Trauma Case Reports 51 (2024) 101012

Contents lists available at ScienceDirect

Trauma Case Reports

journal homepage: www.elsevier.com/locate/tcr

Case Report

Stepping into the Unknown: Unveiling the Rarity of PCL Fracture-Avulsions

Yassine Ben Bouzid *, Rida-Allah Bassir, Monsef Boufettal, Jalal Mekkaoui, Mohamed Kharmaz, Moulay Omar Lamrani, Mohamed Saleh Berrada

Department of Orthopaedic and Trauma Surgery, Ibn Sina University Hospital, Rabat, Morocco

ARTICLE INFO

Keywords:
PCL
Avulsion fracture
Rare
Arthroscopy

ABSTRACT

Tears of the posterior cruciate ligament (PCL) are rare, and avulsion fracture of the tibial attachment of the posterior cruciate ligament is even rarer. These injuries usually occur in accidents such as car crashes, causing acute pain, swelling as well as total functional impotence of the knee. Studies on the incidence of these injuries show variable results, but there appears to be an upward trend. The surgical management of PCL avulsion fracture is not clearly established, although arthroscopic techniques are becoming more popular due to their potential benefits. However, some medical centers may have limited access to these methods, thus preferring open surgery options. A case of LCP avulsion fracture in a 36-year-old female patient was reported, and surgery was successfully performed, leading to full recovery after six months with full knee mobility and posterior stability.

Introduction

Tears of the posterior cruciate ligament (PCL) are uncommon injuries, among which PCL avulsion fractures at the tibial insertion stand out for their extreme rarity. These fractures usually occur following injuries such as car accidents, where the knee is flexed and subjected to a recoil force at the pretibial area [1].

PCL tears are usually associated with intra-substance tears of the ligament, but cases of femoral detachment and tibial avulsion have also been reported [2]. As for the incidence of these PCL injuries, studies show fluctuating results, with reports indicating rates ranging from 3 % to 38 % of acute knee injuries [1,3,4]. However, more recent data suggest an upward trend in incidence over time, underlining the importance of better understanding and monitoring of these injuries [5].

Although several studies have investigated the management and clinical outcome of PCL avulsion fractures, there is no clear consensus yet on the best surgical approach for these specific cases [6]. Techniques for fracture reduction and fixation via arthroscopy are gaining increasing interest among sports injury specialists, due to their potential benefits, such as faster recovery and less tissue damage [1,4,5]. Nevertheless, it is essential to note that access to these methods may be limited in some medical facilities that have not yet fully mastered or adopted arthroscopic technology. Consequently, open reduction and internal fixation remain the preferred surgical option for some patients due to the challenges of learning and mastering arthroscopic techniques [7].

* Corresponding author.
E-mail address: yassine.benbouzid2@gmail.com (Y.B. Bouzid).

https://doi.org/10.1016/j.tcr.2024.101012
Accepted 2 April 2024
Available online 3 April 2024

Case presentation

A 36-year-old female patient was involved in a car accident with a direct impact to her left anterior knee in extension, causing acute knee pain with swelling and total functional impotence. The patient was admitted to the emergency room for clinical and radiological evaluation as well as treatment. Clinical examination revealed pain over the entire knee, accentuated by palpation of the posterior aspect of the knee as well as by knee extension. The patellar tap test was positive. Knee testing revealed a stable joint in both varus and valgus motion, with a negative anterior drawer test. However, the posterior drawer test was positive suggesting a Grade III laxity. Two radiographic views of the knee, frontal and lateral, revealed a discontinuity in the articular surface of the tibia (Fig. 1). Additional CT scans were ordered, revealing avulsion of the posterior tibial spine and the entire retro-spinal surface in a large ascending fragment (Fig. 2).

The surgical indication was retained. The patient was placed in the prone position with a tourniquet at the base of the left lower limb. Using the Trickey approach (Fig. 3), the posterior aspect of the proximal extremity of the tibia was exposed. Following a longitudinal arthrotomy, the bone fragment is reduced and stabilized using two 5 mm-diameter partially threaded cannulated screws, including one with a washer (Fig. 4). After image C-arm verification, we proceeded with a layered closure, with immobilization by splinting the knee in extension.

The postoperative course was simple. Analgesic medication was prescribed, in addition to thromboprophylaxis for 2 months. No weight-bearing was allowed for a period of 2 months, with immobilization in extension by a splint. During the first two months, passive mobilization of the knee was allowed in a flexion-extension range of 0° to 90° to prevent flexion deformity and stiffness. Partial weight-bearing was allowed after two months, along with the initiation of active mobilization. At 6 months post-op, full weight-bearing was regained with total knee mobility. In addition, there was no knee laxity and no posterior instability.

Discussion

Around 20 % of all knee ligament injuries are attributed to posterior cruciate ligament (PCL) tears [8]. These injuries are often associated with road traffic accidents; people practicing contact sports are particularly at risk of PCL tears [1,9]. Avulsion fractures of the posterior cruciate ligament (PCL) share a similar mechanism with intrasubstance PCL tears [2]. These avulsion fractures most commonly occur following road traffic accidents, particularly a motorcycle accident, where a dashboard injury occurs when the bent knee is subjected to a backward-directed force at the proximal tibia. Another common mechanism is sports trauma, in which hyperextension of the knee can lead to injury [2]. Tibial PCL avulsion fractures are the most common of the isolated PCL fractures, but concomitant injuries are often observed, including meniscal and additional ligament injuries [2].

The detection of avulsion fractures of the posterior cruciate ligament (PCL) is of crucial importance. Among the different perspectives used to examine the knee and gather evidence of other lesions, the lateral view has proven to be the most valuable. Avulsion fractures of the PCL are characterized by a focal discontinuity of the PCL facet at the back of the tibia [10]. However, care must be taken to avoid underestimating fragment displacement. An important feature to consider when radiographically assessing PCL injuries is its insertion point, which lies approximately 10 mm below the joint line. This has a direct impact on the visualization of fragments in the presence of lesions. Indeed, fragments with a displacement of less than 10 mm may be missed on conventional radiography. For better visualization, these fragments need to be displaced by more than 10 mm, which makes their radiographic identification easier.

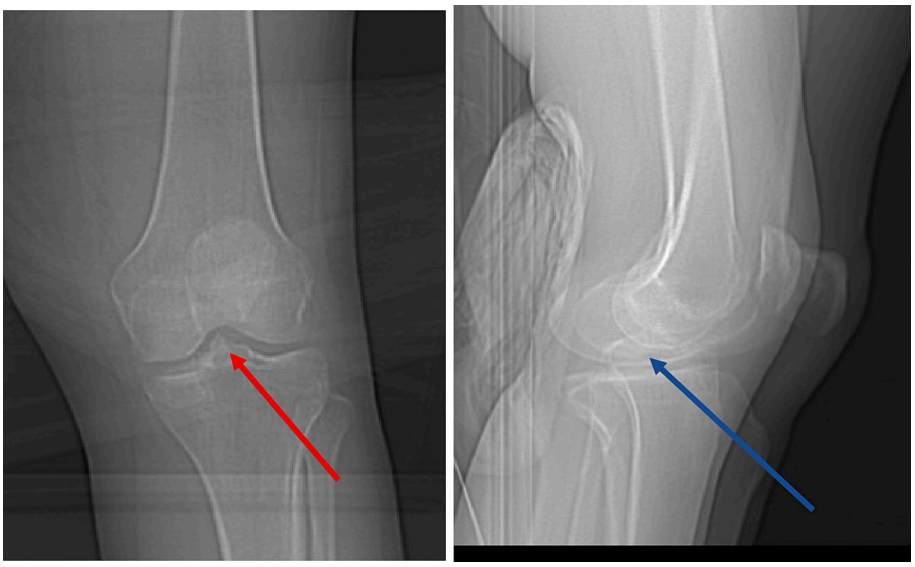

Fig. 1. Standard radiography shows a discontinuity in the joint space (red arrow) with an ascending fragment at the expense of the tibial spine complex (blue arrow). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

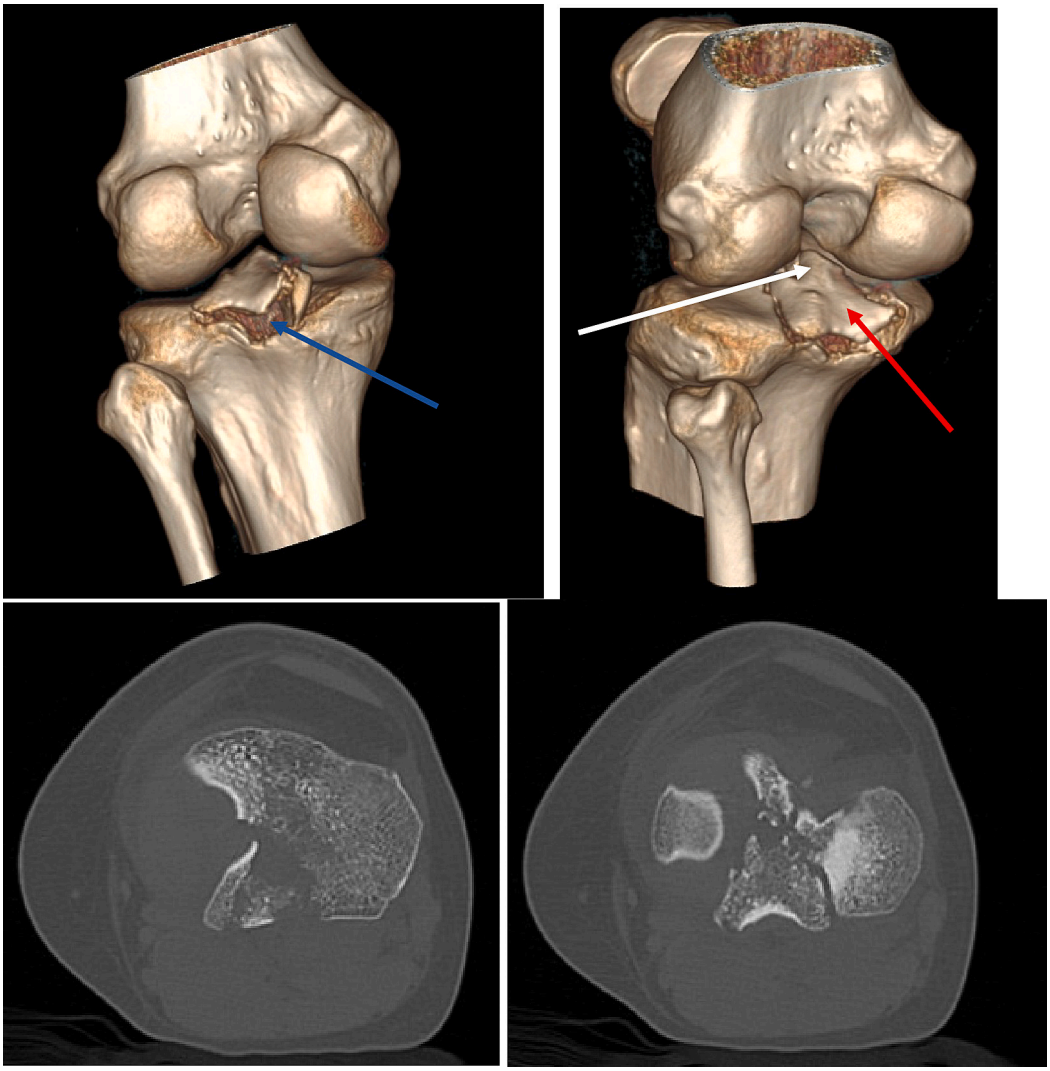

Fig. 2. CT scans with 3D reconstruction confirm the diagnosis, showing a large articular fragment involving the posterior tibial spine (white arrow) and the entire retro-spinal surface (red arrow). The avulsion is also obvious (blue arrow). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Thus, when fragments of this range are clearly detectable, this may indicate a significant displacement of the PCL [11].

When posterior cruciate ligament (PCL) avulsion is suspected in a patient, but visualization is unclear on radiographs or the degree of displacement is uncertain, magnetic resonance imaging (MRI) is recommended for further evaluation [11,12]. Indeed, the avulsion fracture of the PCL appears on radiographs as a focal discontinuity in the posterior part of the tibia [13]. To obtain additional information on the size and fragmentation of fracture fragments, as well as for possible preoperative planning, CT scans with 3D reconstructions can be used [10–13]. This more advanced imaging approach is highly valuable for a better understanding of PCL lesions and can guide clinical decisions for effective, personalized treatment strategies.

Avulsion fractures of the posterior cruciate ligament (PCL) are classified into three types according to the Meyers McKeever classification, each with specific characteristics. Type I refers to fractures with no displacement of the fragments, type II is characterized by a slight displacement of the posterior edge with an intact anterior cortex acting as a hinge, while type III presents a complete displacement with no osseous connection [2,6]. For Type I fractures, where the fracture fragments show no displacement, non-surgical treatment can be considered. However, in cases of type II and III fractures, where there is significant displacement, a surgical approach is generally recommended. Surgical reduction and fixation are techniques commonly used to stabilize the avulsed fragment and promote optimal recovery. The choice of treatment, therefore, depends on the fracture classification, as each type of fracture requires a specific approach to ensure adequate ligament repair and successful patient recovery. Accurate fracture evaluation and informed decision-making based on injury severity are essential to achieve the best clinical and functional outcomes for patients with avulsed PCL fractures [2,6].

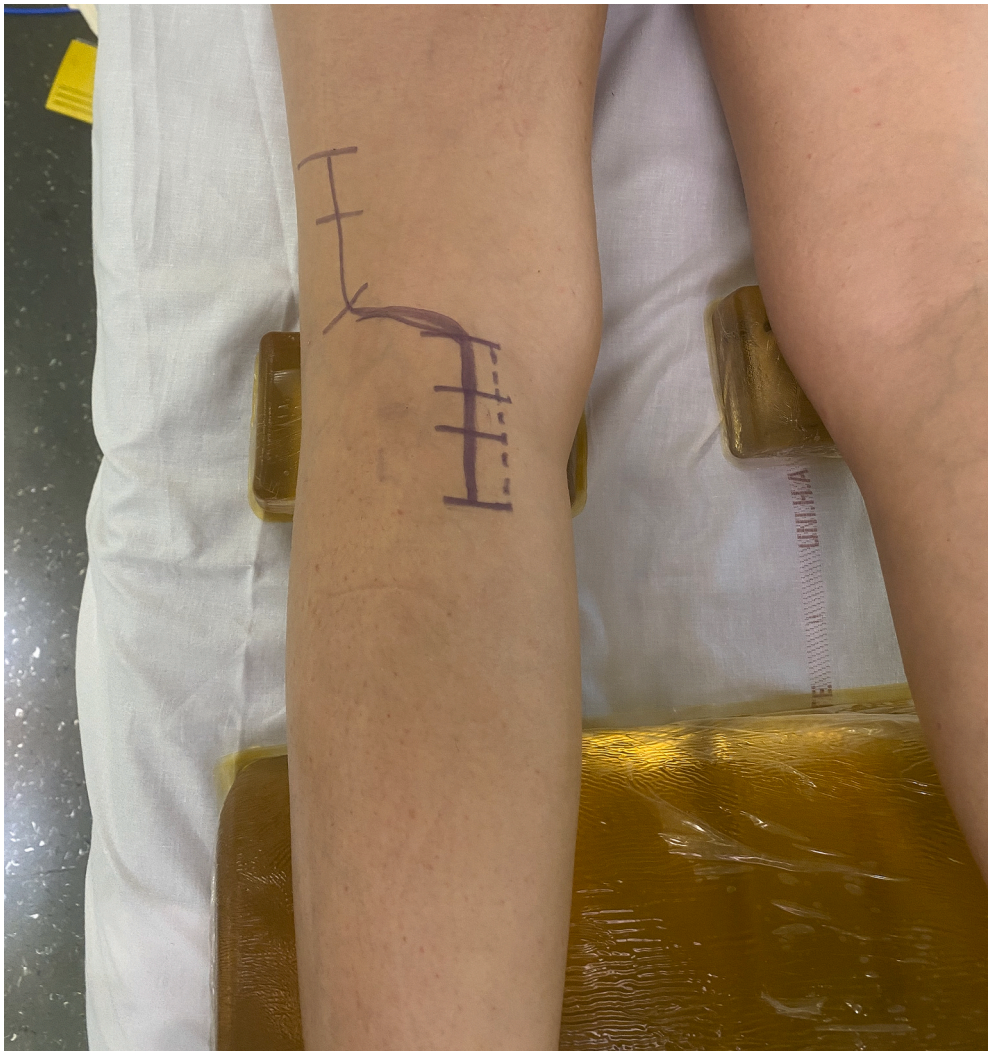

Fig. 3. The proximal end of the tibia was approached using the Trickey method.

The treatment of posterior cruciate ligament (PCL) avulsion fractures is a challenging field in which various therapeutic approaches are available, but none has yet established itself as the surgical technique of reference [14, 15]. The choice of treatment must be carefully evaluated, taking into account several factors such as the type and size of the fracture, the extent of displacement, the presence of comminution, and potential associated lesions [13]. A study by Zhao et al. suggests that displaced fractures of less than 5 mm can be successfully treated non-operatively [11]. However, despite the potential benefits, it is crucial to consider the long-term risks, such as loss of knee range of motion and residual PCL laxity, which could turn into major problems for the patient [16].

Arthroscopic surgery is considered the optimal option for the treatment of avulsive posterior cruciate ligament (PCL) fractures due to its minimally invasive nature. Materials commonly used for surgical fixation include metal screws, sutures, steel wires, and anchors [17–22].

However, arthroscopic restoration presents technical challenges, a steep learning curve and requires specialized equipment, which can make this procedure more difficult to perform than open surgery. Many primary care facilities may prefer the arthroscopic approach for its practicality. On the other hand, open surgical approaches such as the classic posterior medial or S-shaped incision for rigid internal fixation (ORIF) carry risks of vascular and nerve damage, while the open posteromedial technique offers better exposure of the fracture without compromising nerves and blood vessels. The T-shaped incision is also preferred for its simplicity and minimal effect on the knee in terms of scarring [22].

Several studies have compared open and arthroscopic surgical approaches for avulsive PCL fractures. Ling et al. performed a randomized study with a small sample of patients and observed similar results in terms of postoperative range of motion, Lysholm score and STS laxity instrumented with the KT-1000 between both groups [23]. Similarly, Sabat et al. conducted a retrospective review and found that arthroscopic treatment was advantageous in terms of laxity measurement, while Lysholm scores, Tegner activity, IKDC scores, and single-leg hop test were comparable between arthroscopic and open approaches [23]. However, it is important to note that

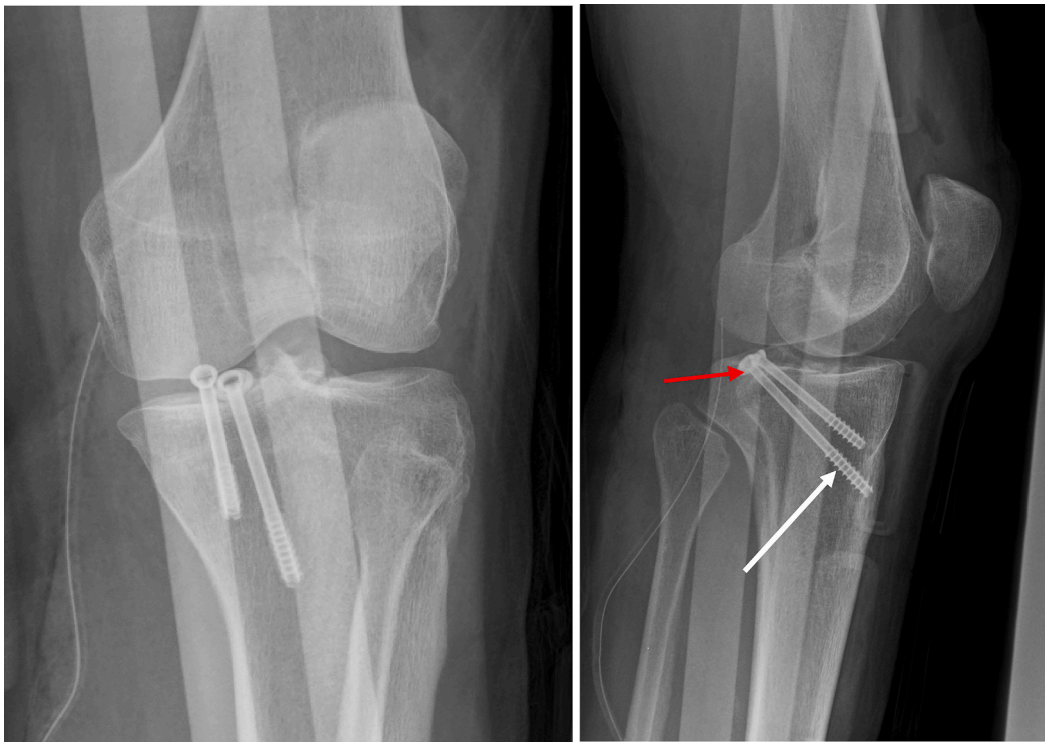

Fig. 4. The fragment was secured by two cannulated screws threaded partially (white arrow). Fixation was reinforced with a washer on one screw (red arrow). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

arthroscopic reduction and fixation can be more complex and require special expertise, which may explain why some primary medical institutions still prefer the open approach for these specific cases of avulsive PCL fractures.

Ethics approval and consent to participate

The study is exempt from ethical approval in our institution. Written informed consent was obtained from the patient for the publication of this case report and accompanying images.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Consent

Written informed consent was obtained from the patient for publication and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Guarantor

Ben Bouzid Yassine, M.D.

CRediT authorship contribution statement

Yassine Ben Bouzid: Writing – original draft. **Rida-Allah Bassir:** Data curation. **Monsef Boufettal:** Data curation. **Jalal Mekkaoui:** Formal analysis, Writing – review & editing. **Moulay Omar Lamrani:** Writing – review & editing. **Mohamed Saleh Berrada:** Formal analysis, Investigation.

Declaration of competing interest

The authors declare that there is no conflict of interest.

Data availability

The datasets used and analyzed during the study are available from the corresponding author.

References

[1] A.T. Janousek, D.G. Jones, M. Clatworthy, et al., Posterior cruciate ligament injuries of the knee joint, Sports Med. 6 (1999) 429–441.
[2] Hooper PO. Management of posterior cruciate ligament tibial avulsion injuries: a systematic review. Am. J. Sports Med.
[3] Barros MA. Surgical treatment of avulsion fractures at the tibial insertion of the posterior cruciate ligament: functional result. Rev. Bras. Ortop. (English ed.). 50 (6):631–7.
[4] Fanelli GC. Posterior cruciate ligament injuries in trauma patients: part II. Arthroscopy. 11(5):526–9.
[5] Mariani PP. Surgical treatment of posterior cruciate ligament and posterolateral corner injuries. An anatomical, biomechanical and clinical review. Knee. 10(4): 311–24.
[6] A. Katsman, E.J. Strauss, K.A. Campbell, M.J. Alaia, Posterior cruciate ligament avulsion fractures, Curr. Rev. Musculoskelet. Med. 11 (3) (Sep 2018) 503–509, https://doi.org/10.1007/s12178-018-9491-2. PMID: 29869136; PMCID: PMC6105473.
[7] H. Qi, Y. Lu, M. Li, C. Ren, Y. Xu, T. Ma, Q. Wang, K. Zhang, Z. Li, Open reduction and internal fixation of the tibial avulsion fracture of the posterior cruciate ligament: which is better, a hollow lag screw combined with a gasket or a homemade hook plate? BMC Musculoskelet. Disord. 23 (1) (Feb 11 2022) 143, https://doi.org/10.1186/s12891-022-05096-0. PMID: 35148737; PMCID: PMC8840316.
[8] D.J. Deehan, L.A. Pinczewski, Arthroscopic reattachment of an avulsion fracture of the tibial insertion of the posterior cruciate ligament, Arthroscopy 17 (4) (2001) 422–425.
[9] M.S. Schulz, K. Russe, A. Weiler, et al., Epidemiology of posterior cruciate ligament injuries, Arch. Orthop. Trauma Surg. 123 (4) (2003) 186–191.
[10] Griffith JF. Cruciate ligament avulsion fractures. Arthroscopy. 20(8):803–12.
[11] Zhao J. Arthroscopic treatment of acute tibial avulsion fracture of the posterior cruciate ligament with suture fixation technique through Y-shaped bone tunnels. Arthroscopy. 22(2):172–81.
[12] Dhillon MS. Posterior cruciate ligament avulsion from the tibia: fixation by a posteromedial approach. Acta Orthop. Belg. 69(2): 162–7.
[13] E.A. White, Cruciate ligament avulsion fractures: anatomy, biomechanics, injury patterns, and approach to management, Emerg. Radiol. 20 (5) (2013) 429–440.
[14] Chen C-H. Surgical treatment of posterior cruciate ligament injury. Chang Gung Med. J. 30:480–92. 16.
[15] Malempati C. Current arthroscopic concepts in repairing posterior cruciate ligament tibial-sided avulsions. Orthopedics (Thorofare, N.J.). 38(9):563–9.
[16] K.D. Shelbourne, T.J. Davis, D.V. Patel, The natural history of acute, isolated, nonoperatively treated posterior cruciate ligament injuries. A prospective study, Am. J. Sports Med. 3 (1999) 276–283.
[17] M. Veselko, V. Saciri, Posterior approach for arthroscopic reduction and antegrade fxation of avulsion fracture of the posterior cruciate ligament from the tibia with cannulated screw and washer, Arthroscopy 19 (8) (2003) 916–921 (22).
[18] U. Horas, S.A. Meissner, C. Heiss, et al., Arthroscopic fxation of posterior cruciate ligament avulsion fractures: a new minimally invasive technique, Knee Surg. Sports Traumatol. Arthrosc. 18 (6) (2010) 781–783 (23).
[19] W. Chen, D. Tang, L. Kang, et al., Efects of microendoscopy-assisted reduction and screw fxation through a single mini-incision on posterior cruciate ligament tibial avulsion fracture, Arch. Orthop. Trauma Surg. 132 (4) (2012) 429–435 (24).
[20] S.M. Jazayeri, A.A. Esmaili Jah, M. Karami, A safe postero-medial approach to posterior cruciate ligament avulsion fracture, Knee Surg. Sports Traumatol. Arthrosc. 17 (3) (2009) 244–247 (25).
[21] J. Gui, L. Wang, Y. Jiang, et al., Single-tunnel suture fxation of posterior cruciate ligament avulsion fracture, Arthroscopy 25 (1) (2009) 78–85 (26).
[22] Nicandri GT, Klineberg EO, Wahl CJ, et al. Treatment of posterior cruciat.
[23] Sabat D. Displaced posterior cruciate ligament avulsion fractures: a retrospective comparative study between open posterior approach and arthroscopic single-tunnel suture fixation. Arthroscopy. 32(1): 44–53.