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Case Report

A Case Report of a Rare Presentation of Semimembranosus Tibial Plateau Avulsion: The Bony Ramp Lesion

Arash Sharafat Vaziri[1], Hamid Rabie[2], Iman Menbari Oskouie[3], Mohammad Tahami[4], Nazanin Rahimdoost[5,*]

[1] Orthopedic Surgeon, Center for Orthopedic Trans-Disciplinary Applied Research, Tehran University of Medical Sciences, Tehran, Iran
[2] Orthopedic Surgeon, Department of Orthopedic Surgery, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran
[3] General Practitioner, Urology Research Center, Tehran University of Medical Sciences, Tehran, Iran
[4] Assistant Professor, Bone and Joint Diseases Research Center, Department of Orthopedic Surgery, Chamran Hospital, Shiraz University of Medical Sciences, Shiraz, Iran
[5] General Practitioner, Center for Orthopedic Trans-Disciplinary Applied Research, Tehran University of Medical Sciences, Tehran, Iran

[*] Corresponding author: Nazanin Rahimdoost; Center for Orthopedic Trans-Disciplinary Applied Research, Tehran University of Medical Sciences, Tehran, Iran. Tel: +98-9120308351 Email: nazanin_rahimdoost@yahoo.com

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Abstract

Background: Tibial plateau posteromedial rim avulsions by semimembranosus tendon are a rare entity that have been reported in a few studies so far with controversial mechanisms. They are reported to accompany anterior cruciate ligament (ACL) or meniscal injuries. Their main fracture planes are usually placed in the coronal plane.
Case Report: The patient was a 52-year-old man with a hyperextension-valgus tibial plateau fracture. The imaging studies revealed a compression fracture of the lateral and an avulsion fracture of the posteromedial plateau. However, no soft-tissue injuries were detected. The fragment was avulsed in the axial plane and covered by the medial meniscal posterior horn, creating the pattern of a longitudinal tear in the meniscal ramp lesion, but actually without any soft-tissue injuries. It was fixated using the tension band wiring technique with two Kirschner wires (K-wires) and one cancellous screw. Radiological and functional outcomes were excellent at 12-month follow-up.
Conclusion: This fracture pattern merits special attention due to its unusual presentation, causing the meniscal posterior horn to separate from the articular surface. "Bony ramp lesion" best describes the simultaneous separation of the posterior horn of the medial meniscus (PHMM) and its underlying bony fragment without the meniscal tear that takes place in an actual medial meniscal ramp lesion.

Keywords: Medial Meniscus; Case Reports; Knee Injuries; Tibial Plateau Fractures

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Background

Rim avulsion fractures are considered a common type of tibial plateau fractures. Moore (1) and Hohl (2) included this type of injury in a separate class, mainly with regard to the lateral plateau. Avulsions of the posteromedial rim of the plateau associated with the semimembranosus tendon are rare and have been reported in a few studies so far (3-8). They have been frequently reported to happen with simultaneous injuries to the cruciate ligaments and medial meniscus. Meniscal ramp lesions are defined as a longitudinal tear in the periphery of the posterior horn of the medial meniscus (PHMM) that would cause a disruption in the meniscocapsular attachments or the presence of meniscotibial ligament tears (9). In this case report, we aim to describe a semimembranosus avulsion fracture of the tibial plateau with a pattern that has not been represented in previous studies and that resembles a ramp lesion.

Case Report

A 52-year-old man was admitted to the trauma emergency department by ambulance due to severe left knee pain following a road accident. The knee was hyperextended at the time of collision, and a valgus producing force was applied to its lateral side. There were no additional injuries to the knee after this accident. The patient was initially unable to bear his weight on his left leg. His past medical and surgical history was unremarkable. On physical examination, the affected knee showed tenderness on the medial and lateral sides and moderate soft-tissue swelling with intact skin and no overt signs of malalignment or neurovascular injury.

Pre-operative lateral and anteroposterior (AP) plain radiography revealed an isolated depression fracture of the lateral plateau (Figure 1).

Figure 1. Anteroposterior (AP) and lateral views of plain radiography demonstrating lateral tibial plateau fracture

Computed tomography (CT) was performed to investigate the fracture in more detail for proper operation planning. CT revealed a depressed fracture of the lateral plateau and posteromedial plateau avulsion with its main fracture plane in the axial plane (Figure 2).

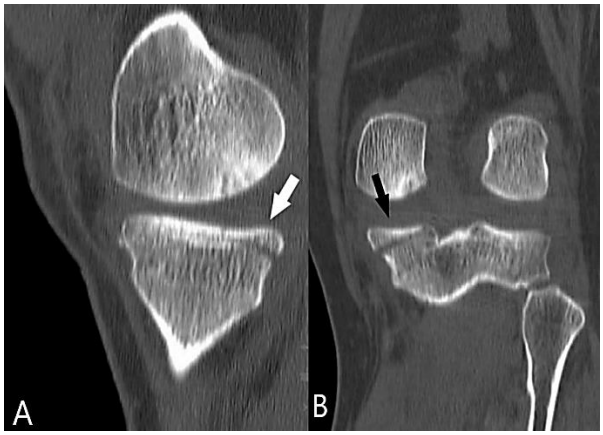

Figure 2. Sagittal (A), and coronal (B) computed tomography (CT) demonstrating the posteromedial plateau avulsion, parallel to the joint surface

On magnetic resonance imaging (MRI) examination, the avulsed fragment was covered with an intact PHMM and connected to the semimembranosus tendon's direct head. MRI showed no signs of additional ligamentous or capsular disruption or meniscal tear.

The patient was taken to the operation room the next day after completing primary evaluations and hemodynamic stabilization. No temporary external fixation was used prior to surgery due to the absence of major soft-tissue injuries. The operation was performed in a single stage. Tests for assessing anterior cruciate ligament (ACL) integrity were performed under anesthesia and were all negative. A tourniquet cuff was placed on the proximal femur. The patient was positioned in a semi-lithotomy position to achieve simultaneous access to medial and lateral sides without the need to change the position. The lateral plateau fixation was done primarily through a standard anterolateral approach. The mosaic-like comminuted fragments were reduced, and the depression was elevated using bone grafts secured by a lateral buttress plate. It was revealed at the surgical exploration that the avulsed fragment was at the posteromedial rim of the tibial plateau exactly beneath the PHMM. The fracture line was oriented in the axial plane (Figure 3).

Figure 3. Schematic illustration of the fracture pattern

The meniscotibial ligament was intact and attached to the avulsed fragment at its inferior insertion site to the tibia. The meniscocapsular ligament and periphery of PHMM were also intact. The avulsed fragment was fixated to prevent instability. A posteromedial incision was used for this purpose using the tension-band wiring technique by two Kirschner wires (K-wires) proximally at the avulsed fragment and one cancellous screw distally at the metaphysis (Figure 4). Weight-bearing was delayed until complete radiological union, considered as the absence of joint incongruity and step-offs of more than 2 mm, for 8 weeks. Early range of motion (ROM) with exercises for hamstring and quadriceps improvement were considered right after surgery.

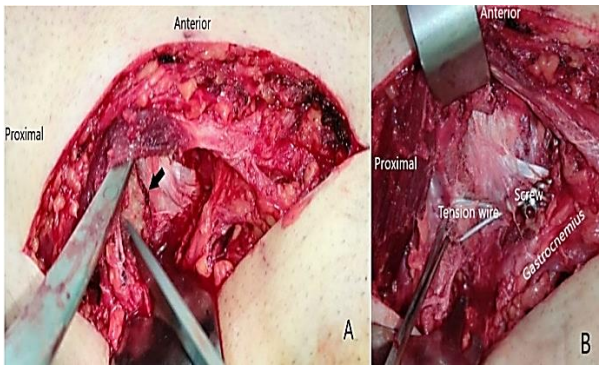

Figure 4. The incision was made at the posteromedial side of knee. The transverse fracture line is demonstrated in figure A (black arrow). The fixation was done using two Kirschner wires (K-wires) and one screw with a figure-of-eight tension wire (B).

The patient was followed for 12 months postoperatively. The results of the surgery were excellent, according to the functional Rasmussen score (10). There was < 5° varus or valgus deformity and no instability upon extension or flexion. The patient could bear weight on his affected knee without significant discomfort and was able to return to his daily activities with a ROM of 0°-120° and extension lag of 0°-10°. Wound healing was achieved with no complications. Radiographic results were also satisfactory (Figure 5).

Figure 5. Post-operative anteroposterior (AP) and lateral plain radiography of the patient's knee. The lateral condylar fracture was fixated using a bone graft, subchondral raft screw, and lateral buttress plating (black arrows). The posteromedial avulsion fixation was done using tension-band wiring by two Kirschner wires (K-wires) and one cancellous screw (white arrow).

Discussion

In this case report, we presented a rim avulsion of posteromedial tibial plateau by semimembranosus that caused the overlying PHMM to be separated from the articular surface attached to it. This pattern resembles the meniscal allograft in bone plug technique for transplantation (11).

The meniscal ramp lesion is described as a posterior horn longitudinal tear with respect to disruption of meniscotibial and/or meniscocapsular ligamentous attachments (9). Cavaignac et al. suggested that the meniscotibial and meniscocapsular ligaments were attached to separate sites at the posteroinferior and posterosuperior aspects of the medial meniscus, respectively (12). Different studies have suggested the role of sudden contraction of the semimembranosus muscle and transmission of the generated force through its ligamentous connections to the medial meniscus. This mostly happens through the connections between the semimembranosus tendon's capsular arm and the meniscocapsular ligament (13). The direct arm of the semimembranosus tendon is attached to a groove at the posteromedial side of the proximal tibia. In the patient presented in our study, it is postulated that the underlying mechanism for this phenomenon can be explained by transmission of the generated force from sudden contraction of the semimembranosus muscle through its direct arm to the posteromedial rim of the proximal tibia. This is in contrast to its transmission through the capsular arm and meniscocapsular ligament, which would have caused a true meniscal ramp lesion.

This mechanism has been discussed in previous studies with posteromedial avulsion fractures of the tibial plateau. Yao and Lee reported two cases of avulsion fractures of the posteromedial tibial plateau caused by the sudden contraction of the semimembranosus muscle. The knee was flexed, and the tibia was externally rotated and abducted at the time of injury. They suggested that due to the strength of the tendon's trunk, the insertion site of the direct tendon of the semimembranosus was avulsed instead of tendon trunk getting disrupted. In their study, damage to the ACL and medial meniscus accompanied the avulsion in all cases (3). Vanek conducted a cadaveric study and concluded that tibial plateau posteromedial fracture happened with a varus-external rotation force applied to the 60°-80° flexed knee. ACL tear was a prerequisite to this phenomenon. He explained this by anterior displacement of the tibial plateau, which happened after ACL rupture (4).

In contrast to other studies, the fractured fragment was not attached to the semimembranosus tendon in Vanek's experiment. Therefore, he rejected the mechanism of sudden contraction of the semimembranosus as the underlying mechanism of this injury. Chan et al. also described ten cases with the same injury pattern accompanied by ACL tear in all of them. The proposed mechanism by Chan et al. involved a valgus force in contrast to Vanek's. They suggested posteromedial avulsion fracture of the plateau by semimembranosus muscle tendon as an additional sign for detecting ACL tears (5). Al-Humadi et al. reported a case of posteromedial tibial plateau avulsion with torn posterior cruciate ligament (PCL) and intact ACL, with no capsular rupture. The PHMM was also torn. This could be explained by the attachment of the oblique popliteal ligament of the semimembranosus tendon to the posterior oblique ligament of the knee and medial meniscus. They also suggested a valgus-hyperextension force as the cause of this injury. They used a posterior approach with K-wires and posterior-to-anterior lag screws to fix the fracture (6).

Khoshnoodi et al. reported the same pattern and mechanism as Al-Humadi et al., with the exception of the presence of capsular injury in addition to PCL rupture (7). John et al. also reported a patient with posteromedial tibial plateau avulsion fracture with PCL rupture. ACL and medial meniscus were intact. They fixed the fragment using the posteromedial approach by two screws with spiked washers just inferior to the fragment to provide buttressing effect from the posterior side (8).

Conclusion

Our case represents a semimembranosus sudden contraction that caused avulsion of the posteromedial articular surface of the medial condyle in the axial plane, similar to Vanek's study (4) and in contrast to other mentioned studies. This morphology made it challenging to fix the avulsed fragment using conventional methods. Contrary to Vanek's study, we believe this fracture was caused by semimembranosus sudden contraction. Unlike other studies, no cruciate ligament injuries were observed during surgical exploration and pre-operative MRI examination in our patient. The meniscocapsular and meniscotibial ligaments were also intact and connected to the separated fragment. The unique feature of this case is the separation of the bony fragment along with its overlying PHMM, which creates the pattern of a ramp lesion. However, due to the absence of ligamentous or peripheral medial meniscal injury, we decided to name this type of fracture a "bony ramp lesion". This type of posteromedial tibial plateau rim avulsion requires careful reduction since the consequences of the meniscal injury that creates the pattern of a ramp lesion might complicate the fracture.

Conflict of Interest

The authors declare no conflict of interest in this study.

Acknowledgements

All processes pertaining to consent and ethics were approved by the Ethics Committee of Center for Orthopedic Trsns-Disciplinary Applied Research, Tehran University of Medical Sciences, Tehran, Iran, with the following approval ID: IR.TUMS.COTAR.REC.1403.037. The study was conducted according to guidelines of Declaration of Helsinki.

References

1. Moore TM. Fracture--dislocation of the knee. *Clin Orthop Relat Res*. 1981;(156):128-40. [PubMed: 7226641].
2. Hohl M. Managing the challenge of tibial plateau fractures. *J Musculoskel Med*. 1991;8(6):70-86.
3. Yao L, Lee JK. Avulsion of the posteromedial tibial plateau by the semimembranosus tendon: diagnosis with MR imaging. *Radiology*. 1989;172(2):513-4. doi: 10.1148/radiology.172.2.2748833. [PubMed: 2748833].
4. Vanek J. Posteromedial fracture of the tibial plateau is not an avulsion injury. A case report and experimental study. *J Bone Joint Surg Br*. 1994;76(2):290-2. [PubMed: 8113295].
5. Chan KK, Resnick D, Goodwin D, Seeger LL. Posteromedial tibial plateau injury including avulsion fracture of the semimembranous tendon insertion site: ancillary sign of anterior cruciate ligament tear at MR imaging. *Radiology*.

1999;211(3):754-8. doi: 10.1148/radiology.211.3.r99jn16754. [PubMed: 10352602].
6. Al-Humadi M, Fulkerson EW, Egol KA. Semimembranosus tendon mediated avulsion fracture of the posteromedial tibial plateau. *J Trauma*. 2009;66(1):E1-E3. doi: 10.1097/01.ta.0000242218.33654.2c. [PubMed: 18277293].
7. Khoshnoodi P, Tehranzadeh AD, Dunn JM, Tehranzadeh J. Semimembranosus tendon avulsion fracture of the posteromedial tibial plateau associated with posterior cruciate ligament tear and capsular rupture. *Skeletal Radiol*. 2014;43(2):239-42. doi: 10.1007/s00256-013-1719-z. [PubMed: 24026070].
8. John R, Chouhan DK, Dhillon MS. Neglected, semimembranosus osteochondral avulsion fracture of the posteromedial tibial plateau. *Trauma Case Rep*. 2018;15:16-22. doi: 10.1016/j.tcr.2018.04.004. [PubMed: 29876497]. [PubMed Central: PMC5987264].
9. Strobel MJ. Knee joint-special part. In: Strobel MJ, editor. Manual of arthroscopic surgery. Berlin, Heidelberg, Germany: Springer Berlin Heidelberg; 2002. p. 97-669.
10. Rasmussen PS. Tibial condylar fractures. Impairment of knee joint stability as an indication for surgical treatment. *J Bone Joint Surg Am*. 1973;55(7):1331-50. [PubMed: 4586086].
11. Trentacosta N, Graham WC, Gersoff WK. Meniscal allograft transplantation: state of the art. *Sports Med Arthrosc Rev*. 2016;24(2):e23-e33. doi:00132585-201606000-00002. [PubMed: 27135295].
12. Cavaignac E, Sylvie R, Teulieres M, Fernandez A, Frosch KH, Gomez-Brouchet A, et al. What is the relationship between the distal semimembranosus tendon and the medial meniscus? A gross and microscopic analysis from the SANTI Study Group. *Am J Sports Med*. 2021;49(2):459-66. doi: 10.1177/0363546520980076. [PubMed: 33332976].
13. Yoon KH, Yoo JH, Kim KI. Bone contusion and associated meniscal and medial collateral ligament injury in patients with anterior cruciate ligament rupture. *J Bone Joint Surg Am*. 2011;93(16):1510-8. doi: 10.2106/JBJS.J.01320. [PubMed: 22204006].