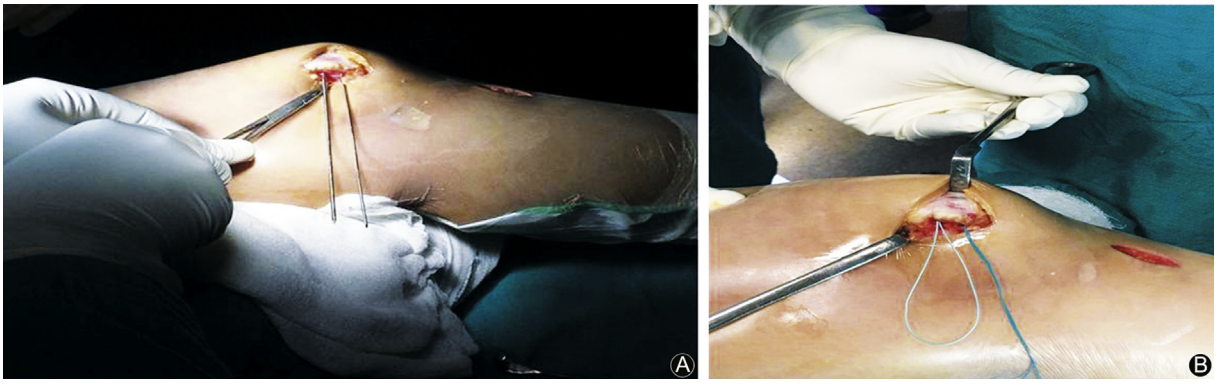

Fig. 1. Direction of patellar tunnel. (A) Two parallel transverse tunnels made through patella using two guide wires; (B) Ethibond passing through the patellar tunnel.

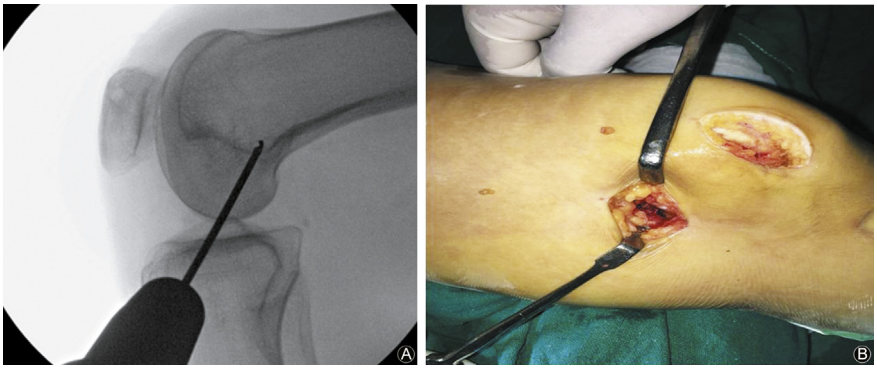

Fig. 2. Femoral attachment of graft. (A) Schottle point identified under C-arm (anatomic insertion of MPFL); (B) Soft tissue dissected to expose femoral condyle to make a tunnel.

MPFL reconstruction

Harvested semitendinosus graft was made symmetrical along the whole length and both ends of tendon were smoothened and whip stitched using Ethibond suture (size 2-0). Both ends of graft were shuttled through the transosseous tunnels created in patella (Fig. 3A). Both free ends were negotiated to the femoral tunnel through a soft tissue span created by a blunt artery forceps in layers 3 and 4 of the medial patellar tissues. Both free ends of graft were routed into the femoral tunnel using a looped Ethibond suture. Appropriate sized biodegradable interference screw was used to fix the graft in femoral tunnel with knee flexed between 30° and 45° (Fig. 3B).

The suture exiting from anterolateral thigh were pulled to tighten the graft while keeping the knee in 30° flexion and constantly tracking the patella in tochlear groove laterally, so as to avoid over-tightening. The arthroscope was placed back in the knee, and patellar tracking observed. The surgical site was irrigated with normal saline solution. Soft tissue of the retinaculum was repaired adequately and tension free closure was done in layers. The patient was placed in a knee immobilizer and physiotherapy was started postoperatively, progressively increasing the range of motion over a period of six weeks to achieve full range of motion along with quadriceps setting exercises. Full weight bearing was allowed at 6 weeks. Return to sports was generally allowed at 16–20 weeks range depending on quadriceps strength. Functional assessment was done using Kujala score.[7]

Results

Over the follow-up period, a total of 20 patients (8 male and 12 female) were evaluated. The mean age of patients at the time of injury was 21 (17–34) years. All patients gained adequate knee stability and full arc of motion within three months after intervention. No case of fracture patella was noted intraoperatively while drilling for the tunnels or during follow-up. There were no major postoperative complications related to procedure or rehabilitation. There was no recurrence of instability of patella over the follow-up time of 26.4 (23–30) months. Significant and sustained improvement in pain was observed over follow-up period.

Three cases complained of anterior knee pain, which resolved within six months of physiotherapy. One patient had range of movement up to 110° which however did not affect her daily activity of life.

There was significant improvement in mean Kujala score from 57.8 ± 14.8 preoperatively to 87.8 ± 12.1 postoperatively. Patella apprehension test was found negative in sequential follow-up of all patients.

Discussion

Graft and complications

Recurrent instability after patellar dislocation, even after conservative management, remains the main indication for surgical reconstruction of MPFL. Multiple techniques have been described for the reconstruction of medial constraints of patella, from medial plication to ligament reconstruction. MPFL reconstruction still remains mainstay of the treatment. Hamstring, especially the semitendinosus, remains the most common used autograft for MPFL reconstruction. Other autografts include gracillis tendon, quadriceps tendon, adductor magnus graft, patellar tendon graft, etc.[8–14]

Major variation exists in patellar fixation techniques of the graft. Grossly they can be divided in 2 groups: one group involves graft fixation using suture or suture anchors without patellar tunnel; the other group involves graft fixation using patellar tunnels ranging in size from 2.4 to 4.5 mm.

Complications of MPFL reconstruction techniques include recurrent dislocation, subluxation, patellar fracture, improper placement of graft, positive apprehension test, and over-tightening leading to stiffness and pain.[10,11] Literature was thoroughly evaluated regarding complications of various procedure and complied as Table 1.[6,10,12,13,15-18]

In our study, there was no episode of recurrent subluxation, dislocation or patellar fracture. Persistent knee pain as reported in literature could be due to implant-related impingement, tunnel

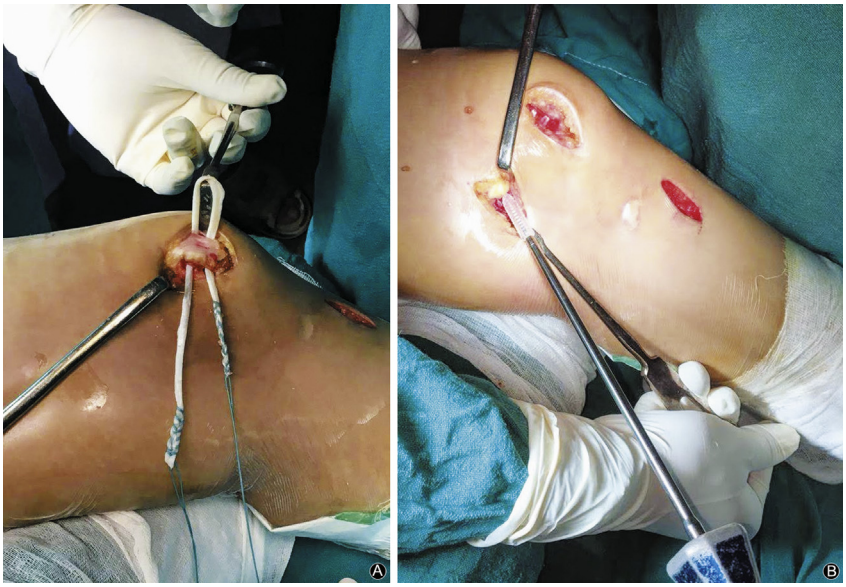

Fig. 3. Graft placement and fixation. (A) Semitendinosus graft passing through transosseous tunnel; (B) Fixation of graft with screw.

Table 1
Literature review of various grafts used for medial patellofemoral ligament reconstruction and complications noted.

Study (Year)	Method of fixation	Complications and incidence
Shah et al (2012)[10]	Tunnel technique	Overall complication rate (29.8%); recurrent dislocation/ subluxation (3.3%); apprehension/hypermobility (8.6%)
	Suture technique	Overall complication rate (21.6%); recurrent dislocation/ subluxation (4.8%); apprehension/hypermobility (24%)
Song et al (2014)[12]	Hamstring autograft fixed with 2 suture anchors	Positive apprehension test on follow-up (5.0%)
Fink et al (2014)[13]	Quadriceps tendon fixed with 2 sutures	Positive apprehension test on follow-up (11.7%)
Panni et al (2011)[6]	Semitendinosus graft with divergent patellar 2-tunnels	Patellar fracture in 1 patient (2.1%); no episode of re-dislocation
Christiansen et al (2008)[14]	Gracilis graft looped through 2 transverse 4.5-mm drill holes fixed with Interference screw	Patellar re-dislocation (2.3%); Subluxation (6.8%); Chronic pain (9.1%)
Panagopoulos et al (2008)[15]	Single hamstring tendon graft passed through the medial intermuscular septum at the adductor's magnus insertion and fixed to the superomedial pole of the patella.	Patellar fracture in 1 patient (4%)
Kang et al (2014)[16]	Horizontal Y-shaped semitendinosus tendon autograft with 2 bundles tensioned at 0° and 30° of knee flexion	No postoperative complications; no apprehension test
Csintalan et al (2014)[17]	Doubled semitendinosus graft	Recurrent subluxations (10.7); positive apprehension sign (12.5%) of Reoperation (3.6%)
Ahmad et al (2009)[18]	Hamstring graft fixed by docking on patella and interference screw fixation on the femur	No episode of subluxation or dislocation

enlargement, implant cut through, etc. However in our study, knee pain was non-significant as there was no interference screw or anchor usage for graft fixation at patellar end. Apprehension was not noted in any of our patients postoperatively. So the results in our study are in conformity or better than reported in the literature.

Patellar tunnel

There are multiple variations in patellar tunnel placement described in literature. Table 2[14,19,20] summarizes the variations in direction of patellar tunnels and associated complications.

Patellar fracture is a dreadful complication of MPFL reconstruction which can be mainly attributed to direction of patellar tunnels. This can be minimized by direction of tunnels starting from medial patellar border and exiting through anterior patellar surface. It is of utmost importance that both the tunnels should be mainly in proximal half of the patella i.e. above the equator and should be parallel to each other. Fig. 4 shows the direction of parallel tunnels in patella and graft through the two parallel tunnels. This configuration is better than parallel transverse tunnels, transversing the entire medio lateral width of patella which is prone to more severe stress risers as it is exactly perpendicular to the force of pulling quadriceps tendon. The medial surface of patella is generally wide enough to accommodate two 4.5 mm tunnels that are fashioned obliquely so that they start in the medial surface of patella, go obliquely and exit on the anterior surface of patella near its middle.

By using posteromedial surface for entry portal of tunnel and exiting via the anterolateral surface of the patella, we achieved an increase in surface thickness of anterior tunnel wall, and hence less chances of fracture.

Functional outcome

Functional evaluation was done using Kujala scoring system in present study. The mean preoperative Kujala score was 57.8 ± 14.8, which showed significant improvement after MPFL reconstruction (87.8 ± 12.1). Previous studies revealed similar results with the mean postoperative Kujala score ranging from 84 in Christiansen et al[14] study to 90.9 in both Song et al[12] and Kang HJ et al[16] studies.

From our preliminary study, the MPFL reconstruction creating patellar tunnels is a valid, safe and effective surgical procedure to treat patellar dislocation. The most important result of our study was the significant increase in the main evaluation scales (Kujala score) and the considerable improvement of clinical symptoms in patients examined with a 24 months follow-up from the MPFL reconstruction surgery. Advantage of the described technique is that it restores the main anatomic restraint to lateral patellar displacement with the secure fixation technique allowing for early rehabilitation. The implantless fixation of the patellar end of the graft avoids major implant-related complications like impingement, failure, etc and increases cost-effectiveness of whole procedure which is specifically relevant in a developing country like India.

Limitation

A limitation of this technique is that it is designed to recreate the anatomic neutralizing force on the patella; it does not function to medialize the patella. Therefore other procedures may be needed along with this technique to address lower limb malalignment like distal tibial tuberosity medialization procedure and trochlear dysplasia correction procedure. Our study has few limitations. The most obvious are small number of cases and the short term of follow-up.

Table 2
Direction of patellar tunnels and associated complications.

Study (Year)	Patellar tunnel	Complications (Affected No. of cases/Incidence)
Mohammad et al (2017)[19]	Single transverse tunnel	Anterior knee pain (9); metal irritation (3); instability requiring revision surgery (2)
Mohammad et al (2017)[19]	Two parallel tunnels	Anterior knee pain (3); no patellar fracture
Schiphouwer et al (2017)[20]	Two transverse parallel tunnels	Patellar fracture (3.6%, more in males); instability (8.1%)
Panni et al (2011)[6]	Divergent patellar transverse 2 tunnels	No patella re-dislocation
Christiansen et al (2008)[14]	Two transverse tunnels	Patellar dislocation (1); subluxation (3); chronic pain (4)

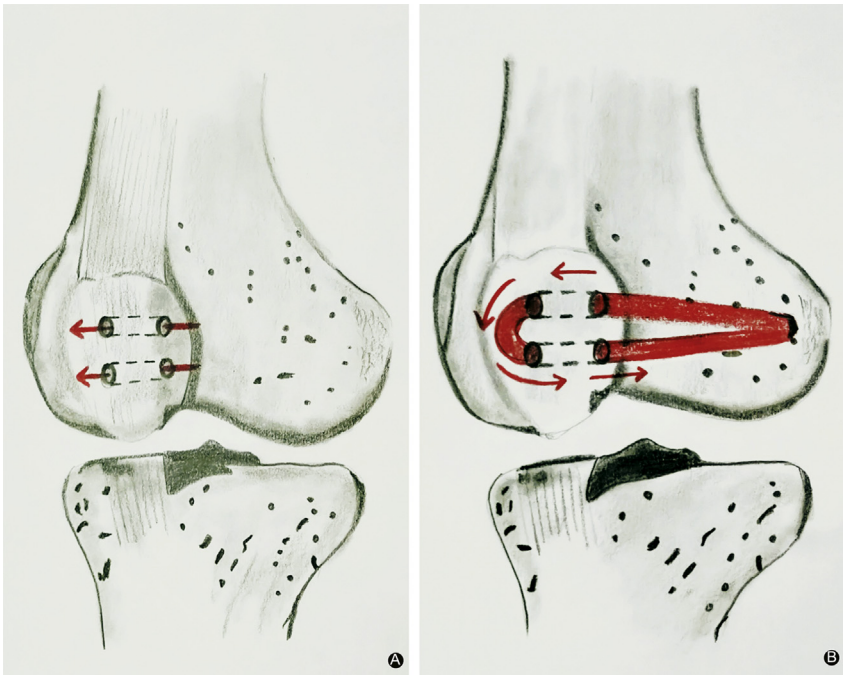

Fig. 4. Sketch diagram of tunnel direction and graft placement. (A) Direction of patellar tunnels; (B) Direction of graft.

Conclusion

This study shows promising results with transosseous technique using two parallel transverse obliquely directed tunnels, without using any implant for autograft fixation in MPFL injuries of knee. It is a simple and less demanding technique for fixation and avoids implant-related complications as loosening, broken implant or cut-through of implant through bone. It is also cost-effective and thus of relevance in developing countries.

Funding

Nil.

Ethical statement

Approval has been obtained from local ethics committee before conduction of this study.

Conflicts of interest

The authors declare no conflicts of interest.

References

1. Sillanpää P, Mattila VM, Iivonen T, et al. Incidence and risk factors of acute traumatic primary patellar dislocation. *Med Sci Sports Exerc*. 2008;40:606–611. https://doi.org/10.1249/MSS.0b013e318160740f.
2. Feller JA, Amis AA, Andrish JT, et al. Surgical biomechanics of the patellofemoral joint. *Arthroscopy*. 2007;23:542–553.
3. Bollier M, Fulkerson JP. The role of trochlear dysplasia in patellofemoral instability. *J Am Acad Orthop Surg*. 2011;19:8–16.
4. Diederichs G, Issever AS, Scheffler S. MR imaging of patellar instability: injury patterns and assessment of risk factors. *Radiographics*. 2010;30:961–981. https://doi.org/10.1148/rg.304095755.
5. Schottle PB, Fucentese SF, Romero J. Clinical and radiological outcome of medial patellofemoral ligament reconstruction with a semitendinosus autograft for patella instability. *Knee Surg Sports Traumatol Arthrosc*. 2005;13:516–521.
6. Panni AS, Alam M, Cerciello S, et al. Medial patellofemoral ligament reconstruction with a divergent patellar transverse 2-tunnel technique. *Am J Sports Med*. 2011;39:2647–2655. https://doi.org/10.1177/0363546511420079.
7. Kujala UM, Jaakkola LH, Koskinen SK, et al. Scoring of patellofemoral disorders. *Arthroscopy*. 1993;9:159–163.
8. Lenschow S, Schliemann B, Gestring J, et al. Medial patellofemoral ligament reconstruction: fixation strength of 5 different techniques for graft fixation at the patella. *Arthroscopy*. 2013;29:766–773. https://doi.org/10.1016/j.arthro.2012.12.004.
9. Park MC, Cadet ER, Levine WN, et al. Tendon-to-bone pressure distributions at a repaired rotator cuff footprint using transosseous suture and suture anchor fixation techniques. *Am J Sports Med*. 2005;33:1154–1159.
10. Shah JN, Howard JS, Flanigan DC, et al. A systematic review of complications and failures associated with medial patellofemoral ligament reconstruction for recurrent patellar dislocation. *Am J Sports Med*. 2012;40:1916–1923. https://doi.org/10.1177/0363546512442330.
11. Bollier M, Fulkerson J, Cosgarea A, et al. Technical failure of medial patellofemoral ligament reconstruction. *Arthroscopy*. 2011;27:1153–1159. https://doi.org/10.1016/j.arthro.2011.02.014.
12. Song SY, Kim IS, Chang HG, et al. Anatomic medial patellofemoral ligament reconstruction using patellar suture anchor fixation for recurrent patellar instability. *Knee Surg Sports Traumatol Arthrosc*. 2014;22:2431–2437. https://doi.org/10.1007/s00167-013-2730-6.
13. Fink C, Veselkoc M, Herbort M, et al. MPFL reconstruction using a quadriceps tendon graft: part 2: operative technique and short term clinical results. *Knee*. 2014;21:1175–1179. https://doi.org/10.1016/j.knee.2014.05.006.
14. Christiansen SE, Jacobsen BW, Lund B, et al. Reconstruction of the medial patellofemoral ligament with gracilis tendon autograft in transverse patellar drill holes. *Arthroscopy*. 2008;24:82–87. https://doi.org/10.1016/j.arthro.2007.08.005.
15. Panagopoulos A, van Niekerk L, Triantafillopoulos IK. MPFL reconstruction for recurrent patella dislocation: a new surgical technique and review of the literature. *Int J Sports Med*. 2008;29:359–365.
16. Kang HJ, Cao JH, Pan S, et al. The horizontal Y-shaped graft with respective graft tension angles in anatomical two-bundle medial patellofemoral ligament reconstruction. *Knee Surg Sports Traumatol Arthrosc*. 2014;22:2445–2451. https://doi.org/10.1007/s00167-014-3005-6.
17. Csintalan RP, Latt LD, Fornalski S, et al. Medial patellofemoral ligament (MPFL) reconstruction for the treatment of patellofemoral instability. *J Knee Surg*. 2014;27:139–146. https://doi.org/10.1055/s-0033-1360652.
18. Ahmad CS, Brown GD, Shubin Stein BE. The docking technique for medial patellofemoral ligament reconstruction: surgical technique and clinical outcome. *Am J Sports Med*. 2009;37:2021–2027. https://doi.org/10.1177/0363546509336261.
19. Mohammed R, Hunt N, Gibbon AJ. Patellar complications in single versus double tunnel medial patellofemoral ligament reconstruction. *J Orthop Surg (Hong Kong)*. 2017;25. https://doi.org/10.1177/2309499017691007, 2309499017691007.
20. Schiphouwer L, Rood A, Tigchelaar S, et al. Complications of medial patellofemoral ligament reconstruction using two transverse patellar tunnels. *Knee Surg Sports Traumatol Arthrosc*. 2017;25:245–250. https://doi.org/10.1007/s00167-016-4245-4.