CASE REPORT

Hoffa fracture: should precautions be taken during fixation and rehabilitation?

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A coronal fracture of a femoral condyle (Hoffa fracture) is an unusual injury and there are only a handful of reports discussing it. We report a case of a 52-year-old worker who fell from a height, suffering lower limb injuries, including a Hoffa fracture with comminution, and had problems with malunion during the postoperative period. Clinicians should be aware that rehabilitation programmes need to be tailored to the method of fixation used to manage this uncommon fracture pattern.

Introduction

An isolated coronal fracture of either or both femoral condyles is an unusual injury. First mentioned by Friedrich Busch in 1869, it was later named after Albert Hoffa in 1904. It is classified as a type 33B3 fracture according to the AO (Arbeitsgemeinschaft für Osteosynthesefragen) classification. It has been postulated that the mechanism of injury is axial compression to the knee with transmission of the ground reaction force through the tibial plateau to the femoral condyles. In a flexed position the posterior portion of the lateral condyle is the leading part of the knee receiving the impact. Although Hoffa fractures can occur in either femoral condyle, this positioning makes them more common on the lateral side. A solitary Hoffa fracture is a rare occurrence, but the fracture is not uncommon when associated with supracondylar or intercondylar fractures of the femur sustained by high energy trauma.[1] As this kind of fracture configuration is exposed to continual shear stresses in both the coronal (varus/valgus) and sagittal (flexion/extension) planes, it is an intrinsically unstable type of intra-articular fracture that warrants operative fixation. Indeed, cases of malunion and non-union have been reported where Hoffa fractures have not been managed surgically.[2]

Case report

In March 2008, a 52-year-old container terminal worker presented to the emergency department after a fall from a 5-foot high platform led to axial loading of his left knee. His left knee was painful and swollen. He also had a left bi-malleolar fracture and a crack in the right ilium, which was regarded as a stable pelvic fracture. Physical examination of the knee revealed diffuse tenderness and swelling compatible with haemarthrosis. The distal peripheral pulses were palpable and no neurological deficit was noted in the lower limbs. Admission radiographs of the knee (Fig 1a, b) showed an isolated coronal intra-articular fracture of the lateral femoral condyle, with proximal migration of the fragment. A long leg slab was applied.

The patient was operated on 2 days after admission. He was put in a supine position under general anaesthesia, and a tourniquet was applied over the left thigh. An anterior midline skin incision was followed by a lateral parapatellar arthrotomy. The patella was deflected to the medial side while the knee was flexed. A Hoffa fracture was found over the lateral femoral condyle, with the condylar fragment displaced proximally. Another similar incomplete coronal crack was noted over the fragment (Fig 2a). The articular cartilage over the femoral condyles was bruised. The collateral ligaments, cruciate ligaments and the menisci were intact. After anatomical reduction of the fracture, fixation was accomplished using two 6.5-mm cancellous screws with 16-mm thread introduced anteroposteriorly through the non-articular surface, in a direction perpendicular to the fracture line so as to achieve interfragmentary compression (Fig 2b, c). Although there was a crack in the condylar fragment, the bone was not osteoporotic and the strength of screw purchase in the bone was adequate for providing interfragmentary compression. The reduction and the alignment of the screws were confirmed by intra-operative fluoroscopy. Intra-articular insertion of the screws was ruled out. Before wound closure, satisfactory stability was tested with knee flexion up to 135°. Operative fixation of the bi-malleolar ankle fracture, performed during the same session, was uneventful and immaterial to the subsequent management of the Hoffa fracture.

Key words
Femoral fractures; Fracture fixation, internal; Knee injuries

Hong Kong Med J 2009;15:385-7

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Hoffa骨折：在固定和康復的過程中須要作出哪些防範？

股骨髁冠狀面骨折（即Hoffa骨折）並不常見，只有很少有關的文獻報告。本文報告一名52歲工人，他從高處墜下，引致下肢受創，包括粉碎性的Hoffa骨折。病人術後出現畸形癒合。要處理這種罕見的骨折病例，醫生要注意病人的康復療程以配合其使用的固定方法。

Continuous passive movement was initiated after removal of the drain. It was started at 0-45° and increased stepwise to 0-90° over 3 days. Physiotherapists supervised joint mobilisation and non–weight-bearing walking exercises. External immobilisation was not deemed necessary. The patient tolerated the rehabilitation programme well and did not complain of any locking or snapping of the knee before being discharged, 8 days after the operation.

Although progressing normally when reviewed in the outpatient clinic 3 weeks post-surgery, at 5 weeks after the operation the patient complained of severe knee pain and relapse of the joint swelling. There had been no further injury events, and he had been compliant in avoiding premature weight-bearing use of that limb. An X-ray of the knee showed proximal redisplacement of the condylar fragment with a mild step on the articular surface (Fig 1c-f). His inflammatory markers, including a white blood cell count, erythrocyte sedimentation rate and C-reactive protein, were all normal. Clinically, there was no evidence of infected implants that might explain the failure of fixation. The patient opted for conservative management, continuing non–weight-bearing walking and restriction of knee movement with a static knee extension brace for 6 weeks. The fracture healed eventually 3 months after the operation, without further displacement. The functional outcome was satisfactory, as a 0-135° range of active movement returned, and he could ambulate independently, though residual pain affected his walking tolerance.

Discussion

As a general principle, the management goal for all types of intra-articular fractures is to achieve anatomical reduction and adequate stability enabling early mobilisation. It is generally accepted that operative fixation of Hoffa fractures is necessary to achieve this goal. The rarity and peculiar anatomical location of Hoffa fractures renders their management a challenge. There are some factors that may lead to inadequate fixation.

Fracture configuration hindering a firm interfragmentary compression by lag screws

Most of the discussion of this entity appears in case reports or small series,[3,4] so, as yet, there is no consensus on the method of fixation (in terms of anterior/posterior direction of screw insertion, and what type/size/number of screws to use) that is both safe to perform and superior to other methods. The conventional method, employed in our case, is to use a lateral parapatellar approach with placement of two partial-thread 6.5-mm cancellous screws in an anteroposterior (AP) direction. The choice of screws may vary; Holmes et al[5] reported achieving fixation using four 3.5-mm cortical screws in the AP direction, plus washers. The direction of screw insertion may also vary; a biomechanical study by Jarit et al[6] found the posteroanterior (PA) manner of screw insertion to be superior to AP insertion. This finding could not be readily translated to clinical practice, however, as taking either a lateral or posterior surgical approach is necessary when using the PA direction, but these carry higher risks. For a lateral condyle Hoffa fracture, the lateral approach can be used to gain access to the posterior portion of the lateral femoral condyle between the iliotibial band and the biceps femoris tendon, but this risks damage to the common peroneal nerve, which runs along the posterior border of the biceps. The posterior approach puts the popliteal vessels at risk. Besides, if one is using the PA direction the screw heads have to be countersunk beneath the articular surface, thus disrupting the cartilage. In our case, comminution of

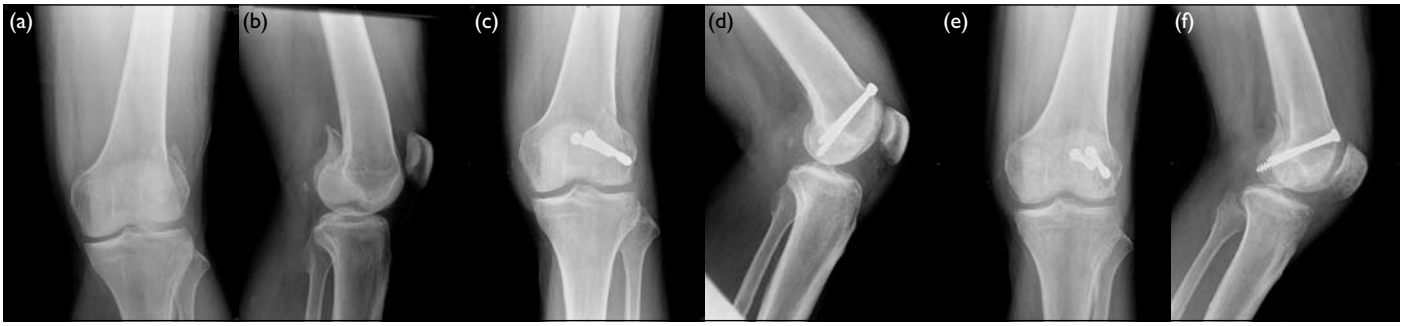

FIG 1. Radiographs showing the (a, b) Hoffa fracture, (c, d) early postoperative period, and (e, f) knee after redisplacement

the condylar fragment (Fig 2a) was also regarded as a factor that weakened the strength of the fixation.

Shear stresses

In Hoffa fractures, the fragment is continually exposed to physiological shearing stresses in the sagittal plane during normal flexion/extension. Varus/valgus stress also exists in the coronal plane even though the collateral ligaments are intact, as in our case. The lag screws can only provide interfragmentary compression; there is no available hardware able to both neutralise the physiological shearing stress and be, at the same time, easily placed over the posterior side of the distal femur. In order to buttress the fragment against the shearing force, screws could have been applied on the posterior aspect just above the fragment to stop it from superiorly migrating. This postulated technique is almost infeasible, however, due to limited access when using the lateral parapatellar exposure.

Limited choice of implants

In those cases where the Hoffa fracture is associated with a supracondylar or intercondylar fracture, the fixation considered would be different. Plating is indicated in these conditions. Plates with broad distal expansion, such as condylar buttress plates and locking compression condylar plates, allow screw insertion into the posterior fragment in a transverse manner. This is an uncommon circumstance where the broad distal expansion of these less popular plates may have a modest advantage over the Less Invasive Stabilisation System plate, by providing better coverage of the posterior aspect of the femoral condyles (Fig 2d-f).

Bone quality

The rate of bone loss in osteoporosis is more rapid in trabecular bone than cortical bone. As this is an epiphyseal fracture through trabecular bone, the strength of screw purchase is expected to diminish with age. Despite thoughtful planning of reduction and fixation, with all the above points addressed, adequate stability of internal fixation cannot be guaranteed.

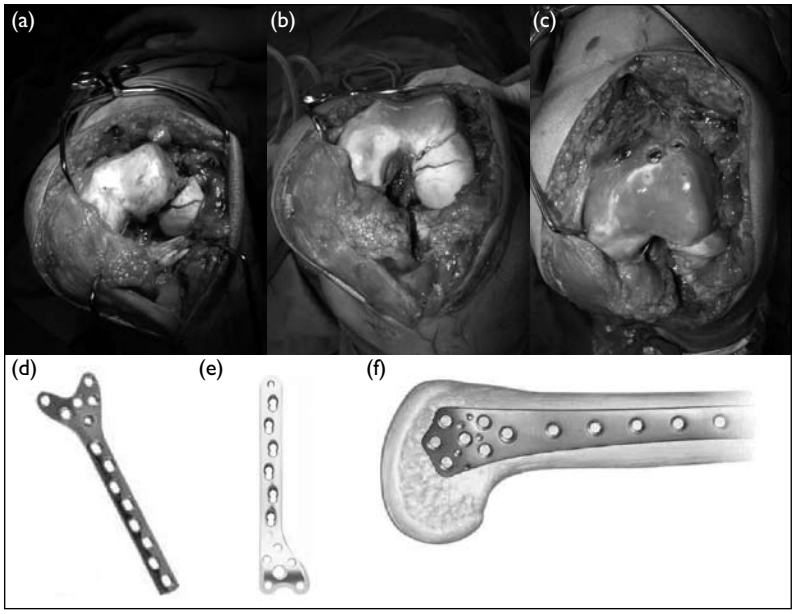

FIG 2. Photos showing the Hoffa fracture (a) with a similar incomplete crack over the fragment, and (b, c) after reduction and fixation. Plates mentioned for distal femoral fractures—(d) condylar buttress plate, (e) locking compression condylar plate, and (f) a Less Invasive Stabilisation System plate showing its limitation for covering the posterior aspect of the condyles

As far as rehabilitation is concerned, there is always a conflict between fracture site stability and early mobilisation. Whatever forms of fixation are employed, stability of the construction must be tested intra-operatively with adequate knee movement. This reproduces the physiological stresses and intra-articular events that would happen during physical rehabilitation. In cases of doubt, Lewis et al[2] recommended plaster immobilisation in full extension for 6 weeks, because in such a position the posterior joint capsule is tightened to provide splintage to the condylar fragment, and any axial loading can be borne by the anterior portion of the condyles. Besides slowing down the rehabilitation programme, a shorter follow-up interval, every 1-2 weeks, is also necessary, and the clinician must remain vigilant and investigate any unexplained increase in pain or swelling during the course of rehabilitation.

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