



## Case Report

## Hoffa fracture associated with tibial shaft fracture and multiple ligament avulsion fractures: A case report

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## ABSTRACT

Hoffa fracture combined with tibial shaft fracture and multiple ligament avulsion injuries is extremely rare. Herein, we report a case of medial Hoffa fracture with associated fracture of tibial shaft and avulsion fractures of multiple ligaments secondary to knee dislocation. A 17-year-old female with history of a motorcycle accident was referred to our hospital after knee joint reduction at a regional trauma center. Preoperative radiology revealed a medial Hoffa fracture associated with tibial shaft fracture, inferior pole patellar fracture, fibular head fracture and multiple ligament avulsion fractures including anterior cruciate ligament, posterior cruciate ligament and medial collateral ligament. A less invasive approach via arthroscopy-assisted technique and minimally invasive plate osteosynthesis (MIPO) technique was used for fracture reduction and fixation. Six months postoperatively, the patient had arthrofibrosis and adhesiolysis under arthroscopy was performed. At the last follow-up of 24 months, the patient regained knee full range of motion and returned to pre-injury level of activities. Although minimally invasive techniques were used to speed recovery, the orthopaedic surgeon should still be aware of the possibility of postoperative arthrofibrosis as multiple site fractures may need longer immobilization.

## Introduction

Hoffa fractures are rare injuries characterized by femoral condylar fractures in the coronal plane. They are often associated with high-energy trauma and are more commonly seen in the lateral femoral condyle than the medial femoral condyle [1]. While Hoffa fractures in association with femoral fracture [2], tibial fracture [3] or soft tissue injury [4] have been reported, there were no reports regarding the occurrence of a medial Hoffa fracture combined with ipsilateral tibial shaft fracture and multiple ligament avulsion fractures. Herein, we report a case of Hoffa fracture in the medial condyle with ipsilateral tibial shaft fracture, tibial avulsion fractures of the anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL) as well as femoral avulsion fracture of the medial collateral ligament (MCL).

## Case report

A 17-year-old female with history of a motorcycle accident was referred to our hospital after diagnosing with right knee dislocation and reduction at a regional trauma center. Physical examination revealed swelling and tenderness of the right middle tibia

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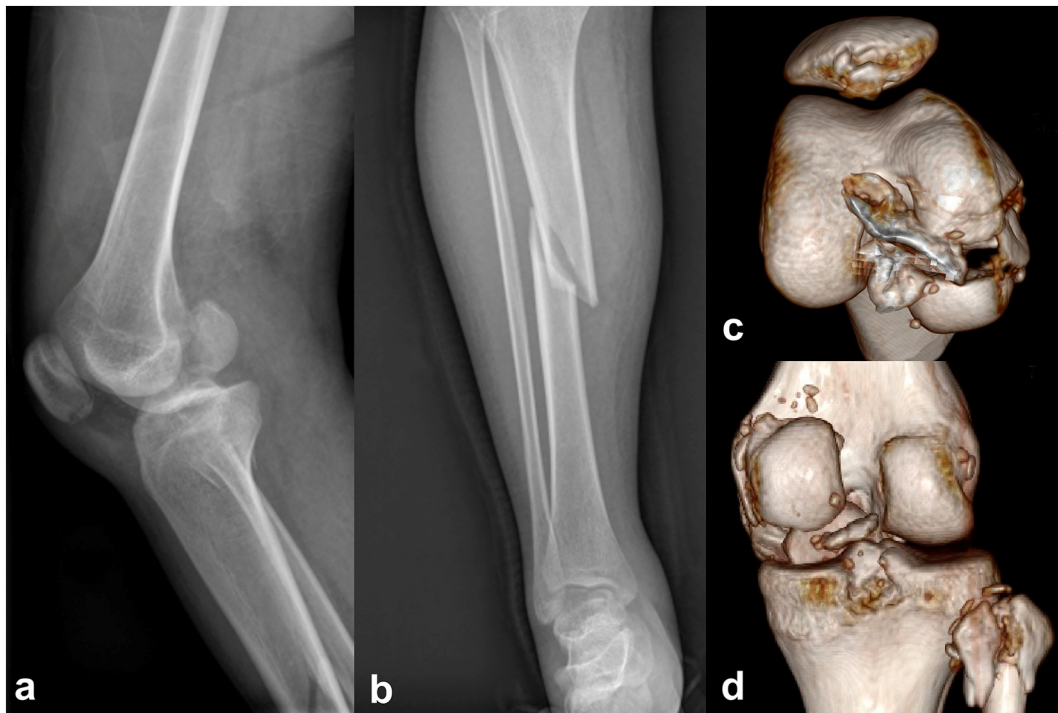
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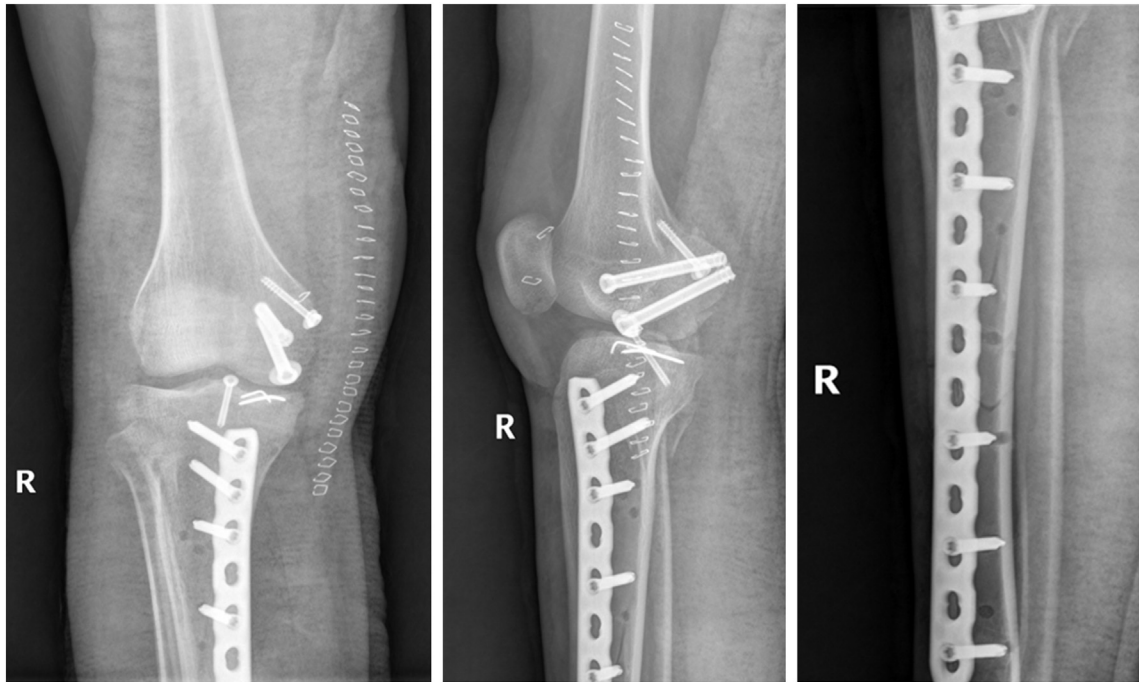


**Fig. 1.** (a) Preoperative lateral radiograph showing coronal fracture of the medial femoral condyle with fractures of tibial plateau, patella and proximal fibula. (b) Preoperative radiograph showing an oblique fracture of the midshaft tibia. (c) Preoperative three-dimensional CT scanning (axial view) showing displaced fragment of the tibial plateau incarcerated in the Hoffa fracture as well as patellar and medial collateral ligament femoral attachment fractures. (d) Preoperative three-dimensional CT scanning (posterior view) showing tibial-side avulsion fracture of the posterior cruciate ligament, medial Hoffa fracture, tibial plateau fracture and fibular fracture.

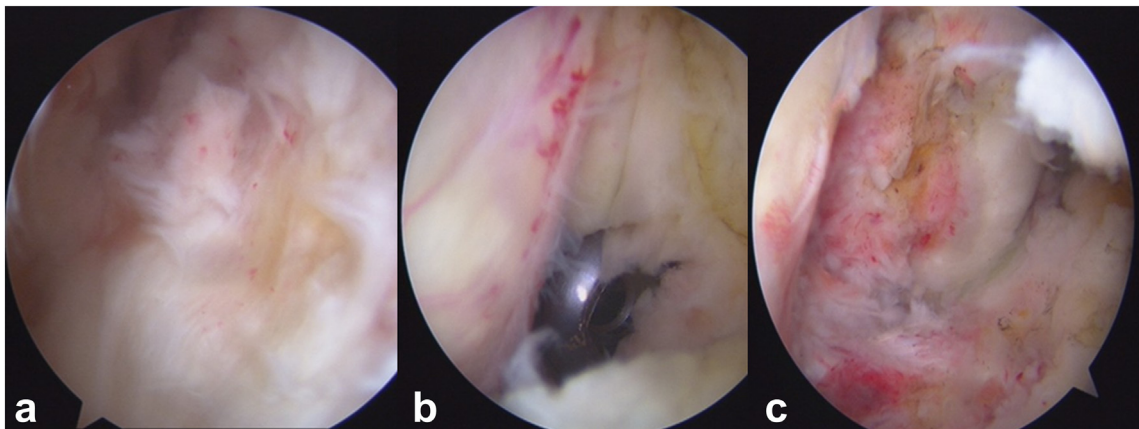
and right knee. Gross deformity of the right calf was identified. The tibial and knee injuries were closed and there was no vascular deficit of the extremity shown by computed tomographic angiography (CTA). Anterior drawer, posterior drawer, floating patella, medial stress and Lachman test were positive. Plain radiograph and computed tomography (CT) scanning of the right knee revealed Hoffa fracture of the medial femoral condyle and multiple site fractures including tibial midshaft, tibial plateau, proximal fibula and inferior pole patella (Fig. 1). Magnetic resonance imaging (MRI) further confirmed multiple ligament avulsion injuries of the ACL, PCL and MCL.

The surgery was scheduled 5 days after admission. The reduction and fixation of the midshaft tibial fracture was achieved by minimally invasive plate osteosynthesis (MIPO) technique. The displaced tibial plateau fragment which includes the entire ACL attachment was found incarcerated in the medial Hoffa fracture. The fragment was then reduced and fixed with two 1.2-mm Kirschner pins paralleling the articular surface and a 4.0-mm cannulated lag screw. A PCL tibial drill guide (Smith & Nephew Endoscopy, Andover, MA) was used to establish two bone tunnels with 2.0-mm Kirschner pins to the medial and lateral border of the PCL tibial avulsion site. Two MB66 sutures (Ethicon, Somerville, NJ) were shuttled through the tibial tunnels by No. 2 polydioxanone (PDS) (Ethicon) guide sutures in a crossover configuration. The PCL avulsed fragment was reduced by pulling tightly each end of the MB66 sutures and tied over the anteromedial cortex of the tibia with the knee at 90° of flexion. Next, two Kirschner wires were used to provisionally stabilize the Hoffa fracture, followed by two 6.5-mm cannulated lag screws placed from anterior to posterior for fixation. The MCL femoral avulsion fracture was subsequently reduced and fixed with a 4.0-mm cannulated screw padded with washer (Fig. 2). The knee joint was examined to be stable intraoperatively.

The patient was immobilized in full-extension using a knee brace with cotton pad protecting the PCL. Quadriceps strengthening, isometric exercises, controlled knee range of motion and straight-leg raises were started postoperatively. The patient was allowed partial weight-bearing using axillary crutches at week 4. At 6 months follow-up, the patient had no pain in her right knee. Plain radiograph revealed union of all the fractures. However, the flexion of the knee was limited to 45°. Arthroscopic adhesiolysis was subsequently performed and the internal fixation of the knee fractures was removed (Fig. 3). The patient was immediately allowed active and passive knee movement after surgery. Tibial fracture fixation was removed 1 year after the index surgery (Fig. 4). At the final follow-up (24 months), the patient's right knee achieved a full range of motion and she returned to preinjury level of activities. The preoperative Lysholm score (37), International Knee Documentation Committee (IKDC) score (40) and Tegner score (2) improved to 92, 85 and 8 at last follow-up, respectively.



**Fig. 2.** Postoperative anteroposterior and lateral radiographs of the right knee and tibial shaft demonstrating good alignment of the fracture.



**Fig. 3.** Arthroscopic images showing (a) intra-articular scar tissue, (b) Hoffa fracture screw fixation and (c) after screw removal and adhesiolysis.

## Discussion

Hoffa fractures are very rare orthopaedic injuries and are challenging in diagnosis and surgical treatment. Although Hoffa fractures can involve only one condyle or both condyles, lateral fractures are estimated to be three times more common than medial fractures [1]. Given the unstable, intra-articular injury nature of Hoffa fractures, conservative treatment is often associated with inferior outcomes such as nonunion or malunion [5,6]. Currently, open reduction and internal fixation combined with early functional exercises is recommended to obtain good long-term results [7]. In addition to Hoffa fractures, tibial-side PCL avulsion fractures are also uncommon, especially in the Western world where motorcycle accidents are less frequent compared to Asia countries [8,9]. Our patient sustained a knee dislocation with medial Hoffa fracture, tibial midshaft and plateau fracture, proximal fibular fracture, patellar fracture and multiple ligament avulsion fractures. Such complex injuries could have a devastating effect on the knee joint and are extremely rare. To our best knowledge, this case is the first report of medial Hoffa fracture associated with tibial shaft fracture and multiple ligament avulsion injuries, which present a real challenge to orthopaedic surgeons.

In our case, the Hoffa fracture of the medial femoral condyle was reduced and fixed with two antero-posterior screws which is proven effective in previous reports [4,10]. The PCL tibial avulsion injury and tibial shaft fracture are addressed through arthroscopy-assisted technique and MIPO technique to restore the stability, respectively. Those minimally invasive technique might play an



**Fig. 4.** Anteroposterior and lateral radiographs of the right knee at 12 months follow-up showing complete union of all fractures.

important role in minimizing the soft tissue problem and accelerating the rehabilitation process. Nevertheless, postoperative knee stiffness was found at 6 months follow-up owing to arthrofibrosis. The patient subsequently underwent manipulation under anesthesia and arthroscopic lysis.

Regarding the optimal surgical treatment for tibial avulsion fractures of the PCL, no consensus has been reached. In a retrospective study comparing open posterior approach and arthroscopic suture fixation for tibial-side PCL avulsion fractures, both methods yielded comparable clinical outcomes at 1 year of follow-up, though postoperative knee laxity was better in the arthroscopic group [9]. A recent systematic review by Hooper et al. concluded that patients with PCL tibial avulsion fractures had similar outcomes after open or arthroscopic surgical treatment. Interestingly, arthroscopic approach is associated with slightly higher incidence of arthrofibrosis [8]. Although factors contributing to arthrofibrosis after arthroscopic surgery are not clear, patients sustained multiple site fractures as in our case may require extended period of immobilization postoperatively which could lead to excessive scar formation and eventually loss of motion.

In conclusion, we reported a unique case of medial Hoffa fracture associated with tibial shaft fracture and multiple ligament avulsion fractures. Orthopaedic surgeons who treat a patient sustained multiple site fractures should be aware of the possibility of postoperative arthrofibrosis though minimally invasive approach was adopted.

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## Declaration of competing interest

None.

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