The Knee 26 (2019) 515–520

Contents lists available at ScienceDirect

The Knee

Case report

Combined Patellar Tendon lengthening and partial Extensor Mechanism Allograft reconstruction for the treatment of patella infera: A case report

C. Fiquet *, N. White, R. Gaillard, E. Servien, P. Neyret, S. Lustig

Centre Albert Trillat, Service de Chirurgie Orthopédique, Hôpital Universitaire Lyon Nord, Lyon, France

ARTICLE INFO

Article history:
Received 8 September 2018
Received in revised form 5 November 2018
Accepted 21 December 2018

Keywords:
Patella infera
Patellar Tendon lengthening
Hourglass Extensor Mechanism Allograft

ABSTRACT

Patella infera is an uncommon but potentially crippling pathology of the knee, resulting in stiffness and anterior knee pain. Several surgical methods have been described for its treatment, but there remains no clear technique of choice.

We present the case of a 63-year-old male with patella infera, affecting a native knee, following Complex Regional Pain Syndrome. This patient was treated with a combined technique of Patellar Tendon lengthening and partial Hourglass Extensor Mechanism Allograft reconstruction. The results were excellent at 24 months of follow-up. To our knowledge, this technique has not yet been published, and we present it as a promising treatment option in selected cases.

1. Introduction

Patella infera is an uncommon pathology of the knee joint, defined by an abnormally low position of the patella relative to the joint line. It is secondary to the retraction, and ultimately permanent shortening of, the patellar tendon (PT), due to a trauma of the knee. This trauma may be surgical, accidental, inflammatory or infectious. The PT, peripatellar retinaculae, and retropatellar fat pad, all show the same retraction and fibrosis pattern [1,2]. As a consequence of the retraction and the abnormal patellar position, the biomechanics of the knee joint are modified. Patellofemoral pressure is increased in flexion, which can cause a typical burning pain and loss of flexion range.

Several techniques have been described for the surgical treatment of patella infera [2,4–9]; however there remains no consensus as to which is best.

In this case report, we describe the treatment of a case of patella infera in a native knee, with a technique of combined PT lengthening and hourglass partial Extensor Mechanism Allograft (EMA) reconstruction.

Abbreviations: PT, Patellar Tendon; EMA, Extensor Mechanism Allograft; ROM, Range of Motion; KSS, Knee Society Score; CDI, Caton–Deschamps Index; ATT, Anterior Tibial Tuberosity; QT, Quadricipital Tendon; EL, Extensor Lag; TKA, Total Knee Arthroplasty.

* Corresponding author.
E-mail addresses: charlesfiquet@hotmail.fr, (C. Fiquet), romain.gaillard@chu-lyon.fr, (R. Gaillard), elvire.servien@chu-lyon.fr. (E. Servien).

https://doi.org/10.1016/j.knee.2018.12.012
0968-0160/

2. Case report

A 63-year-old male patient presented to another institution complaining of left knee pain and limited Range of Motion (ROM), of four years of duration. This commenced after a fall while walking, during which his knee sustained a direct blow against a curb. The pain did not respond to initial medical management and an MRI scan was performed, revealing a lesion of the medial meniscus. This was treated arthroscopically. The patients' symptoms increased following this procedure, and a diagnosis of post-traumatic Complex Regional Pain Syndrome was made. At this time patella infera was first observed.

When first seen in our centre, the patient was unable to work or participate in sport due to pain. He described the pain as a burning sensation around the patella, and on the sides of the knee, increased by flexion. On physical examination, the affected knee could move from zero degrees of extension to 90° of flexion, which compared with zero to 130 on the contralateral knee. The calculated Knee Society Score (KSS) Knee and Function scores were respectively 40 and 60. The Caton–Deschamps Index (CDI) calculated on lateral radiograph showed patella infera with 0.5 (normal 1 $\pm$ 0.2) on the affected knee and 1.1 on the contralateral knee (Figure 1).

2.1. Operative procedure

Prior to surgery, a fresh-frozen cadaveric allograft was obtained from the tissue bank, in compliance with the French Biomedicine Agency regulations. A calibrated lateral x-ray of the contralateral knee was performed and the dimensions of the PT and patella were used to obtain a precisely matched graft.

The patient was positioned supine, with a tourniquet placed proximally on the thigh, and the knee at 90° of flexion. A longitudinal anteromedial incision was made to expose the Anterior Tibial Tuberosity (ATT), the retracted PT, the Patella, and the Quadriceps Tendon (QT). During exposure, the allograft was being prepared according to a protocol that included systematic bacteriological sampling followed by 20 min of soaking in an antibiotic solution (Rifampicin 600 mg/l), and then 20 min of soaking in warm serum.

This technique combines lengthening of the PT and stabilisation by partial hourglass EMA reconstruction. The method of PT lengthening used was described by Dejour et al. in 1992 [3].

The extensor mechanism is incised longitudinally, from two centimetres proximal to the patella to the ATT. A “lateral flap” was created: its proximal part being composed of a superficial portion of the vastus lateralis muscle and the lateral half of the superficial lamina of the QT. Thus, the lateral and deep half of the QT stays in continuity with the patella. Distally, the flap was composed of the lateral retinaculum, the lateral prepatellar velum that has been gently detached from the patella and at the distal end by the lateral part of the remaining PT that was left inserted on the ATT. The corresponding “medial flap” was composed of (from proximal to distal) the full thickness, medial half of the QT, the whole patella, and the medial part of the PT which we gently detached and mobilised from the ATT (Figure 2). At this point, an adhesiolysis was performed in order to allow the patella to regain its normal height.

Preparation of the native patella and ATT to receive the allograft then began. The planned bone resection was marked with ink. An hourglass shaped trench 10 mm deep was carved into the native patella using a small oscillating saw in order to receive the patellar bone block. After determining the optimal positioning of the graft, a deep bone trough was created using an oscillating saw on the native ATT, to receive the tibial bone block.

The allograft patella was cut in the shape of an hourglass (wide proximally and distally and narrower in the middle) with an oscillating saw [4]. This particular shape enhanced the primary press fit of the bone block, diminishing the risk of distal sliding. It

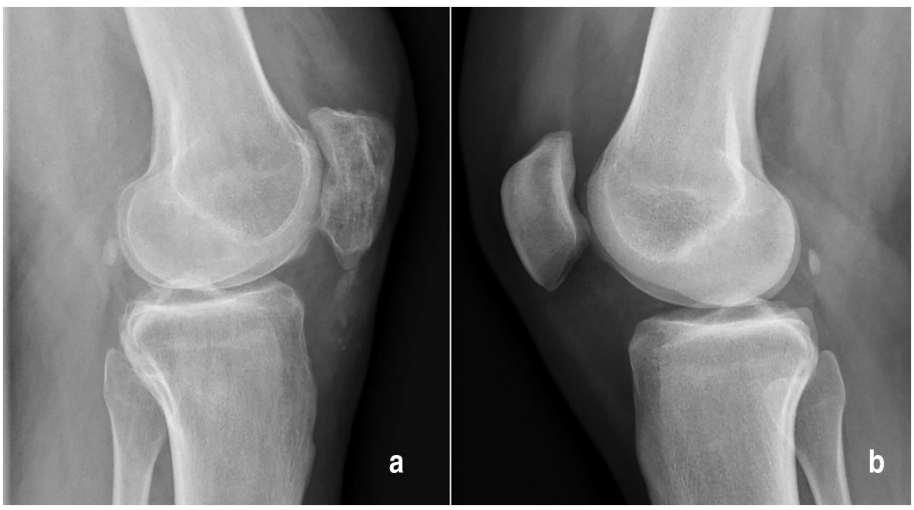

Figure 1. Preoperative radiographs: a. Lateral view of affected knee showing patella infera with CDI = 0.5 (<0.6). b. Lateral view of the contralateral knee with a normal CDI of 1.

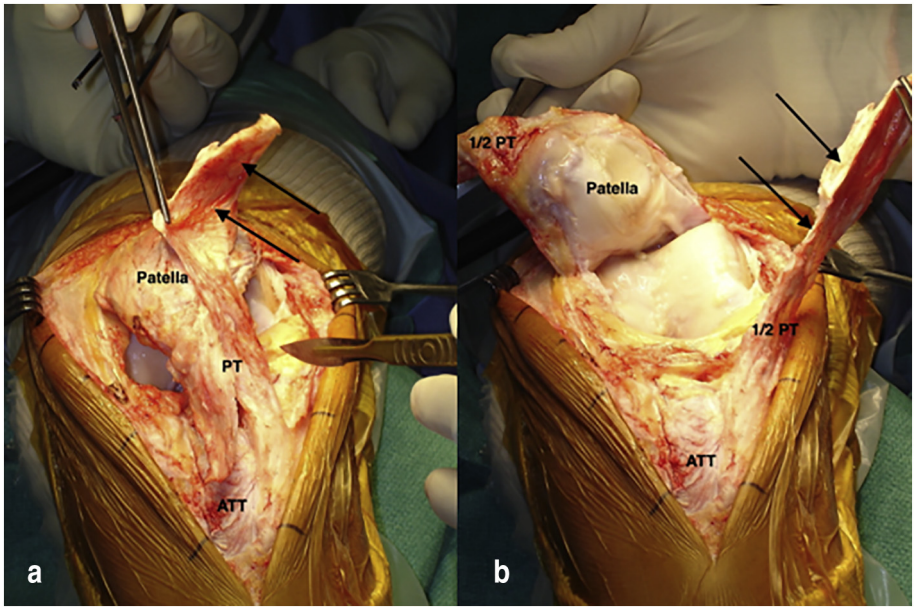

Figure 2. Anterior operative view of the knee during the Patellar Tendon lengthening: this view decrypts the Z-plasty technique. The black arrows point to the external flap. ATT: Anterior Tibial Tuberosity. ½ PT: medial or lateral half of the PT.

also preserved a large tendinous insertion on both ends without compromising the bone block. The allograft's ATT was then resized with the saw, so as to tightly fit the recess created distally, at the tibial insertion site.

The graft was placed, with the patellar bone block fitting in its trough and secured by three transosseous transverse cerclage wires. The tibial bone block was placed in its trough and stabilised by three bicortical compression screws. Post-fixation with a Hooper screw was also applied. The QT was then sutured by strong non-absorbable interrupted sutures. In this case, the medial flap (medial half of the PT) was reinserted 20 mm proximal than its original insertion using a metallic staple (Figure 3). The "hourglass" original technique is depicted in Figure 4 and the combination of the two techniques is depicted in Figure 5.

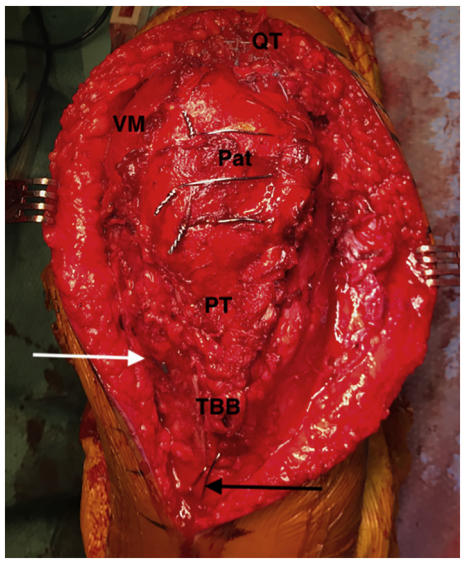

Figure 3. Anterior operative view of the allograft in situ in the receiving knee, after tourniquet release and before wound closure. The white arrow indicates the medial flap being stabilised 20 mm higher by a metallic staple. The black arrow indicates the post-fixation on a Hooper screw. VM: Vastus Medialis. QT: The allograft quadricipital portion is sutured by strong non-absorbable sutures. Pat: The hourglass patellar bone block is stabilised by three metallic wires. PT: Allograft patellar tendon. TBB: Tibial bone block pressfit in its trough and firmly stabilised by three compressive screws.

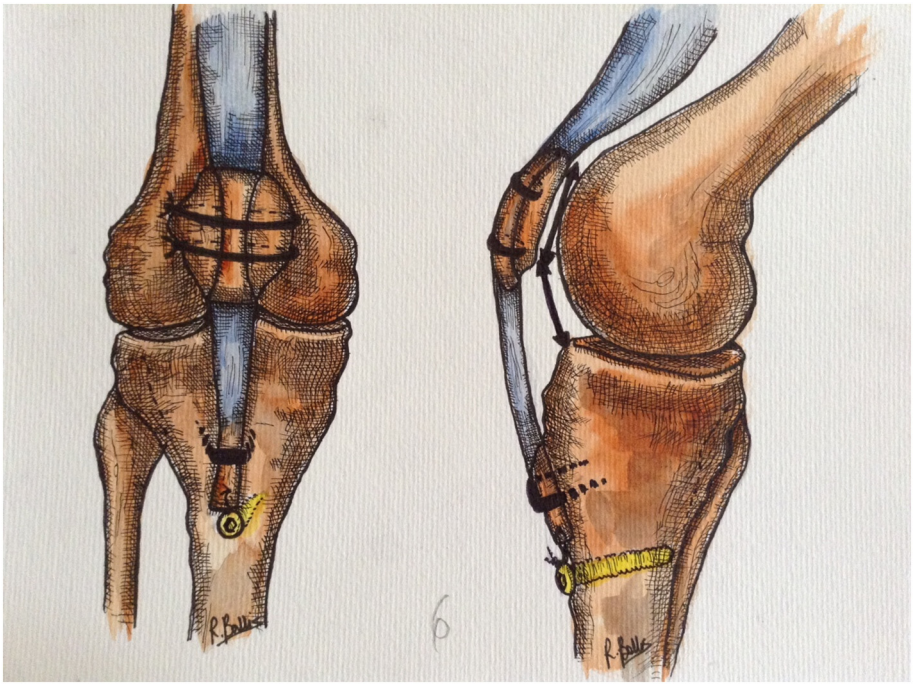

Figure 4. Schematic views of the "hourglass" partial EM allograft technique in a native knee: a. Extensor Mechanism Allograft with an "hourglass" shape patellar bone block. b. Partial Hourglass Allograft stabilised in a patellar trough with metallic wires and ATT trough with compressive screws. Author: Dr. Rosa Ballis.

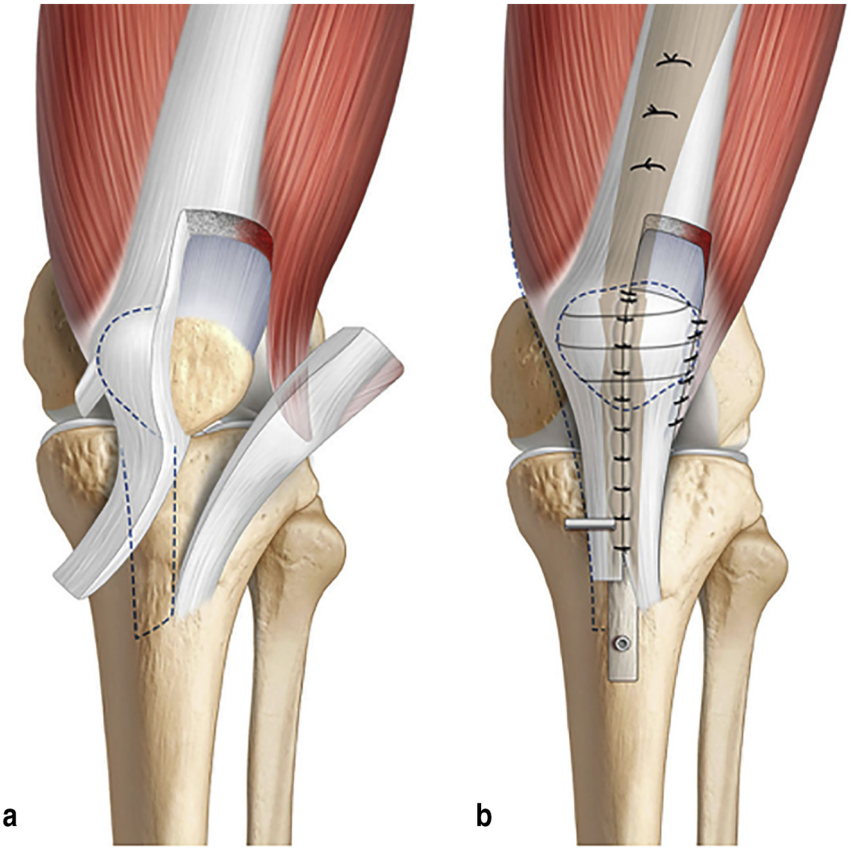

Figure 5. Schematic views of the combined technique of Z-plasty and partial Hourglass Extensor Mechanism Allograft in a native knee: a. Patellar Tendon lengthening by Dejour's technique. b. Postoperative view showing the partial allograft in place and the Z-plasty sutured. Author: Marc Donon.

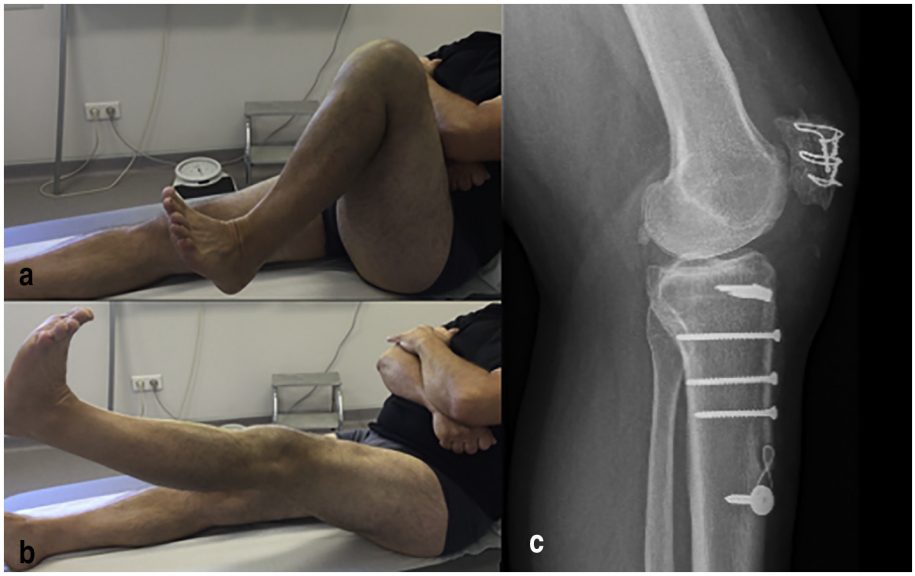

Figure 6. Clinical and radiologic outcome at 24 months of follow-up: a & b: Excellent clinical result with 130° of flexion and no extensor lag. c. Lateral view radiograph at 24 months of follow-up: we can note the bone healing and the absence of secondary migration. The CDI was normalised at 1.

2.2. Postoperative care

The patient was allowed to weight bear immediately with two splints: one ambulatory splint for the day at 0°, and one worn at night at 45° of flexion. Flexion commenced immediately as tolerated, with instructions to gradually increase under supervision to a limit of 90° for 45 days. The postoperative period was uneventful and at the six week mark, 75° of flexion was achieved without difficulty and no Extensor Lag (EL) was found. The splint was then removed and full ROM allowed. At six months, the patient had regained full extension, 130 of flexion, and had no extensor lag. At 24 months post-surgery, the patient displayed a strong active knee extension associated with 130° of flexion (Figure 6a–b). He did not complain of pain, and his KSS Knee and Function scores were 80 and 100 respectively. Radiographs showed complete bone healing and the CDI was normalised at 1 (Figure 6c).

3. Discussion

Patella infera is an uncommon but severe pathology. Classically, it can be seen after an insult to the knee, which in many cases may be surgical. It has been documented to have occurred following Anterior Cruciate Ligament reconstruction using the middle third of the PT, patella instability surgery, Total Knee Arthroplasty (TKA), direct or indirect injury like our patient, or infection; in summary, any pathology that causes inflammation then fibrosis, leading to retraction of the PT, fat pad and periretinacular tissues [1,5]. If left untreated, the retraction leads to a permanent shortening of the PT, thus lowering the patella.

The methods proposed to evaluate the patellar height are numerous, like the CDI [1] or its modified version mCDI applicable to both prosthetic and native knees [6], the Insall–Salvati Ratio [7] or the Blackburne–Peel Ratio [8]. Historically, we prefer using the CDI which is a pertinent and reliable index. The patella is defined as infera with a CDI <0.6.

To date, the two most frequently reported surgical treatments are ATT proximalisation (PT length $>$ 25 mm) [9] and Patellar Tendon lengthening (PT length $<$ 25 mm) [3]. ATT proximalisation has demonstrated satisfying outcomes; however, it does not address the pathologic shortening of the tendon. In that regard, PT lengthening seems more logical. Dejour's technique consists in a Z-plasty of the tendon. Gideroglu showed in an in-vitro study that Z-plasty was associated with significantly better results regarding lengthening, load to failure, and stiffness than other techniques [10].

Reports of alternative techniques consist of case reports, or series with inadequate follow-up to allow conclusions to be made. In et al. reported a lengthening in a single patient using the Ilizarov technique [11]. They described an excellent result with 120° of flexion at three months. Mariani in 1994 reported encouraging preliminary results with four patients at a 12 month mean follow-up, using a technique of combined PT lengthening and contralateral EM Autograft [12]. However, the follow-up in this series is short. Yoo et al. also reported a satisfactory outcome at 18 months on a patient who underwent reconstruction using Achilles tendon allograft for severe patella infera following TKA [13]. In this technique, the tendon was not lengthened but instead detached from its tibial insertion. Jeong and Wang in 2013 described a similar lengthening technique, but chose to reinforce with a Tibialis Anterior allograft fixed by bio-absorbable crosspins [14]. Finally, some authors favour tendon lengthening with reinforcement by a semitendinosus allograft.

For this case, we chose to use an hourglass shaped variant of partial EMA [4,15]. The use of allograft was preferable to autograft in this case because of the absence of donor site morbidity, in a patient who had previously developed chronic regional pain syndrome. Further, there is some evidence that tissue integration is similar [16]. The Z-plasty would normalise the patellar height

and the allograft would supply good quality tendon tissue and solid fixation to allow early mobilisation, reducing the chance of patella infera recurrence, EL or rupture.

There are a number of important key points. The patellar bone block's hourglass shape and its stabilisation by wires are paramount in order to prevent secondary migration, and the rehabilitation protocol should be carefully conducted and monitored to ensure success.

4. Conclusion

This combined PT lengthening and hourglass EMA technique can be a reliable option on native knees with mild to severe patella infera, producing a good clinical outcome in this case. In our opinion, this technique could also be applied to patella infera after TKA for which isolated PT lengthening presents a greater risk of secondary rupture or patella infera recurrence.

Conflicts of interest

C. Fiquet: None.
N. White: None.
R. Gaillard: None.
E. Servien: S&N consultant; Institutional support: Amplitude, Corin.
P. Neyret: Royalties from Tornier; Institutional support: none.
S. Lustig: S&N, Medacta and Lepine consultant; Institutional support: Amplitude, Corin.
This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors.

Acknowledgement

We thank Mr. Marc Donon and Dr. Rosa Ballis for their excellent artwork.

References

[1] Caton J, Deschamps G, Chambat P, Lerat JL, Dejour H. Patella infera. Apropos of 128 cases. Rev Chir Orthop Reparatrice Appar Mot 1982;68:317–25.
[2] Paulos LE, Wnorowski DC, Greenwald AE. Infrapatellar contracture syndrome. Diagnosis, treatment, and long-term followup. Am J Sports Med 1994;22:440–9.
[3] Dejour D, Levigne C, Dejour H. Postoperative low patella. Treatment by lengthening of the patellar tendon. Rev Chir Orthop Reparatrice Appar Mot 1995;81:286–95.
[4] Fiquet C, Schneider A, Ballis R, Servien E, Neyret P, Lustig S. Reconstructing the chronically disrupted knee extensor mechanism after total knee arthroplasty: hourglass variant of the original partial allograft technique. Orthop Traumatol Surg Res 2017;103(8):1197–200.
[5] Sharma V, Tsailas PG, Maheshwari AV, Ranawat AS, Ranawat CS. Does patellar eversion in total knee arthroplasty cause patella baja? Clin Orthop Relat Res 2008;466:2763–8.
[6] Caton JH, Prudhon JL, Aslanian T, Verdier R. Patellar height assessment in total knee arthroplasty: a new method. Int Orthop 2016;40:2527–31.
[7] Insall J, Salvati E. Patella position in the normal knee joint. Radiology 1971;101:101–4.
[8] Blackburne JS, Peel TE. A new method of measuring patellar height. J Bone Joint Surg Br 1977;59:241–2.
[9] Drexler M, Dwyer T, Marmor M, Reischl N, Cameron H, Sternheim A, et al. The treatment of acquired patella baja with proximalization of the tibial tuberosity: surgical technique and six year clinical outcome. Arthroscopy 2013;29:e155.
[10] Gideroglu K, Toksoy S, Akan M, Yildirim S, Sümbüloğlu E, Akoz T. In-vitro comparison of the lengthening and biomechanical properties of three tendon lengthening techniques. Eklem Hastalik Cerrahisi 2009;20:107–13.
[11] In Y, Kim SJ, Kwon YJ. Patellar tendon lengthening for patella infera using the Ilizarov technique. Bone Joint J 2007;89-B:398–400.
[12] Mariani PP. A new surgical procedure for the treatment of patella infera. Knee Surg 1994;2:238–41.
[13] Yoo J-H, Chang J-D, Seo Y-J, Baek S-W. Reconstruction of a patellar tendon with Achilles tendon allograft for severe patellar infera — a case report. Knee 2011;18:350–3.
[14] Jeong JS, Wang JH. Treatment of patella infera by patellar tendon lengthening and augmentation with tibialis anterior tendon allograft. Knee 2014;21:605–8.
[15] Magnussen RA, Lustig S, Demey G, Masdar H, ElGuindy A, Servien E, et al. Reconstruction of chronic patellar tendon ruptures with extensor mechanism allograft. Tech Knee Surg 2012;11:34–40.
[16] Robertson A, Nutton RW, Keating JF. Current trends in the use of tendon allografts in orthopaedic surgery. J Bone Joint Surg Br 2006;88:988–92.