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Knee central pivot bicruciate avulsion and proximal anterior cruciate ligament tear primary repair: A rare case report

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ABSTRACT

The knee is susceptible to complex injuries after trauma including fractures, multiple ligamentous lesions and avulsions due to its numerous tendinous, ligamentous and meniscal attachments. The authors describe a rare case of a 33-year-old male patient with a trauma of the right knee following a motorcycle accident, who sustained avulsion of both femoral and tibial insertion sites of anterior cruciate ligament and avulsion of tibial insertion of posterior cruciate ligament without other associated ligament lesions. The patient underwent a clinical-anamnestic and imaging evaluation to identify the lesions. Knee X-rays showed a tibial avulsion of anterior and posterior cruciate ligaments confirmed by CT scan, classified as type 3b according to Meyers and McKeever. The authors decided for a surgical management: reduction and internal fixation of anterior and posterior cruciate ligament tibial bone fragments and repair of anterior cruciate ligament femoral avulsion using suture pull-out technique. The patient has been followed, with accurate clinical and radiological follow up controls, for 12 months and showed excellent clinical outcomes using Tegner-Lysholm Knee Score (95/100 points) and good range of motion and knee stability.

Introduction

Cruciate ligaments lesions, mainly of anterior cruciate, are constantly increasing in people involved in pivoting sports, other athletic activities and not only. Cruciate ligaments injuries, according to the site of rupture, can be classified in proximal, mid-substance, distal tear and proximal or distal avulsion (less common) [1]. Avulsion fractures can be seen on X-ray, but Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) are mandatory for lesion characterization and surgical planning. The purpose of this article was to report a rare case of a tibial central pivot avulsion fracture with anterior cruciate ligament (ACL) femoral tear and describe an appropriate diagnostic and therapeutic protocol.

Case report

A 33 years-old male came to our emergency department (ED) because of motorcycle crash. On admission, he complained pain and

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functional impairment of the right knee, without loss of consciousness or focal neurologic deficits. Clinical exam revealed swollen knee, tenderness to palpation, positivity of anterior and posterior Drawer and Lachman tests and stability under Varus-Valgus stress. Knee X-rays, taken in ED, showed a tibial avulsion of anterior and posterior cruciate ligaments (PCL) (Fig. 1). The patient underwent a CT scan, that confirmed a comminuted avulsion-fracture of tibial spines, (Fig. 2) classified as type 3b according to Meyers and McKeever. No other injuries were reported. The patient was discharged with no weight bearing leg cast, painkillers and anti-thromboembolic prophylaxis. Ten days later, after swelling reduction, patient underwent surgery. Under general anesthesia, 2 g of intravenous cephalosporin was administered before inflation of a thigh tourniquet. The patient was placed in prone position and the posteromedial Lobenhoffer approach was used. The arthrotomy revealed the avulsed posterior tibial spine. The bony fragment, preliminary reduced with Kirshner (K) wires, under fluoroscopic control, was fixed with a 3 mm partially threaded cannulated screw and a washer. Following, the patient was positioned supine and the surgical field was changed to allow anterior approach. Mini medial parapatellar access was performed to expose the anterior tibial spine fragment. The arthrotomy revealed a large fragment preliminary reduced with K-wires, under fluoroscopic control, and then fixed with 2.7 mm Herbert screw. During evaluation of ACL tension, its femoral avulsion was disclosed and subsequently repaired with Pull-Out technique. Final fluoroscopic controls confirmed good fracture reduction. Postoperatively, the knee was braced in extension for 4 weeks and the patient was mobilized non-weight-bearing with two crutches. Additionally, rehabilitation protocol was activated to regain the quadriceps strength. Pivoting sport was not recommended for 6 months and contact sports for 9. The follow up time was 12 months. The clinical and radiological assessment was performed every 30 days for the first 3 months. After 12 weeks of follow-up, the knee was stable without ligament laxity in any direction of motion, the range of motion (ROM) was 0°-130°. X-rays controls reported fractures consolidation (Fig. 3) and full weight-bearing was allowed. During the last follow-up after 12 months, the patient was able to perform his basic activities of daily living. The Tegner-Lysholm Knee scoring scale was excellent (95/100 points). The clinical examination revealed a well healed scar, normal gait and negative Lachman and Pivot Shift tests.

Discussion

The cruciate ligaments lesions involving mid-substance are commonly documented while the fractures of intercondylar tibial eminence remain less described in literature. Although avulsion fracture of both femoral and tibial insertions of cruciate ligaments are documented, to our knowledge a case of tibial central pivot avulsion with anterior cruciate ligament femoral tear is not described in literature. The treatment of avulsion fractures of tibial pivot has changed during decades, starting from conservative management and progressing to open or arthroscopic reduction. The optimal approach and fixation method to treat these injuries is still debated. In adult, the tibial pivot avulsion commonly results from hyperextension trauma, such as sport trauma or traffic accidents. The first classification of tibial pivot fracture was developed by Meyers and McKeever. They described three types of fracture pattern according to displacement and comminution: non-displaced or minimally displaced avulsions (type I), displacement of anterior fragment with preserved posterior cortical hinge (type II), displaced with involvement of ACL insertion or include entire intercondylar eminence (type IIIa/IIIb). Zaricznyj introduced type IV including both displacement and comminution (Fig. 4). The main objective of treatment is to reduce the fracture anatomically. In type I, there is general agreement for conservative approach with knee immobilization. In type



Fig. 1. Tibial pivot fracture X-ray a: Antero-posterior view, b: Lateral view.



Fig. 2. Tibial pivot fracture CT Scan a-b: Antero-posterior view, c: Lateral view.

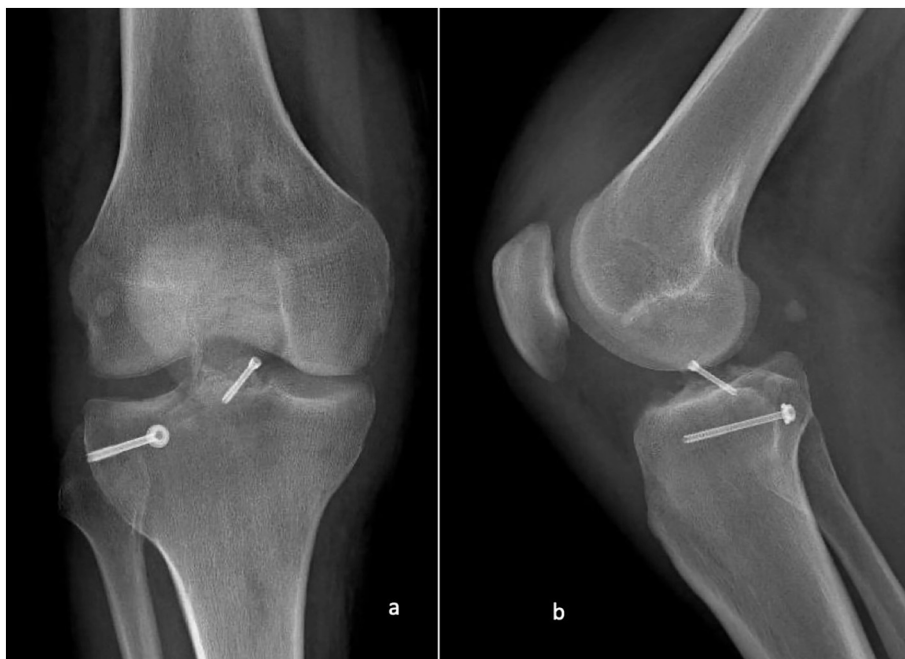


Fig. 3. X-rays at 12 months post-operatively a: Antero-posterior view, b: Lateral view.

II treatment remains controversial. If a good reduction is not confirmed at x-rays after close treatment, a surgical approach is suggested. Some authors [2] concluded that displacement less than 5 mm can treat conservative obtaining good functional results. Others [3] recommend surgical treatment for both II and III types. In type III and IV, operative approach is indicated, because conservative treatment can lead to high rate of complications, like non-union, stiffness, loss of ROM and instability. [4] Tibial avulsion fracture of PCL are often associated to other knee lesions, and an exhaustive physical examination is required. The optimal treatment of PCL tibial avulsion remains challenging. While a conservative management is adopted in case of non-displaced fractures and of multiple ligament injuries, the operative fixation is preferred for displaced PCL avulsion [5]. According to literature, numerous controversial results are described for conservative treatment [6]. The surgical treatment methods range from the open surgery to arthroscopic technique with several types of internal fixation. Some authors [5] recommended open approach because it offers direct visualization and allows anatomic reduction with compression. In literature many authors examined arthroscopic and open technique. Sabat et Al. [7], compared the two surgical options obtaining comparable results. Hooper et Al. [8] in a systematic review, reported comparable outcomes of Lysholm score between arthroscopic and open approach but who treated arthroscopically had higher recovery of pre-injury activities. ACL tibial avulsion may undergo reduction in case of significant displacement to restore articular congruity. A competent ACL is necessary to recover optimal knee function. Moreover, an untreated tibial avulsion can lead to instability and loss of

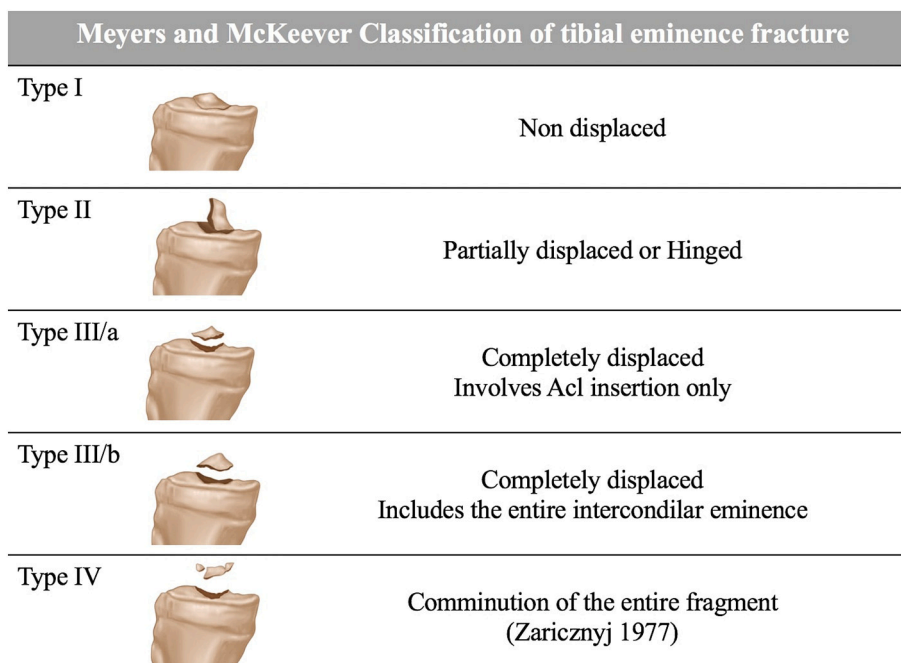


Fig. 4. Tibial spines Modified Meyer and McKeever Classification.

ROM in extension. In literature different techniques are mentioned. Open reduction and fixation with cannulated screws provides fracture stabilization, good ligament tension and bone-to-bone healing, but the risk of hardware impingement, of blocking extension and the possibility of additional surgery for hardware removal are documented [9]. Arthroscopic technique allows a direct view of reduction with less invasive approach but needs a long learning curve. Some authors [10] report efficacy result with open approach highlighting the relevance of anatomical reduction and direct visualization of synthesis stability. Others [11] prefer arthroscopic fixation to treat displaced ACL tibial avulsion because this technique allows treatment of concomitant pathology, earlier mobilization, avoiding knee stiffness and residual instability. In our experience, the open approach ensured surgeons to have a direct view of the fractures, check the anatomic reduction e verify the proper ligaments tension. The patient could have started the immediately rehabilitation program reducing the risk of stiffness.

Conclusion

In our case report we recommend the importance of prompt diagnosis with clinical-anamnestic evaluation and second level imaging, to develop the best surgical planning according to lesion classification type, surgeon preference and functional request. With this regard, the patient may recover the knee function and prevent short and long-term consequences of delayed treatment, in particular morbidity associated with post-traumatic osteoarthritis.

Ethics approval

The local institutional review board approved this study.

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Declaration of competing interest

The authors declare that they have no competing interests.

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References

- [1] J.P. Van der List, D.N. Mintz, G.S. DiFelice, The location of anterior cruciate ligament tears: a prevalence study using magnetic resonance imaging, *Orthop J Sports Med* 5 (2017), 232596711770996.
- [2] E.W. Edmonds, M.M. King, A.T. Pennock, Results of displaced pediatric tibial spine fractures: a comparison between open, arthroscopic, and closed management, *J. Pediatr. Orthop.* 35 (2015) 6.
- [3] C. Coyle, S. Jagernauth, M. Ramachandran, Tibial eminence fractures in the paediatric population: a systematic review, *J. Child. Orthop.* 8 (2014) 149–159.
- [4] M. Tuca, N. Bernal, E. Luderowski, D.W. Green, Tibial spine avulsion fractures: treatment update, *Curr. Opin. Pediatr.* 31 (2019) 103–111.
- [5] A. Katsman, E.J. Strauss, K.A. Campbell, M.J. Alaia, Posterior cruciate ligament avulsion fractures, *Curr Rev Musculoskelet Med* 11 (2018) 503–509.
- [6] A. H Kerketta, P.A. Afzal, Rajan DV. An unusual case of both anterior and posterior cruciate avulsion fracture at the insertional site in an isolated injury of skeletally mature knee: a case report, *IOSR J Dent Med Sci* 13 (2014) 05–07.
- [7] D. Sabat, A. Jain, V. Kumar, Displaced posterior cruciate ligament avulsion fractures: a retrospective comparative study between open posterior approach and arthroscopic single-tunnel suture fixation, *Arthrosc J Arthrosc Relat Surg* 32 (2016) 44–53.
- [8] P.O. Hooper, C. Silko, T.L. Malcolm, L.D. Farrow, Management of posterior cruciate ligament tibial avulsion injuries: a systematic review, *Am. J. Sports Med.* 46 (2018) 734–742.
- [9] P. Reynders, K. Reynders, P. Broos, Pediatric and adolescent tibial eminence fractures: arthroscopic cannulated screw fixation, *J. Trauma* 53 (2002) 49–54.
- [10] V. Chawda, R, J. Patel V, M. Ninama D, N. Patel H. Anterior tibial spine (ACL avulsion) fracture treated with open reduction and fixation with screw: surgical technique, functional and clinico-radiological outcomes. *Int J Res Orthop* 5 (2019) 340.
- [11] S.F. DeFroda, J.D. Hodax, K.N. Shah, A.I. Cruz, Tibial eminence fracture repair with double Hewson suture passer technique, *Arthrosc Tech* 6 (2017) e1275–e1279.