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Concomitant ipsilateral proximal tibia and femoral Hoffa fractures

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Objective: The aim of this study was to report our experience on concomitant ipsilateral proximal tibia and femoral Hoffa fractures.

Methods: Nine patients (8 male, 1 female; mean age: 30.9; range: 19-49 years) presented to our emergency room with an ipsilateral proximal tibia and femoral Hoffa fracture, following road traffic accident. Six patients had open fracture. Two patients had ipsilateral femoral shaft fracture, two patients had fracture of intercondylar part of distal femur, one had fracture of patella and one had fracture of both bones of the leg. Out of nine Hoffa's fracture eight involved lateral and one involved medial femoral condyle. There were five type II, two type VI, one type I and one type IV proximal tibial fracture according to Schatzker classification.

Results: Mean duration of follow-up was 13 months (range: 9-21 months). At final follow-up, all fractures united. Mean knee society score was 163 (range: 127-182). Mean ROM at knee joint was 97.4 degrees (75°-115°).

Conclusion: Our results suggest that in this combination of intraarticular fractures anatomic reduction and rigid fixation followed by early mobilization reveal satisfactory results.

Key words: Hoffa's fracture; proximal tibial fracture.

Hoffa fractures or coronal fractures of the femoral condyle were first described by Friedrich Busch in 1869, but these were later named after Albert Hoffa in 1904.[1] While Hoffa fractures are uncommon, their concomitance with proximal tibial fractures is even more uncommon. Hoffa fracture is usually associated with supracondylar or intercondylar fracture of the femur.[2] Association of Hoffa fracture with femoral shaft fracture has also been described in literature.[3,4] But there is no literature on association of Hoffa fracture and proximal tibial fracture.

The aim of this study was to report our experience on concomitant ipsilateral proximal tibia and femoral Hoffa fractures.

Patients and methods

Nine patients (8 male, 1 female; mean age: 30.9; range: 19-49 years) with proximal tibia fractures along with ipsilateral Hoffa fracture were treated and followed up in a tertiary care hospital in Delhi, India. All the patients presented to emergency room (ER) within 6 hours following road traffic accident. All patients had two wheeler related accident. A thorough evaluation of all the patients was done to rule out life threatening injuries. Appropriate set of radiograph were taken for each patient including anteroposterior and lateral views of the knee joint. A computerized tomography (CT) scan with 3D reconstruction was performed for each patient to assess the fracture

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pattern and surgical planning. The Hoffa fractures were classified as medial or lateral and the proximal tibial fractures were classified according to Schatzker classification system. Six out of nine patients had open injury which required urgent debridement and fixation. All closed fractures were operated within 48 hours of injury. All the patients were operated in supine position under tourniquet (except those having associated femoral shaft fracture). Standard approaches and fixation techniques were used for each fracture. In view of open fracture, two patients required monolateral external fixator and one patient required ilizarov type circular external fixator. The details of the patients and operative procedure are shown in table 1. Postoperatively all the patients were advised quadriceps isometric exercises, knee range of motion exercises. At final follow-up union status, range of motion and knee society score was evaluated.

Results

Six out of nine patients had an open fracture. Two patients had ipsilateral femoral shaft fractures, two patients had fracture of intercondylar part of distal femur, one had fracture of the patella and one had fracture of both bones of the leg. Out of nine Hoffa fractures, eight involved lateral and one involved medial femoral condyle. There were five Schatzker type II, two Schatzker type VI, one Schatzker type I, and one Schatzker type IV proximal tibia fractures. The mean follow-up time was 13 months (range: 9 to 21 months). At final follow-up all the fractures united in a mean duration of 8.6 weeks (range: 5 to 14.4 weeks) (Fig. 1 a-c, Fig. 2 a-c). There was no significant difference in the healing time of closed and open fractures. Mean knee society score was 163 (range: 127-182). Mean range of motion at knee joint was 97.4° (range: 75°-115°). The mean flexion was 105° (range:

Table 1. Details of the patients.

Case	Age	Sex	Fracture	Open/ closed	Surgical procedure
1	27	Female	Fracture of supracondylar femur with intercondylar extension with Hoffa fracture of lateral femoral condyle, Schatzker type II fracture of proximal tibia and fracture of shaft of tibia and fibula	Closed	ORIF for distal femur fracture with distal femoral locking plate and 4.0 mm CCS and MIPPO for tibia fracture using proximal tibial and distal tibial locking plates
2	19	Male	Hoffa fracture of lateral femoral condyle, Schatzker type II fracture of proximal tibia, fracture of patella (Fig. 1a-c)	Closed	ORIF for Hoffa fracture using 2.7 mm headless screw and 7.0 mm CCS, ORIF for proximal tibial fracture with 7.0 mm CCS, ORIF for fracture patella with 4.0 mm CCS
3	30	Male	Hoffa fracture of lateral femoral condyle, Schatzker type II fracture of proximal tibia	Open	ORIF of Hoffa fracture with 7.0 mm CCS and ORIF of proximal tibia fracture with locking plate
4	40	Male	Hoffa fracture of lateral femoral condyle, Schatzker type I fracture of proximal tibia	Closed	ORIF of Hoffa fracture with 7.0 mm CCS and ORIF of proximal tibia fracture with locking plate
5	28	Male	Schatzker type VI fracture of proximal tibia, fracture of femoral shaft, Hoffa fracture of medial condyle	Open	CRIF of femur with retrograde femur nail, ORIF of Hoffa fracture with 4.0 mm CCS and headless screw and ORIF of proximal tibia fracture with locking plate
6	20	Male	Schatzker type IV fracture of proximal tibia, fracture of femur shaft, Hoffa fracture of lateral femoral condyle (Fig. 2a-c)	Open	ORIF for shaft of femur fracture with K nail and cerclage wiring, ORIF of tibial fracture with 7.00 mm CCS, ORIF of Hoffa with 4.0 mm CCS
7	25	Male	Hoffa fracture of lateral femoral condyle, Schatzker type II fracture of proximal tibia	Open	ORIF of Hoffa fracture with headless screw, ORIF of proximal tibia fracture with two 7.0 mm CCS and across knee external fixator
8	40	Male	Hoffa fracture of lateral femoral condyle, Schatzker type IV fracture of proximal tibia	Open	ORIF of Hoffa with two 4.0 mm CCS, Ilizarov's ring fixator for proximal tibia fracture
9	49	Male	Fracture of supracondylar femur with intercondylar extension with Hoffa fracture of lateral femoral condyle, Schatzker type II fracture proximal tibia	Open	ORIF of fracture distal femur with locking plate and two 4.0 mm CCS and ORIF of proximal tibia fracture with two7.0 mm CCS and external fixator application

ORIF: Open Reduction and Internal Fixation; CCS: Cannulated Cancellous Screw; MIPPO: Minimally Invasive Percutaneous Plate Osteosynthesis; CRIF: Closed Reduction and Internal Fixation.

Fig. 1. **(a)** Radiograph of the knee joint showing Hoffa fracture of lateral femoral condyle, type II proximal tibial fracture, and fracture of patella. **(b)** Post-operative radiograph showing fixation of Hoffa fracture, fracture of proximal tibia and fracture of patella. An external fixator has also been applied. **(c)** Final radiograph at 1 year showing union of the fractures.

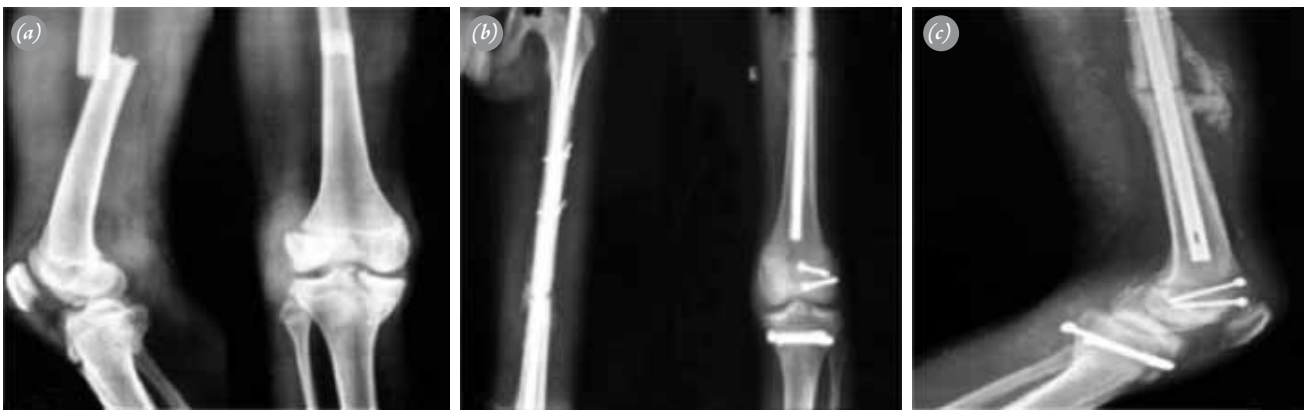

Fig. 2. **(a)** Plain radiograph showing type IV fracture of the proximal tibia, fracture of femoral shaft and Hoffa fracture of lateral femoral condyle. **(b, c)** At final follow-up at 14 months all fractures united.

90°-115°) and mean extension lag was 3° (range: 0°-15°). Three knees had excellent, five had good and one had fair knee function. The knees in which external fixator was applied had poorer outcome than those without external fixator.

Discussion

Coronal plane fracture of the femoral condyle is known as Hoffa fracture. These fractures can involve either medial or lateral condyle of distal femur. Involvement of lateral condyle is more common than medial side.[5] Rarely patient may present with bicondylar fracture.[6,7] Hoffa fractures are classified as OTA type 33-B3 fractures (frontal, partial articular fracture of distal femur). Letenneur classified these fractures into types I, II and III, with three subtypes of type II.[8] Type II fractures are without any soft tissue attachment lying completely free in the joint and are therefore prone to nonunion. In type III fractures, fracture line runs obliquely, therefore respond poorly to conservative management.

The mechanism of injury of Hoffa fracture is not clearly defined. All our patients had two wheeler related accident. Sitting on a two wheeler requires flexion and abduction at the hip joint and flexion at the knee joint. With sudden deceleration due to accident and impact on the lower limb there is transmission of ground reaction force through the tibial plateau to the posterior femoral condyle. This shearing force on femoral condyle leads to Hoffa fracture. Type and configuration of proximal tibial injury depend upon ground impaction force and position of the knee. Due to more common valgus position of the knee at the time of accident, the injuries more commonly involved lateral part of the knee joint.

In the presence of proximal tibial injury Hoffa fracture can be easily missed. So, high index of suspicion is required for diagnosing these injuries. Up to 30% of coronal plane fractures can be missed on plain radiographs.[2] Appearance of foreshortened fractured condyle, varus or valgus malalignment of distal femur, non-superimposition of femoral condyle on lateral view in a plain radiograph should alert the surgeon about this injury. When plain radiographs do not confirm the diagnosis, computerized tomography will be helpful in diagnosis and also

in the preoperative planning.

As both the proximal tibia fracture and Hoffa fracture are intraarticular, anatomic reduction and rigid fixation are the preferred mode of treatment, as they permit early mobilization of the knee and good functional recovery. Treatment of proximal tibial fractures is well defined in literature, but due to their rarity, Hoffa fracture treatment is not well studied. Non-operative treatment of Hoffa fractures leads to malunion, nonunion and stiff knee.[9] In concomitant tibia and Hoffa fractures, the approach depends on the configuration of femur and tibia fracture. The commonly used approaches are parapatellar anterior approach, lateral and medial approach to distal femur, anterolateral and posteromedial approach to proximal tibia. Lieberga et al. described a Gerdy tubercle osteotomy via a lateral parapatellar approach for extensile exposure.[10] The authors recommend standard surgical approaches for fixation of these fractures. The extensile Gerdy's tubercle osteotomy approach should be used for comminuted and complex fractures.

As Hoffa fractures are commonly described as case reports in literature, there is no standard guideline for treatment. A minimum of two screws has been recommended to provide rotational stability.[11] The direction of screw insertion is also controversial. A biomechanical study found posterior to anterior (PA) screw insertion to be superior to anterior to posterior (AP) insertion.[12] But the authors concluded that these findings are difficult to be applied in clinical practice as either a lateral or posterior surgical approach is necessary when using the PA direction, which carries a higher complication rate. [12] A cadaveric study compared the stiffness and load to failure of 3.5 mm cortical lag screws, 4.5 mm cortical lag screws and 6.5 mm cancellous screws, to fix experimentally created Hoffa fractures. There was no difference in stiffness between any groups, but the load to failure was significantly higher for 6.5 mm screws compared with 3.5 mm screws.[13] Hak et al. concluded that in the fixation of posterior femoral condyle fractures, two 6.5 mm screws are more rigid than either single or double 3.5 mm screws and if 3.5 mm screws are used then at least two screws should be used.[14] Herbert and cannulated screws also may be good fixation option. As per authors experience, any of the above mentioned screws can be used for fixation of these fractures. If cancellous screws are used instead of headless screws, a countersunk should be used to bury the head of the screws. Correct positioning of the screws (in both anteroposterior and lateral plane to allow compression at the fracture site) is more critical than the type of the screw itself, in achieving good functional outcome. We also recommend insertion of at least two screws in anterior to posterior direction to achieve better biomechanical stability.

We used external fixator in two of our patients with open injury. Our patients had excellent and good outcomes except one knee where knee spanning external fixator was used (case 7). The other patient in which no knee-spanning external fixator was used had good functional outcome (case 9). The poorer outcome in patient where external fixator was applied can be due to delayed mobilization of the knee because of the external fixator. We suggest the use of knee spanning external fixator only for temporary wound management or for residual knee instability following fracture fixation. If used they should be removed at appropriate time to prevent knee stiffness.

Plating is indicated in cases where the Hoffa fracture is associated with a supracondylar or intercondylar fracture and in patients with osteoporosis.[15] Plates with broad distal expansion, such as condylar buttress plates and locking compression condylar plates also allow screw insertion into the posterior fragment. The role of arthroscopically assisted reduction and internal fixation of femoral condyle fractures is not well defined. McCarthy et al. reported arthroscopic reduction of distal intraarticular femoral fractures with good result.[16] They reported decreased blood loss, shortened operative time, excellent intraarticular visualization, decreased soft tissue dissection, and shortened postoperative recovery with arthroscopy. However, the technique is technically demanding.[16]

We strongly recommend a complete set of knee radiographs, including anteroposterior, lateral, and oblique views for all patients with proximal tibial injuries to not miss this combination of tibial and femoral fractures. A CT scan will also be helpful in the diagnosis of occult cases and preoperative planning. These fractures should be managed by aggressive intervention to achieve anatomical reduction and stable fixation. Along with standard surgical approaches; Gerdy's tubercle osteotomy approach can be used for more extensile exposure for anatomic reduction. External fixator, when used for prolonged period, can lead to knee stiffness.

Conflicts of Interest: No conflicts declared.

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