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Case Report

Orthopaedics Section

Intricate Tibial Plateau Pivot Fracture with PCL Avulsion: A Case Report

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ABSTRACT

This case report presents an unusual type of tibial plateau fracture, referred to as a "pivot fracture," resulting from a high-velocity trauma along with a Posterior Cruciate Ligament (PCL) avulsion, a pattern not covered under standard classification systems. The patient was managed with open reduction of both the pivot fracture and the PCL avulsion fragment through the Burks and Schaffer approach. Postoperative care included a structured rehabilitation protocol. Although there was a delayed union of the femur fracture sustained in the same incident, the patient regained full knee Range of Motion (ROM) by the eighth month. This case highlights the challenging nature of tibial plateau fractures, the need for tailored surgical approaches, and the importance of meticulous preoperative planning, underscoring the necessity for flexible and case-specific treatment strategies.

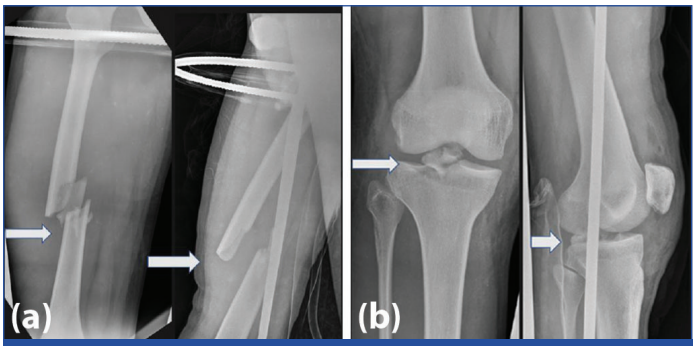
Keywords: Avulsion, Burk and Schaffer technique, Fracture classification, Knee injuries, Pivot fracture, Orthopaedic surgery, Posterior cruciate ligament

CASE REPORT

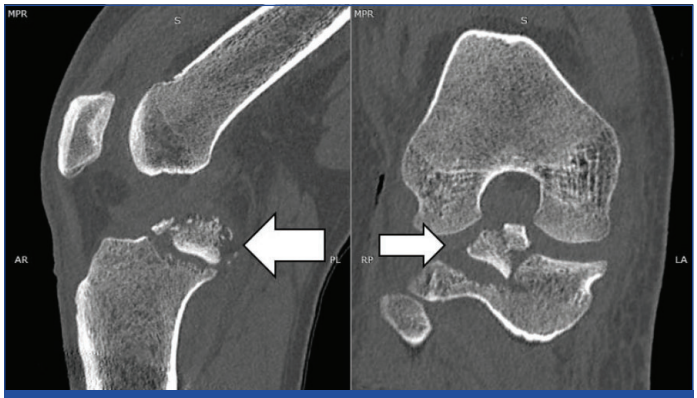
A 20-year-old male was admitted to the Department of Orthopaedics following a high-velocity road traffic accident. The incident occurred when the motorcycle he was riding, collided with a heavy vehicle at an intersection, throwing him off balance and causing him to land with significant force on his right side. He sustained a direct impact to his right thigh, followed by a twisting injury to his right knee as he attempted to regain control. At the scene, he was conscious but disoriented. On arrival at the emergency department, his initial Glasgow Coma Scale (GCS) score was 14/15 (E4V4M6), indicating mild disorientation but no loss of consciousness. His vital signs at admission were: blood pressure 122/80 mmHg, heart rate 102 beats per minute, respiratory rate 20 breaths per minute, and oxygen saturation of 97% on room air.

On physical examination, the thigh region exhibited notable swelling, tenderness and abnormal mobility. In the right knee joint, additional signs of trauma were observed. Laceration of skin about 8 cm extending to the subcutaneous plane was noted over the patellar tendon. Swelling was evident, and the patient exhibited a restricted ROM. Notably, a posterior sag was observed during the examination. There were no signs of distal neurovascular deficits.

Based on the initial clinical assessment, X-ray and CT scan, a diagnosis of closed comminuted shaft of the femur fracture with a concurrent avulsion fracture of the PCL with soft tissue injury over the knee was made [Table/Fig-1,2]. A subsequent staged treatment plan was developed to address the multifaceted fracture patterns and to provide the patient with the most appropriate care.



[Table/Fig-1]: a) X-ray of patient showing shaft of femur fracture-right side; b) X-ray of patient showing proximal tibia fracture-right side.



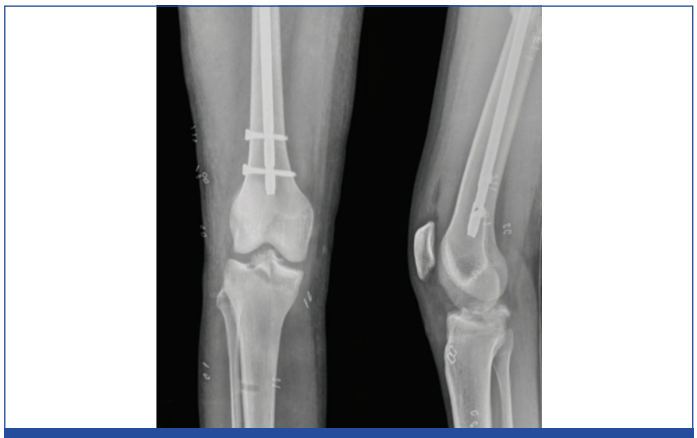
[Table/Fig-2]: CT scan of patient showing proximal tibial fracture-right side.

Stage 1: Emergency debridement of knee laceration with exploration (within 12 hours of injury): The patient underwent emergency debridement of a knee laceration. The surgical team explored the wound to assess the extent of soft tissue injury and ensure proper wound care to minimise the risk of infection.

Stage 2: Open reduction and Intramedullary Interlocking (IMIL) nail for femur (after 48 hours)

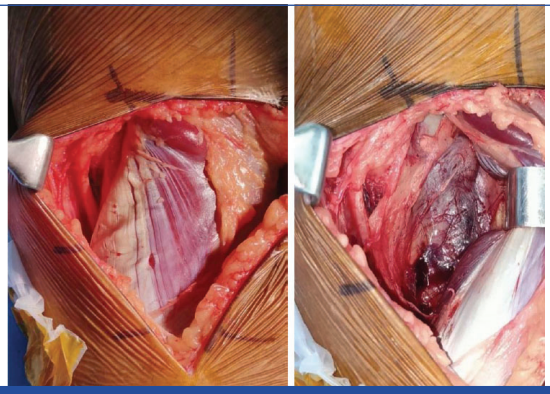
After initial wound care, the patient underwent open reduction and internal fixation for the femur fracture.

The surgical procedure involved the open reduction of the fractured femur, followed by the insertion of an IMIL nail for stable fixation and alignment [Table/Fig-3].



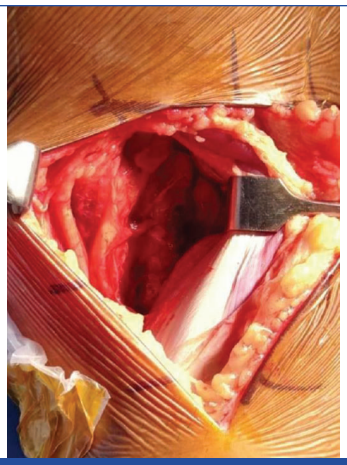
[Table/Fig-3]: Post-femoral fixation X-rays of patient: right knee.

Under anaesthesia, PCL laxity was noted. Anterior lachmann showed only grade 1 laxity [1]. The patient was positioned in a prone manner to facilitate access to the affected knee joint. The surgical approach adhered to the Burk and Schaffer technique [2]. A posterior capsulotomy was performed, creating a surgical entry point to the tibial plateau [Table/Fig-4].



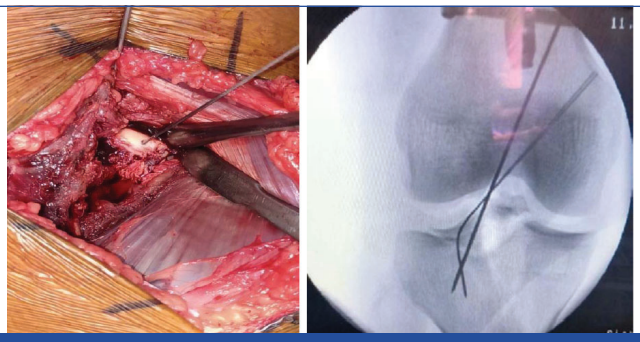
[Table/Fig-4]: Exposure through the Burk and Schaffer approach.

During the surgical exploration, the integrity of the lateral meniscus's posterior body and horn was confirmed, indicating that these crucial structures remained undamaged. Subsequently, the surgical team identified two significant fragments within the joint. The first fragment, measuring 13 x 25 x 7 mm, was identified as the avulsed portion of the PCL, located in a posteromedial position. The second fragment, measuring 15 x 17 x 25 mm, was a posterolateral articular fragment that had flipped 180 degrees within the fracture crater. Remarkably, this fragment was not attached to the PCL [Table/Fig-5].



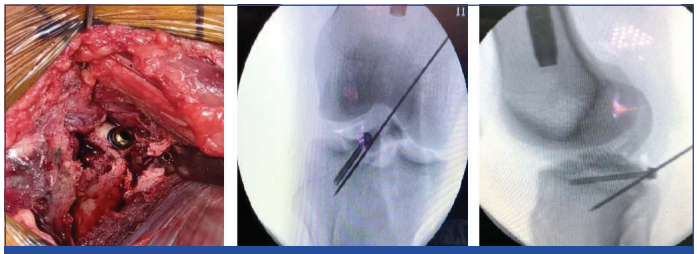
[Table/Fig-5]: Avulsed portion of Posterior Cruciate Ligament (PCL) and flipped posterolateral articular fragment.

The complexity of the fracture became evident as it extended into the posterolateral tibial plateau, emphasising the need for careful and precise reduction. The surgical team manually repositioned the upturned posterolateral fragment to restore its anatomical alignment. To maintain this correction, the fragment was provisionally fixed using K wires [Table/Fig-6].

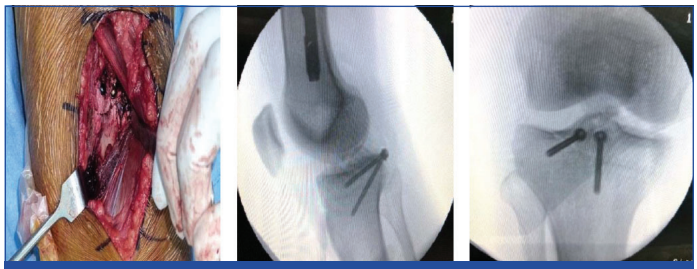


[Table/Fig-6]: Manual reduction and provisional fixation of upturned fragment with K-Wires.

Once the proper reduction was assured, a 4 mm Cannulated Cancellous (CC) screw with a washer was employed to secure the posterolateral fragment in its rightful position. Additionally, the PCL fragment, previously separated from surrounding adhesions, was meticulously and anatomically reduced. It was then firmly fixed in place using another 4 mm CC screw [Table/Fig-7,8].

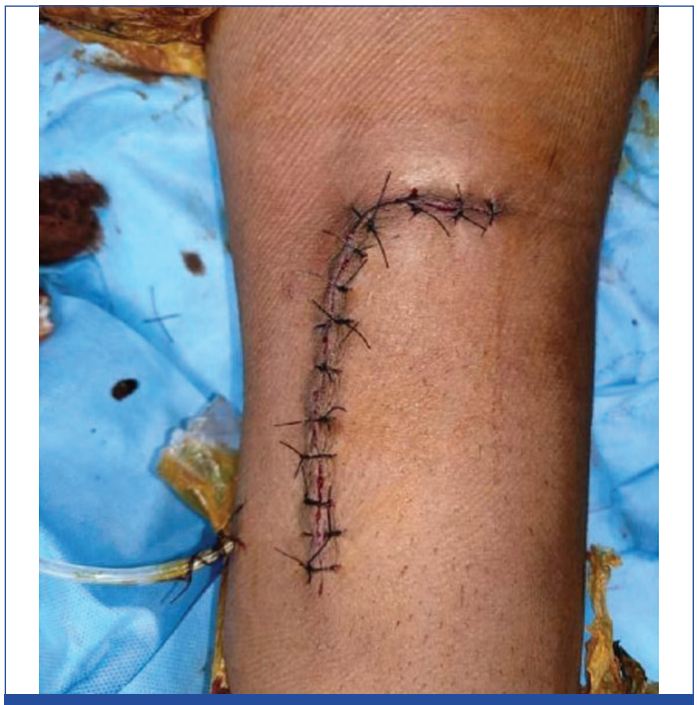


[Table/Fig-7]: Secure fixation of posterolateral fragment and PCL fragment with 4 mm Cannulated Cancellous (CC) screws and washers.



[Table/Fig-8]: Anatomical reduction of PCL fragment, followed by firm fixation using a 4 mm Cannulated Cancellous (CC) screw.

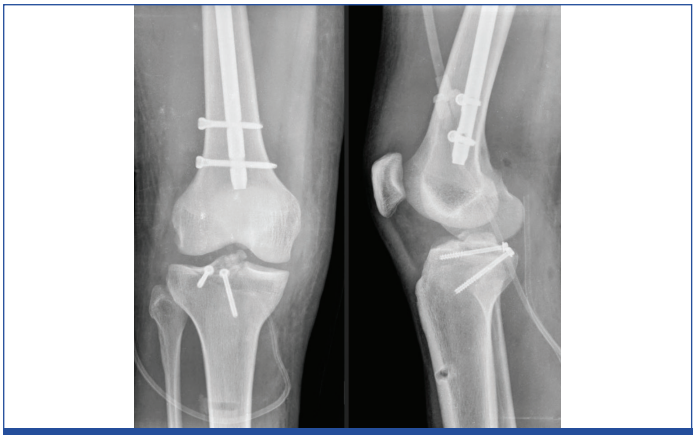
The surgical wound was closed with tension-free sutures to minimise postoperative complications. Following the successful completion of the procedure, the patient was placed in a knee brace, which offered posterior support, aiding in the patient's rehabilitation and recovery journey [Table/Fig-9].



[Table/Fig-9]: Closure of surgical wound with tension-free sutures.

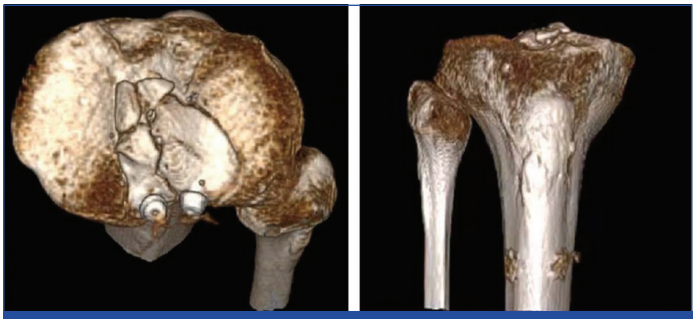
Postoperative management involved using a long knee brace, initiating passive knee ROM exercises after three weeks, maintaining a non-weight-bearing status for two months, and then progressing from partial to full weight-bearing in the following month.

During the third month of recovery, the patient actively engaged in cycling exercises and incorporated ankle weights into their rehabilitation routine. As a result of these efforts, the patient successfully regained a full ROM by the end of the month [Table/Fig-10].



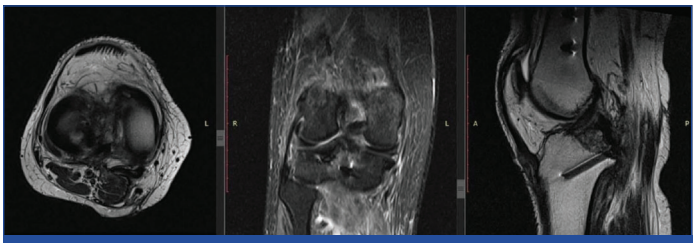
[Table/Fig-10]: Immediate postoperative X-ray of the right side of the knee.

Despite the progress, the femur fracture exhibited signs of delayed union, characterised by a lack of expected healing progression. To address this issue, a treatment plan was developed that included exchange nailing and bone grafting, scheduled for six months postoperation [Table/Fig-11]. However, after discussing the risks and benefits, the patient ultimately chose to decline this surgical intervention.

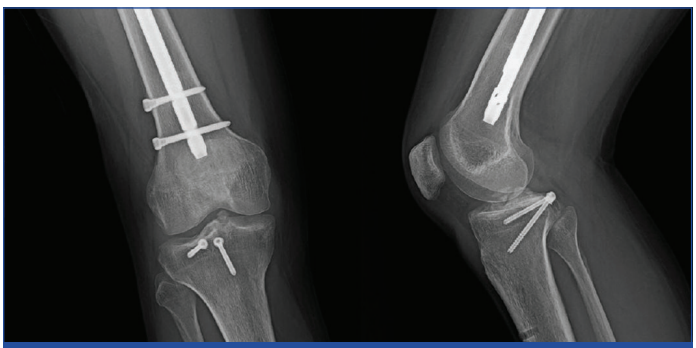


[Table/Fig-11]: Six weeks postoperative Computed Tomography (CT) scan.

The patient sustained another injury to the same area of the thigh eight months later. Fortunately, there was no damage to the knee joint. Upon examination, grade 1 laxity was observed in both the anterior and posterior drawer tests, with no joint line tenderness and a full, stable ROM in the knee [Table/Fig-12]. On follow-up at eight months, X-ray confirmed complete healing of the pivot fracture of the tibial plateau at this point. During this hospital stay, the patient underwent exchange nailing with an augmentation plate due to delayed union of the femur, which subsequently healed in follow-up visits [Table/Fig-13].



[Table/Fig-12]: A 6-week postoperative MRI.



[Table/Fig-13]: An 8-month postoperative X-ray showing healed fracture.

DISCUSSION

Tibial plateau fractures pose considerable diagnostic and therapeutic challenges due to their diverse configurations and frequent association with soft-tissue injuries. While the Schatzker classification remains widely utilised, it often proves inadequate for complex fracture-dislocations and marginal articular injuries [3]. The Hohl and Moore classification extends the framework by incorporating additional variants, yet it still fails to encompass the intricate morphology observed in the present case [4]. In the present case, the patient exhibited a rare injury pattern comprising a posterolateral tibial plateau fracture, a PCL avulsion, and a concurrent femoral shaft fracture. This configuration resembles the mechanism described in a study where a posterolateral tibial plateau fracture resulted from an extension-distraction force transmitted through the PCL. The authors suggested that the broad inferior attachment of the PCL, which extends beyond the articular margin, may predispose it to avulsion-type injuries under such forces [5].

Another study reported a similar “pivot fracture” involving a posterolateral articular fragment, accompanied by acute injuries to the Anterior Cruciate Ligament (ACL), Medial Collateral Ligament (MCL), and posterolateral corner. The proposed mechanism in that case involved knee extension, distraction, and external rotation [6]. In contrast, our patient exhibited minimal ligamentous injury, likely because the femoral shaft fracture absorbed a portion of the impact energy, thereby reducing the force transmitted to the knee structures. The concept that pivot shift-type trauma can result in actual fractures rather than mere bone contusions is well established. One study explained that during such trauma, the posteriorly subluxated lateral femoral condyle can directly strike the posterolateral tibial plateau, producing a depressed or impacted fracture fragment instead of a bone bruise [7].

Follow-up imaging in our case revealed intact ACL fibres, with only partial involvement of the posterior bundle, differing from the case reported by Basques BA et al., where complete ligamentous rupture was observed [8]. Importantly, the lateral meniscus remained unaffected, with no root tear identified. Consequently, diagnostic arthroscopy and ACL reconstruction were deemed unnecessary, and conservative management was pursued, yielding excellent short-term functional recovery. Supporting this perspective, another report described a posterior tibial plateau fracture occurring in the context of chronic ACL deficiency, underscoring how prolonged instability can alter joint biomechanics and heighten fracture susceptibility [7].

Stallenberg B et al., emphasised that posterior tibial plateau fractures may serve as indicators of associated ACL injuries and highlighted the diagnostic utility of lateral knee radiographs in detecting subtle posterior margin fractures [9]. Furthermore, a study identified various morphological types of posterolateral tibial plateau impaction fractures associated with ACL tears, noting frequent co-occurrence with posterior root tears of the lateral meniscus and MCL injuries- features commonly seen in high-energy trauma scenarios [10]. For surgical intervention, we utilised the Burk and Schaffer posterior approach, which provides excellent access to the posterior tibial plateau and has demonstrated efficacy in similar injury patterns [1,11]. This approach facilitated satisfactory fixation of the posterolateral fragment and resulted in favourable radiological and functional outcomes.

Overall, this case underscores the limitations of conventional fracture classifications in addressing complex tibial plateau injuries and illustrates how mechanisms such as pivot shift and extension-distraction forces can manifest in atypical combinations. It reinforces the importance of an individualised treatment strategy that accounts for both osseous and soft-tissue components. When contextualised within existing literature, this case shares commonalities while also presenting unique features, thereby contributing to the evolving understanding and management of tibial plateau fractures with PCL avulsion.

CONCLUSION(S)

This case underscores the complexity of tibial plateau fractures involving PCL avulsion, while also pointing out the gaps in traditional classification systems. A comparison with existing literature reinforces the value of patient-specific evaluation, sound knowledge of injury mechanisms, and customised surgical planning to achieve optimal outcomes in managing such rare and intricate orthopaedic injuries.

REFERENCES

[1] Coffey R, Bordoni B. Lachman Test. [Updated 2023 Jul 24]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK554415/.

[2] Burks RT, Schaffer JJ. A simplified approach to the tibial attachment of the posterior cruciate ligament. Clin Orthop Relat Res. 1990;(254):216-19. PMID: 2323134.

[3] Hooper PO 3rd, Silko C, Malcolm TL, Farrow LD. Management of posterior cruciate ligament tibial avulsion injuries: A systematic review. Am J Sports Med. 2018;46(3):734-42. Doi: 10.1177/0363546517701911. Epub 2017 Apr 24. PMID: 28437619.

[4] Hohl M. Tibial condylar fractures. J Bone Joint Surg Am. 1967;49(7):1455-67. PMID: 6053707.

[5] Hua K, Jiang X, Zha Y, Chen C, Zhang B, Mao Y. Retrospective analysis of 514 cases of tibial plateau fractures based on morphology and injury mechanism. J Orthop Surg Res. 2019;14(1):267. Doi: 10.1186/s13018-019-1321-8.

[6] Katsman A, Strauss EJ, Campbell KA, Alaia MJ. Posterior cruciate ligament avulsion fractures. Curr Rev Musculoskelet Med. 2018;11(3):503-09. Doi: 10.1007/s12178-018-9491-2.

[7] Mostowy M, Ruzik K, Ebisz M, LaPrade RF, Malinowski K. Impaction fractures of the lateral femoral condyle related to anterior cruciate ligament injury: A scoping review concerning diagnosis, prevalence, clinical importance, and management. Clin Orthop Surg. 2023;15(5):781-92. Doi: 10.4055/cios22278.

[8] Basques BA, Gardner EC, Samuel AM, Webb ML, Lukasiewicz AM, Bohl DD, et al. Injury patterns and risk factors for orthopaedic trauma from snowboarding and skiing: A national perspective. Knee Surg Sports Traumatol Arthrosc. 2018;26:1916-26. https://doi.org/10.1007/s00167-016-4137-7.

[9] Stallenberg B, Gevenois PA, Sintzoff SA Jr, Matos C, Andrianne Y, Struyven J. Fracture of the posterior aspect of the lateral tibial plateau: Radiographic sign of anterior cruciate ligament tear. Radiology. 1993;187(3):821-25. Doi: 10.1148/radiology.187.3.8497638.

[10] Bernholt DL, DePhillipo NN, Grantham WJ, Crawford MD, Aman ZS, Kennedy MI, et al. Morphologic variants of posterolateral tibial plateau impaction fractures in the setting of primary anterior cruciate ligament tear. Am J Sports Med. 2020;48(2):318-25. Doi: 10.1177/0363546519893709.

[11] Khatri K, Sharma V, Lakhotia D, Bhalla R, Farooque K. Posterior cruciate ligament tibial avulsion treated with open reduction and internal fixation through the Burks and Schaffer approach. Malays Orthop J. 2015;9(2):02-08. Doi: 10.5704/MOJ.1507.004.

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