

## Case Report

# Concurrent avulsion of posterior cruciate ligament and semimembranosus: a case-based discussion and literature review

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**Abstract:** A 30-year-old male sustained a road traffic accident and presented to our trauma centre with injuries to his pelvis and right knee. Radiology showed closed fractures of the right posterior wall and posterior column of the acetabulum and PCL bony avulsion with posteromedial tibial plateau osteochondral fracture, without any distal neurovascular deficit. He was managed with surgical intervention for both injuries. His hip and knee healed well with a good functional range of motion at 12 months of follow-up. The aim of highlighting this case is that it underscores the rarity of concurrent PCL and semimembranosus (SM) avulsion injuries, emphasizing the importance of comprehensive evaluation and tailored surgical management. Utilizing CT imaging proves instrumental in identifying the associated posteromedial osteochondral fragment. Successful reduction and posterior buttressing of the fragment are crucial for stability against vertical shear forces and subsequent union.

**Keywords:** Avulsion, posterior cruciate ligament, semimembranosus, suture anchor, osteochondral fragment

## Introduction

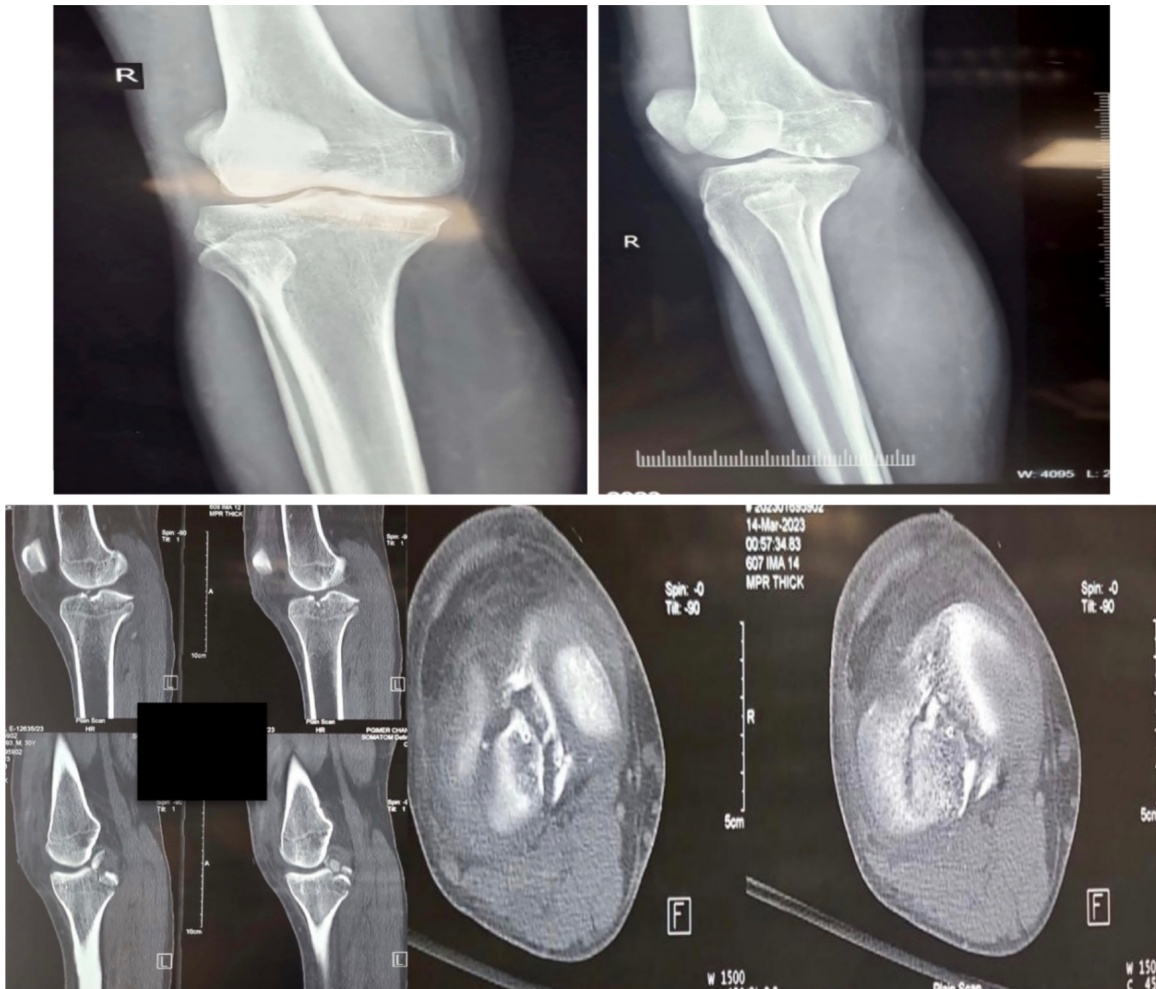
The posterior cruciate ligament (PCL) avulsion is a common high-energy knee injury, caused by a direct force to a bent knee in an anteroposterior direction in dashboard injuries or less commonly due to non-contact injuries by hyperextension or hyperflexion [1]. Osteochondral tibia fractures are mostly caused by impaction injuries of the plateau hitting the femoral condyle [2]. Occasionally an avulsion of the attached muscles at the posteromedial aspect of the tibia plateau can cause such fractures; semimembranosus avulsion is infrequently seen and reported and occurs in conjunction with other ligamentous injuries at the knee [3]. The distal SM tendon is anatomically complex with six individual tendinous branches intricately related to the other structures of the posteromedial corner of the knee giving it stability. Hence it has a strong broad insertion and exerts lesser force in comparison to the biceps femoris tendon which inserts on the fibular head and is avulsed more commonly [4]. The commonest mechanism behind these injuries is the eccentric contraction of the hamstrings

during strenuous activity which leads to failure of the muscle at the myo-tendinous junction and rarely from their bony attachments [5, 6]. In terms of management, these avulsions require a high index of suspicion and appropriate clinic-radiological investigations for early diagnosis and subsequent treatment which includes open or arthroscopic reduction and internal fixation with compression screws, suture anchor augmentation or a low-profile buttress plate [3]. We present a rather rare co-existent injury of the knee with both PCL and semimembranosus avulsed from their respective insertions at the back of the tibial plateau. We also analysed the literature for similar cases and highlighted its management. Written Informed Consent was taken from the patient for publication.

## Case details

A 30-year-old male sustained a road traffic accident while riding a motorcycle, and presented to our trauma centre with injuries to his pelvis and right knee. He had pain in his right knee with restriction of movement and the pelvic compression test was positive; after stabilising

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**Figure 1.** Pre-operative radiology showing bony PCL fragment with osteochondral fragment.

the patient as per the Advanced Trauma Life Support (ATLS) protocol which includes initial assessment of Airway, Breathing and Circulation followed by thorough evaluation of injuries via Primary and Secondary surveys supported by imaging studies [7]. The ATLS protocol helps in identification and management of life-threatening injuries by adequate resuscitation and patient stabilisation. Radiographs and CT scans were done, which showed closed fractures of the right posterior wall and posterior column of the acetabulum and PCL bony avulsion with posteromedial tibial plateau osteochondral fracture, without any distal neurovascular deficit (**Figure 1**).

### Surgical technique

The patient was examined under anaesthesia and posterior sag of the proximal tibia was

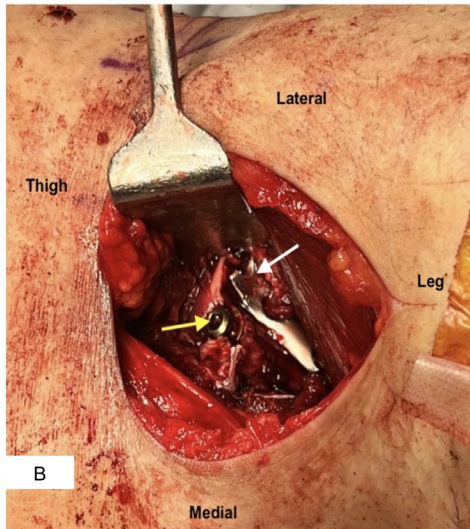
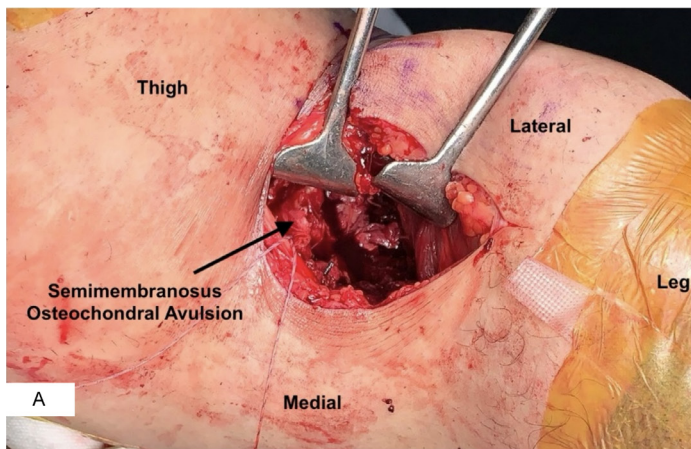
noted. The acetabulum was fixed by the pelvic surgeon with open reduction and plating under general anaesthesia in a lateral position (**Figure 2**). The Patient was then positioned prone and a high thigh tourniquet was applied. A preoperative antibiotic was administered one hour prior to tourniquet inflation in the prone position.

Posterior approach first described by Burks and Schaffer was used and the plane between the medial head of the gastrocnemius and tibia was developed [8]. Insertion of the semimembranosus was found to be avulsed with an osteochondral fragment of the rim, noted after incising the intact posterior capsule (**Figure 3A**). Avulsion of the PCL was also visualised and its bony base was curetted. Suture bites were taken by 3-0 fibre wire braided sutures, through muscle attachment of the osteochondral fragment and the PCL to aid in reduction by

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**Figure 2.** Postoperative X-ray showing plate fixation for acetabular fracture.



**Figure 3.** (A) Intraoperative images showing avulsed semimembranosus osteochondral fragment (black arrow) and (B) showing after stabilization of PCL fragment with a small PTCS (yellow arrow) and a semimembranosus fragment with 1/3<sup>rd</sup> semitubular plate (white arrow).

pulling and derotating; the osteochondral fragment was stabilized with a 1/3<sup>rd</sup> semitubular

plate while the PCL fragment was reduced in its crater and fixed with a small fragment partially threaded cannulated screw (4.0 mm) and augmented with 3.5 mm suture anchor (**Figure 3B**). The final reduction of bony fragments was assessed under fluoroscopy and the knee was found to be stable through a full range of motion with no sag; the posterior capsule was closed with no.1 Vicryl suture and the wound was closed in layers (**Figure 4**). The knee was immobilised in 20° of flexion and a hinged range-of-motion brace was applied. Fracture union was seen radiographically at 12 weeks (**Figure 5**).

The patient had some heterotopic ossification medially and laterally which required manipulation under anaesthesia and functional range of motion was achieved at 12 weeks follow-up (**Figure 6**). Patient was put on continuous passive motion (CPM) after manipulation to maintain the functional range of motion achieved.

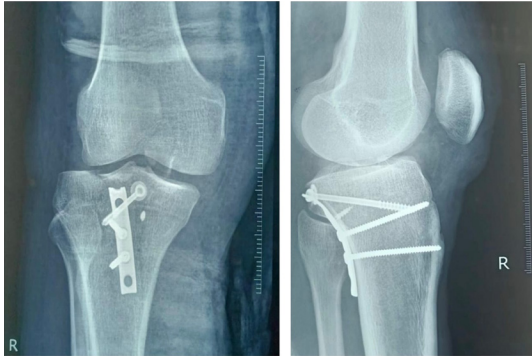
### Discussion

PCL injuries can either be intrasubstance tears of the fibres or avulsion fractures from the tibial insertion or femoral origin sites [9]. These are high-energy injuries and can lead to instability and degeneration, therefore they need early open or arthroscopic reduction and fixation [10]. The majority of avulsion injuries are associated with other ligamentous injuries and managing all of them is crucial for better outcomes.

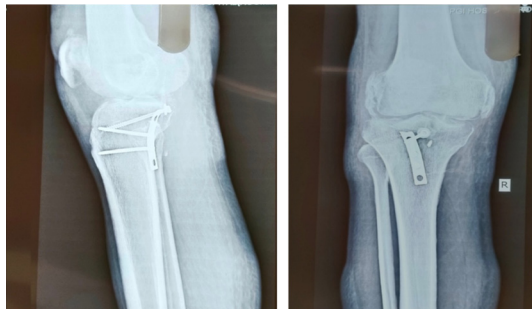
The present case highlights a rather rare combination of knee osseoligamentous injury with co-existent avulsion of the PCL and the semimembranosus tendon; the latter leads to an osteochondral fragment. Such an injury can be easily missed on plain radiographs and a

CT scan is needed to delineate the osteochondral fragment.

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**Figure 4.** Immediate postoperative lateral and frontal radiological images showing accurately reduced posteromedial osteochondral fragment and PCL fragment.



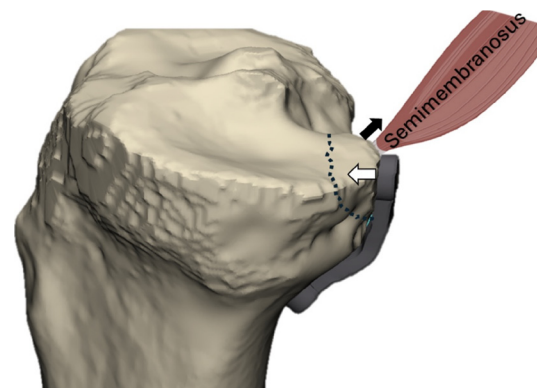
**Figure 5.** Follow-up X-rays at 12 weeks postop showed fracture union and heterotrophic ossification around the knee.

Yao et al. described the 1<sup>st</sup> such osteochondral avulsion associated with an ACL injury and postulated the mechanism to be external rotation and valgus, while Vanek et al. in a cadaveric study described the mechanism to be external rotation and varus (**Table 1**) [11, 12]. These studies concluded that semimembranosus avulsion is always associated with ACL ruptures. However, subsequent reports by Al Hamadi et al. and Koshnoodi et al. described them with PCL avulsions along with meniscal and capsular tears [13, 14]. John et al. described a neglected case of PCL avulsion with semimembranosus avulsion in a 37 years old man and buttressed the fragment with a screw and spiked washer [3].

The issue with the fixation of the fragments in the present case was the nature and size; its chondral part was large relative to the osseous part and visualisation was an issue. John et al. described that once reduced the avulsed frag-



**Figure 6.** Functional knee ROM achieved after manipulation under anaesthesia at 12 weeks follow-up.

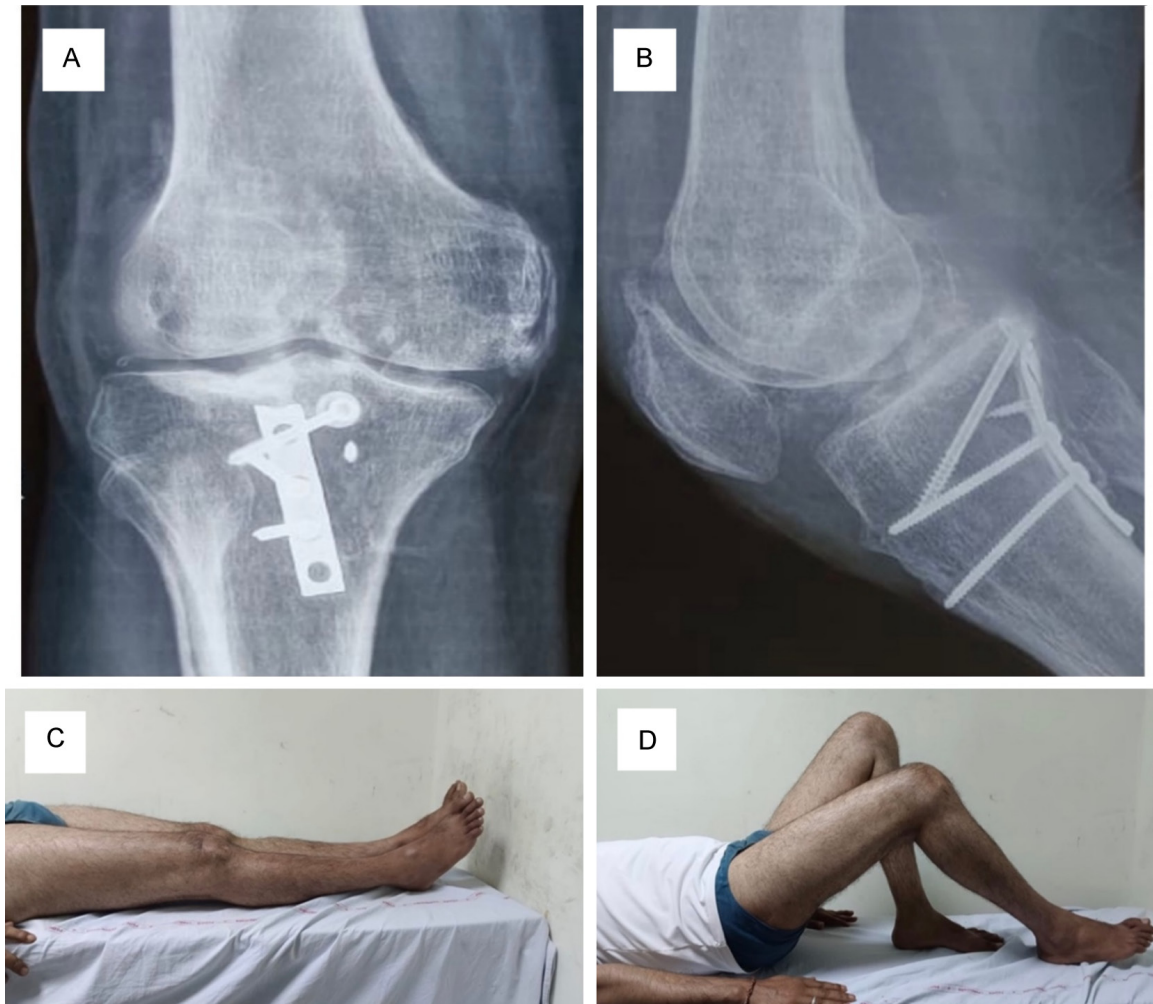


**Figure 7.** Diagrammatic representation of semimembranosus avulsion fragment buttressed by a plate.

ment becomes stable; the shear force of the semimembranosus leads to sagittal instability of such fragments and therefore a posterior buttress screw or plate is sufficient for fixation (**Figure 7**) [3]. We used a 1/3<sup>rd</sup> tubular plate for this purpose and augmented the fixation by tying the sutures placed in the semimembranosus with that in the anchor placed just distal to the crater and our patient was doing well at the end of 1 year (**Figure 8**).

Overall, the present case showcases a rare variant of knee ligamentous avulsion injuries, with a posteromedial osteochondral fragment along with PCL avulsion, the former can be easily missed on plain radiographs and a CT scan

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**Figure 8.** Follow up anteroposterior (A) & lateral (B) radiographs at 12 months follow up along with functional knee range of motion (C and D).

**Table 1.** Reported cases of osteochondral semimembranosus avulsion with associated knee injuries

Sr No.	Authors	Year	No. of Cases	Associated Injuries	Treatment
1.	John R et al. [3]	2018	1	PCL tear	ORIF with lag screws
2.	Khoshnoodi et al. [14]	2014	1	PCL tear Medial meniscus injury Posterior capsule tear	ORIF with locking compression plate; meniscal repair of torn posterior horn of medial meniscus
3.	Al-Humadi M et al. [13]	2009	1	PCL tear Medial meniscus injury	ORIF with lag screws
4.	Chan KK et al. [15]	1999	4/10 cases	ACL tear	Details of fracture management not mentioned
5.	Vanek J [13]	1994	1	ACL tear Medial meniscus injury	Arthroscopic partial meniscectomy
6.	Yao L & Lee LK [11]	1989	2	ACL tear Medial meniscus injury	Not Described

is recommended for delineating it and planning the fixation. Braided fiber sutures can be used to manipulate the fragments and a posterior buttress suffices for fixing the osteochondral fragment.

### Conclusion

This case underscores the rarity of concurrent posterior cruciate ligament (PCL) and semi-membranosus avulsion injuries, emphasizing

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the importance of comprehensive evaluation and tailored surgical management. Utilizing CT imaging proves instrumental in identifying the associated posteromedial osteochondral fragment. Successful reduction and posterior buttressing of the fragment are crucial for stability against vertical shear forces and subsequent union.

### Disclosure of conflict of interest

None.

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