

## Case Report

## Neglected, semimembranosus osteochondral avulsion fracture of the posteromedial tibial plateau

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## ABSTRACT

Semimembranosus avulsion fracture is infrequently reported and is easy to miss on plain radiographs; the mechanism of injury is highly controversial. Initial reports linked it to anterior cruciate ligament and medial meniscal tears. We report an osteochondral semimembranosus avulsion fracture of the posteromedial tibial plateau with associated posterior cruciate ligament rupture. Also described is a novel surgical fixation technique for such osteochondral fractures where the surgical exposure is limited due to the obliquity of the fracture line resulting in a greater involvement of the articular cartilage than the small bony component. The fixation technique described may be used for osteochondral fractures where the application of a conventional compression screw may not be feasible.

Knee joint is a common site for avulsion fractures due to the complex insertions of numerous ligaments, tendons, menisci etc. [1]. A semimembranosus avulsion fracture of the posteromedial tibial plateau is extremely rare and infrequently reported [2–6]. These fractures have usually been observed in association with anterior cruciate ligament (ACL) rupture and medial meniscal injury [2–4].

We report a case of a nine-month-old neglected, osteochondral semimembranosus avulsion fracture of the posteromedial tibial plateau which was associated with posterior cruciate ligament (PCL) rupture and briefly review the associated literature. Till date, only two cases of semimembranosus avulsion fracture with an associated PCL tear have been described in the literature [5,6]. This case is distinctive due to three reasons: osteochondral nature of the avulsed fragment which is uncommon, novel surgical fixation technique used here which was based on the inherent restraint provided by the walls of the crater of the avulsed, osteochondral fragment and the chronic nature at presentation (neglected fracture/nonunion) which has not been described in the literature till date.

## Case details

A 37-year-old male sustained a road traffic accident in which he sustained injury to the left knee. Details of the injury mechanism were unavailable. He consulted a quack in his village who treated him conservatively with indigenous medicines, acupuncture and immobilisation of the knee with a wooden splint. Patient was made to walk two months after the injury. He presented to our outpatient clinic, 9 months after the injury, with a painful and stiff knee and history of recurrent knee effusions; he had an antalgic gait and was able to walk only with the support of a cane. The Lysholm score was 45. On physical examination, he had limited flexion of the knee up to 90° (range-of-motion between 10° and 90°); posterior tibial sag was apparent and the posterior drawer test was positive.

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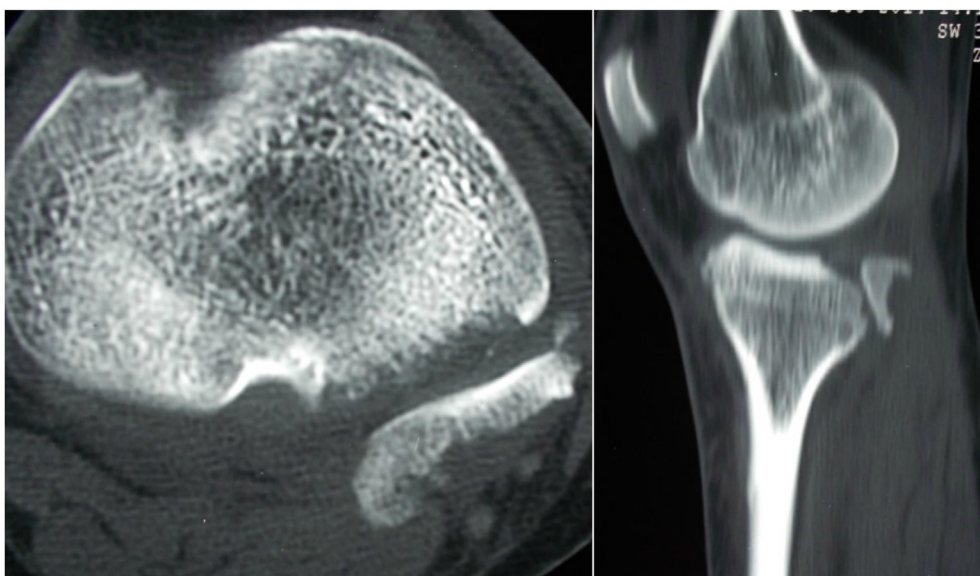


**Fig. 1.** Plain radiographs (frontal and lateral views) demonstrates a fracture of the posteromedial tibial plateau (on presentation at our outpatient clinic nine months post injury).

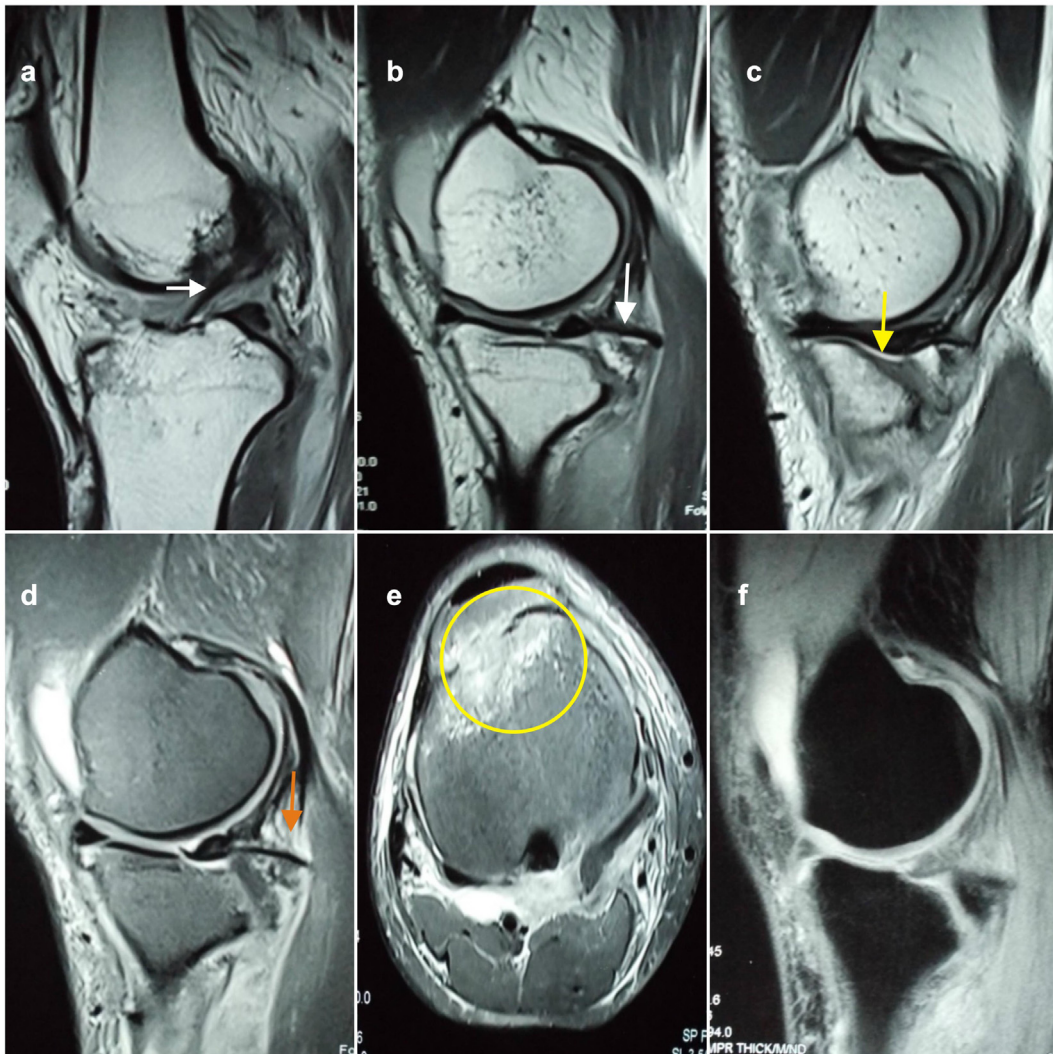
Plain radiographs of the knee revealed a fracture of the posteromedial tibial plateau with a displaced bony fragment (Fig. 1). Computed tomography (CT) scan (with three dimensional reconstruction) was obtained to accurately define the position and size of the displaced articular fragment; it was observed that the fragment had rotated 90° in the sagittal plane with the articular surface of the tibial plateau facing anteriorly (Fig. 2). Magnetic resonance images demonstrated the associated chondral component of the fragment; the articular cartilage being sheared away parallel to the subchondral bone. The size of the osteochondral fragment was disproportionately larger than that visualised on plain radiographs and CT scans with the chondral component extending anteriorly due to the obliquity of the fracture plane. The insertion of the semimembranosus tendon to the avulsed osteochondral fragment was noted in the sagittal views. Complete intra-substance tear of the PCL was observed; however, the ACL was found to be intact and there were no associated meniscal injuries. (Fig. 3).

### Surgical technique

Under general anaesthesia, posterior drawer test was confirmed to be positive. The patient was positioned prone and a high thigh tourniquet was applied but not inflated. Posteromedial approach to the knee as described by Lobenhoffer et al. was used to expose the fracture site (Fig. 4) [7,8]. The avulsed osteochondral fragment was visualised after incising the intact posterior capsule; bony



**Fig. 2.** CT images delineating the displaced fragment. Note that the displaced fragment has rotated 90° in the sagittal plane.



**Fig. 3.** Magnetic resonance images showing intact ACL, ruptured PCL, the attachment of semimembranosus tendon to the osteochondral fragment and the extent of the chondral injury. Note that the size of the bony fragment is disproportionately smaller than the chondral component.

overgrowth of the fragment was debrided. The crater of the osteochondral fragment was freshened and curetted back to bleeding. Thick, Ethibond (Ethicon Inc., Sommerville, NJ) suture bites were taken proximally through the semimembranosus attachment to the fragment. The osteochondral fragment was pulled inferiorly, de-rotated and repositioned deep into the crater by pulling on the Ethibond sutures. After repositioning, the fragment was stable in all directions (except posteriorly) due to the inherent restraint provided by the walls of the crater anteriorly, medially and laterally.

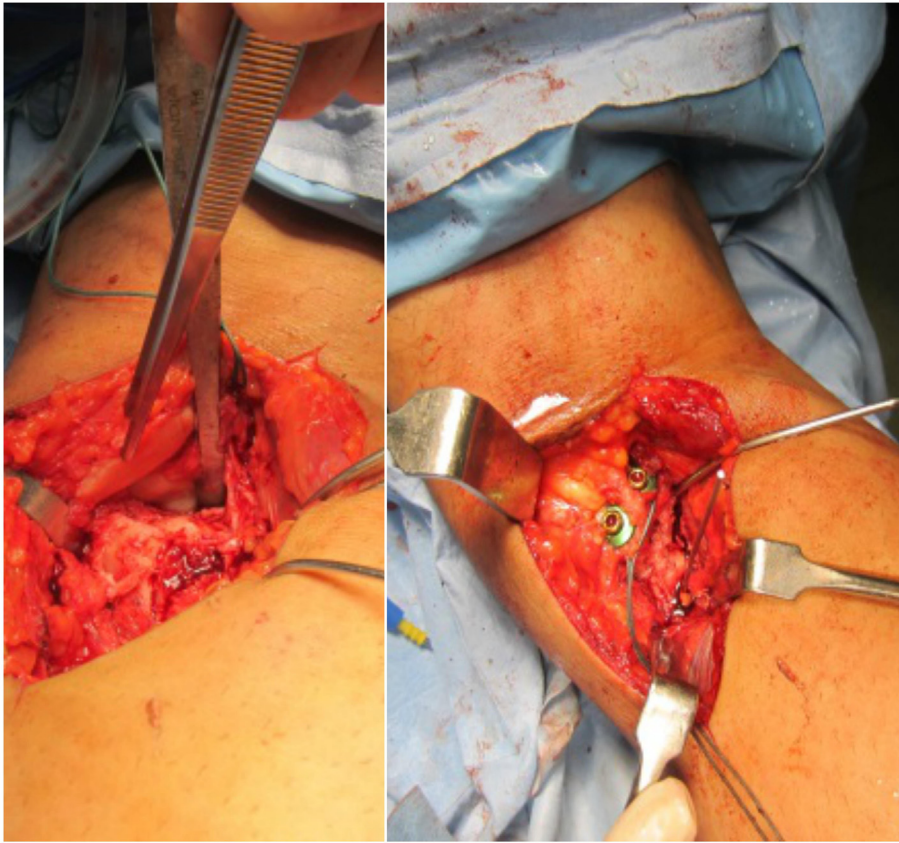
Two small fragment (3.5 mm) partially-threaded cancellous screws with spiked washers were inserted just below the junction of the inferior border of the osteochondral fragment and the inferior crater wall; the spiked washer and the large screw head buttressed the fragment from the posterior aspect. Screws were not passed through the fragment to provide compression owing to the small size of the bony fragment. The sutures tied to the osteochondral fragment were tied to a screw post inserted further inferiorly to provide additional anchorage to the osteochondral fragment. The knee was found to be stable through full range-of-motion (ROM). The posterior capsule was sutured using interrupted #1Vicryl sutures. A Hemovac suction drain was placed and the wound was closed in layers. The knee was immobilised in 20° of flexion and a hinged range-of motion brace was applied. (See Fig. 5)

The post-operative course was uneventful; fracture united radiologically within 12 weeks. On the latest follow-up (at two years after surgery), he had a full ROM of the knee with no subjective symptoms of knee instability (Fig. 6). His Lysholm score had improved to 96 and he had returned to his pre-injury activity level.

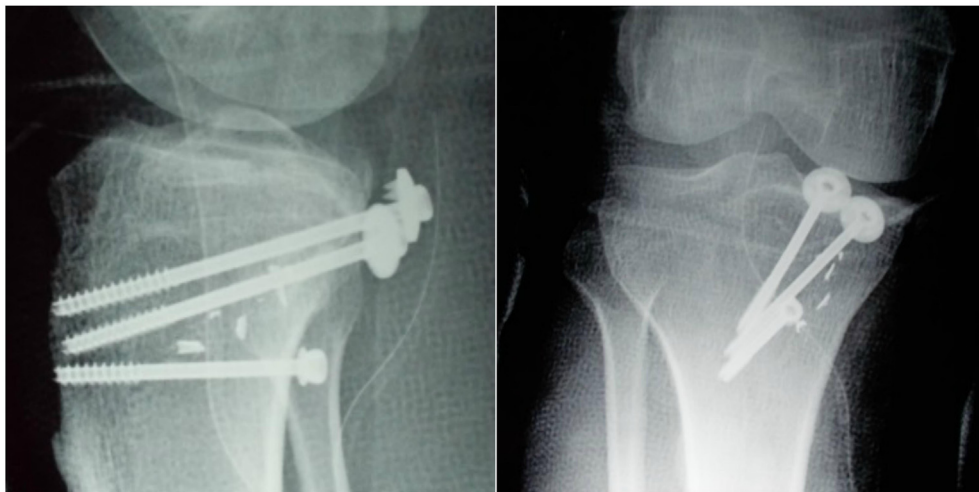
## Discussion

The most important finding of this case report is the osteochondral nature of the avulsed tibial plateau fragment which is





**Fig. 4.** Intra-operative images showing re-creation of crater walls and the subsequent fixation with screw-washers and screw-posts.



**Fig. 5.** Immediate post-operative lateral and frontal radiological images showing accurately reduced posteromedial osteochondral fragment.

exceedingly rare in adults; a neglected semimembranosus avulsion fracture of the tibia (nonunion of semimembranosus avulsion fracture of the tibial plateau) also has never been described in the literature till date to the best of the authors' knowledge. Only five studies have described semimembranosus/posteromedial tibial plateau avulsion fractures till date and the mechanism of injury continues to be obscure and controversial (Table 1) [2–6]. Yao et al. and Vanek J were the first to document semimembranosus avulsion fractures associated with ACL tear [2,3]. Chan et al. reported 4 cases in a series of 10 ACL tear patients and concluded that a semimembranosus avulsion fracture is an ancillary sign of an ACL rupture [5]. All three authors observed that these fractures occur subsequent to an ACL tear and/or medial meniscal injury (posterior horn tear and/or meniscocapsular separation). Yao et al. and

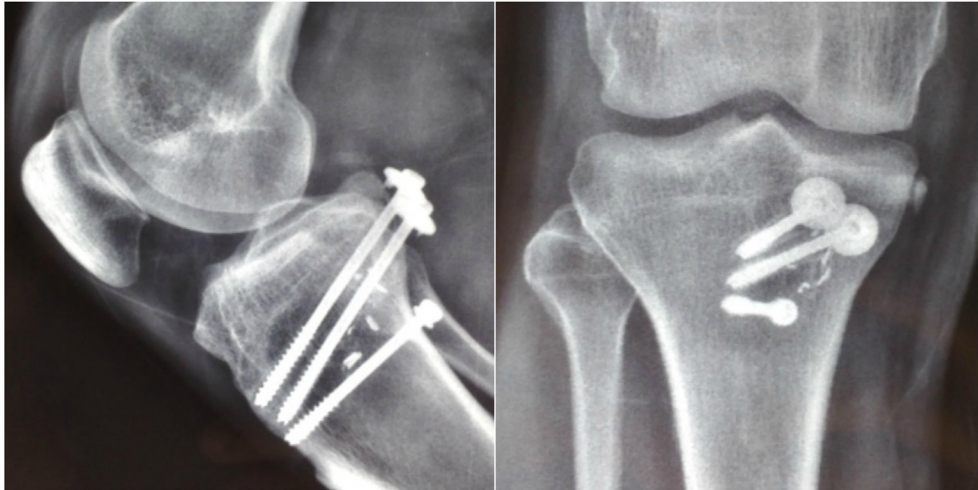


Fig. 6. Plain radiographs (frontal and lateral views) at two years follow-up showing bony union.

Chan et al. postulated that the mechanism of injury is due to a valgus-external rotation force whereas Vanek, who conducted a cadaveric study in addition to his case report, postulated a varus-external rotation force mechanism [2–4].

In this case, there was no associated ACL rupture or medial meniscal injury unlike the above three studies. Only two studies have so far described an association between posteromedial tibial plateau avulsion fractures and PCL rupture [5,6]. Al Humadi et al. reported a case of posteromedial tibial plateau avulsion fracture that was associated with a PCL tear and medial meniscus tear (posterior horn) [5]. Khoshnoodi et al. reported a posteromedial tibial plateau avulsion fracture associated with PCL tear, medial meniscal injury and posterior capsular tear [6]. The ACL was intact in both these reports. Both of these studies postulate that a valgus-hyperextension force mechanism is responsible for this peculiar combination of injuries [5,6].

The case presented above is unique due to the osteochondral nature of the avulsed fragment - a large articular, cartilaginous fragment (which could not be directly visualised due to the limitations in the surgical approach) associated with a small osseous component. We had to modify our fixation strategy from a compression screw strategy to an indirect reduction (utilising the inherent restraint of crater walls) and buttressing (using a screw-spiked washer construct). This case is also distinctive as it was a neglected/chronic avulsion fracture and no such case has been described in the literature till date.

In this case, the osteochondral fracture of the posterior tibial plateau had a large chondral component and a relatively small osseous fragment; after reduction of the fragment into the crater, there was not enough subchondral bone to pass a 3.5-mm compression screw through the bony component of the osteochondral fragment. Also, the tibial plateau is completely covered from the superior aspect by the ball-like femoral condyles throughout the arc of motion of the knee joint; this not only limits the possible angles of screw insertion from the posterior aspect but also makes it impossible to surgically expose the upper end of tibia without dislocating the knee unlike distal femur articular surface. [9,10]

When the osteochondral fragment was pulled back into place into its crater, the fragment's mobility in the coronal and axial plane was limited due to the inherent stability afforded by the intact crater walls on all three sides. However, the avulsed fragment was still unstable in the sagittal plane due to the shearing effect of the semimembranosus tendon on the osteochondral fragment during knee flexion. The use of spiked washers and screws just below the junction of inferior crater wall and inferior border of osteochondral fragment buttressed the fragment and afforded stability in the sagittal plane (Fig. 7). The additional screw post used inferiorly over which the polyester sutures holding the osteochondral fragment were tied augmented the stability afforded by the buttressing screw head-spiked washer construct.

Initially, a staged reconstruction was planned - fixation of the semimembranosus avulsion fracture followed by PCL reconstruction at a later date. However, the patient has demonstrated excellent functional recovery after fracture fixation with no signs of knee instability. Till date, he has no signs of anterior knee pain/instability although he does have grade one posterior sag and a positive posterior drawer test on physical examination. Hence a PCL reconstruction has not been performed till date but it is possible that he may need the procedure in the future.

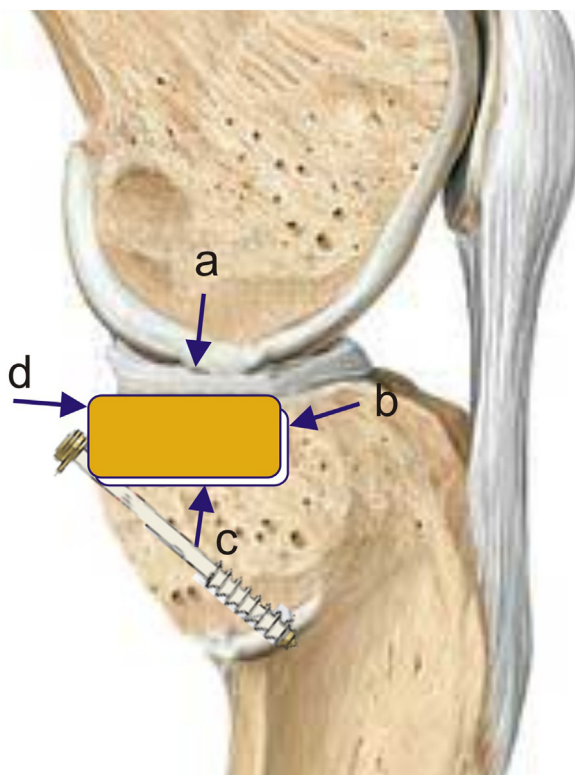
In summary, we presented a rare case of neglected, semimembranosus osteochondral avulsion fracture with associated PCL tear. Trauma care providers must be aware of this unusual injury combination as it is often very easy to miss this fracture on conventional radiographs. Missed diagnosis in such cases may lead to chronic pain and stiffness of the knee.

#### Conflict of interest

The authors declare that they have no conflict of interest.

**Table 1**  
Summary of studies reporting semimembranosus avulsion fractures (arranged in chronological order).

Authors (Year)	Study title	No. of cases	Mechanism of injury	Associated injuries	Treatment
Yao L & Lee LK, <sup>2</sup> (1989)	Avulsion of the posteromedial tibial plateau by semimembranosus tendon: diagnosis with MR imaging	2	Valgus-external rotation	ACL tear Medial meniscus injury	Not mentioned
Vanek J. <sup>3</sup> (1994)	Posteromedial fracture of the tibial plateau is not an avulsion injury: a case report and experimental study	1	Varus-external rotation of flexed knee	ACL tear Medial meniscus injury	Arthroscopic partial meniscectomy
Chan KK et al. <sup>4</sup> (1999)	Posteromedial tibial plateau injury including avulsion fracture of the semimembranosus tendon insertion site: ancillary sign of anterior cruciate ligament tear at MR imaging.	4 out of 10 cases	Valgus-external rotation	ACL tear	Details of fracture management not mentioned
Al-Humadi M et al. <sup>5</sup> (2009)	Semimembranosus tendon-mediated avulsion fracture of the posteromedial tibial plateau.	1	Valgus- hyperextension	PCL tear Medial meniscus injury	ORIF with lag screws
Khoshnoodi et al. <sup>6</sup> (2014)	Semimembranosus tendon avulsion fracture of the posteromedial tibial plateau associated with posterior cruciate ligament tear and capsular rupture	1	Valgus- hyperextension	PCL tear Medial meniscus injury Posterior capsule tear	ORIF with locking compression plate; meniscal repair of torn posterior horn of medial meniscus.



**Fig. 7.** Illustration showing the principle of fixation used in this case. Arrows a, b, c demonstrate the inherent stability afforded by the intact crater walls and the femoral condyles from above. Arrow d demonstrates the anteriorly-directed buttressing action of the screw head placed posterior to the avulsed fragment.

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