

Hoffa Fracture of the Femoral Condyle

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In this report, we present a case of an uncommon coronal fracture of the femoral condyle, known as a Hoffa fracture. Classification of these injuries and commonly associated injuries are discussed. We describe previously proposed mechanisms of injury and review the current literature. The difficulty in establishing radiologic diagnosis on the basis of radiography exclusively is emphasized. Finally, current approaches to operative fixation are outlined.

Introduction

The Hoffa fracture is an uncommon, coronally-oriented fracture which extends through either the medial or lateral condyle [1]. This injury is classified as a Type 33-B3 fracture by the Orthopaedic Trauma Association [2]. A classification scheme for subtyping of Hoffa fractures based on location within the condyle has previously been proposed [1]. The Hoffa fracture is typically seen in the setting of a motor vehicle accident or a fall from a height [1,3,4,5]. The mechanism is not agreed upon and both direct impact and vertical shear with twisting mechanisms have been postulated [1,4].

A high degree of suspicion is integral to radiographic diagnosis as these fractures may be very subtle at radiography [1,3,5]. As this case illustrates, this entity must be kept in mind even in the setting of apparently minor,

lower-energy trauma.

Case Report

A 51-year-old woman presented 10 days after sustaining an injury to her right knee. The patient reported that she had caught her foot on a rug, tripped, and fell. Since the incident, she had experienced progressively worsening knee pain. The patient also complained of pain radiating from the right buttock region down to the leg, as well as longstanding low back pain. She denied paraesthesias or bowel or bladder symptoms. There was no hip pain.

Past medical and surgical history was significant for osteoarthritis of the right knee. She reported background mild, unrelenting pain in her right knee which predated the accident and was first noticed several months prior, when she had undergone arthroscopic treatment for a medial meniscal tear. Spondylosis of the lumbar spine with degenerative disc disease at L4-5 and L5-S1 was previously documented.

On examination, a small right knee joint effusion was detected. Tenderness was elicited upon palpation along the medial joint line and the medial femoral condyle. The patient also had tenderness along the MCL, which showed slight laxity upon stress testing. No ante-

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Abbreviations: CT, computed tomography; MRI, magnetic resonance imaging

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Figure 1. 51-year-old woman with Hoffa fracture of the medial femoral condyle. Even in retrospect, faint, coronally-oriented linear lucency extending through the medial femoral condyle is difficult to appreciate. Cortical disruption at the medial femoral condylar cortex [arrow in (A)], as well as at the junction of the posterior femoral shaft and condyle [arrow in (B)], is very subtle. A joint effusion is present (B).

rior drawer sign could be elicited. Lachman, Steinmann, and McMurray's tests were all negative. The initial clinical impression was an MCL sprain with residual symptoms related to the patient's previous arthroscopic medial meniscal repair.

Prospective review of plain radiographs obtained at the time of the initial clinical evaluation revealed mild medial compartment joint space narrowing in keeping with osteoarthritis. There was also a small joint effusion. Subtle cortical disruption and faint, linear lucency extending through the posterior aspect of the medial femoral condyle was difficult to confirm, even in retrospect (Fig.1).

Subsequently performed MRI revealed a non-displaced, intraarticular fracture of the posterior aspect of the medial femoral condyle. The fracture plane demonstrated an oblique coronal orientation (Fig.2). Prominent surrounding marrow edema was noted. Irregular, truncated, diminutive appearance of the posterior horn of the medial meniscus was thought to represent a recurrent radial tear on a background of post-partial meniscectomy changes.

The patient's symptoms improved with conservative measures including protected weight-bearing and use of a knee brace.

Discussion

The so-called 'Hoffa' fracture refers to an isolated, coronally-oriented fracture of either femoral condyle, with intra-articular extension [1]. This rare injury corresponds to the Orthopaedic Trauma Association Type 33-B3 fracture (frontal, partial articular fracture of the distal femur) [2]. These injuries have previously been classified. Type I fractures extend from an extraarticular location at the junction of the posterior femoral shaft and the proximal aspect of the femoral condyle superiorly to the posterior aspect of the condylar articular surface inferiorly, such that the popliteus tendon insertion and the lateral head of gastrocnemius origin remain attached to the condylar fragment. The anterior cruciate and lateral ligament insertions may be attached to either the condylar or shaft fragment. Type II originate posterior to the posterior femoral shaft-condylar junction, and are therefore potentially entirely intraarticular. Compared to Type I fractures, the aforementioned ligamentous insertions are less likely to be attached to the condylar fragment. In Type III fractures all of the

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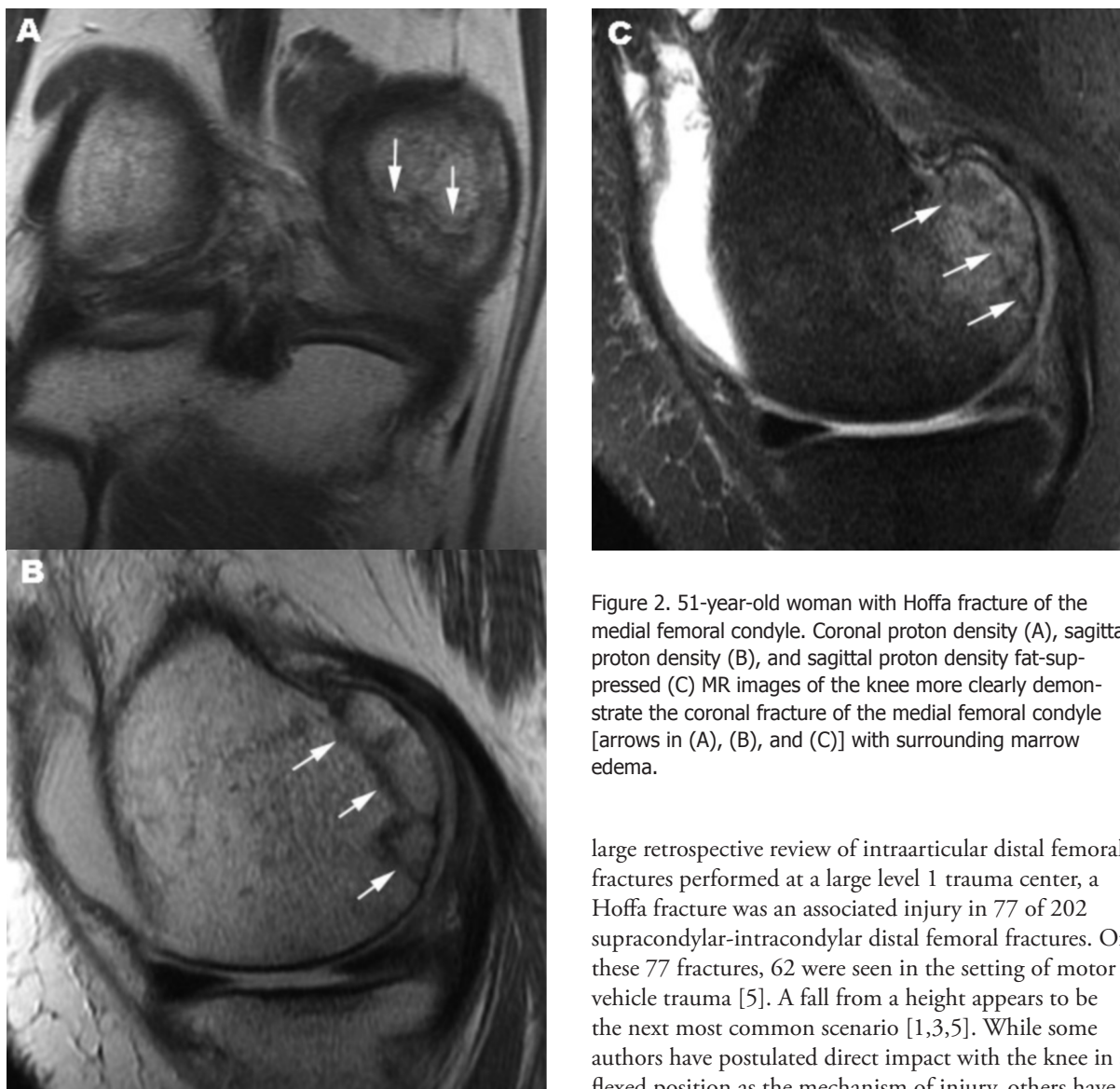


Figure 2. 51-year-old woman with Hoffa fracture of the medial femoral condyle. Coronal proton density (A), sagittal proton density (B), and sagittal proton density fat-suppressed (C) MR images of the knee more clearly demonstrate the coronal fracture of the medial femoral condyle [arrows in (A), (B), and (C)] with surrounding marrow edema.

ligamentous insertions remain attached to the condylar fragment. No relationship between the incidence of avascular necrosis and fracture type has been conclusively demonstrated [1].

Hoffa fractures are seen in the setting of high velocity, high energy trauma. Four of five patients with isolated Hoffa fractures in one series were involved in motor vehicle accidents [3]. In another series, five of seven fractures were sustained in motor vehicle accidents, while a sixth involved a pedestrian hit by a car [1]. In a

large retrospective review of intraarticular distal femoral fractures performed at a large level 1 trauma center, a Hoffa fracture was an associated injury in 77 of 202 supracondylar-intracondylar distal femoral fractures. Of these 77 fractures, 62 were seen in the setting of motor vehicle trauma [5]. A fall from a height appears to be the next most common scenario [1,3,5]. While some authors have postulated direct impact with the knee in a flexed position as the mechanism of injury, others have attributed the fracture to simultaneous vertical shear and twisting forces [1,4].

The Hoffa fracture pattern has been described in both the medial and lateral femoral condyle [1,3,5]. Bicondylar involvement has also been previously reported [4,5,6]. As mentioned already, Hoffa fractures are not infrequently seen in conjunction with other femoral fractures, both distally as well as more proximally, in the shaft [5,6,7]. There have also been reports of associated patellar and/or quadriceps tendon injury [6,8]. In one case, the avulsed patellar tendon became incarcerated

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ated between the fragments of a Hoffa fracture of the lateral femoral condyle, precluding closed reduction [8]. The association of Hoffa fractures with supracondylar-intracondylar distal femoral fractures has already been noted [5].

The coronal oblique orientation of the Hoffa fracture makes this injury notoriously difficult to detect on standard anterior-posterior (AP) and lateral radiographs, particularly if the fracture is nondisplaced (1,3,5). In the AP projection, the x-ray beam does not run tangent to the fracture margins. The intact, anterior aspect of the fractured condyle further obscures the fracture [1]. Moreover, the foreshortened fractured condyle may be overlooked as mere varus or valgus malalignment. If nondisplaced, incomplete superimposition of the condyles may be the sign of fracture; however, this subtle finding may be misinterpreted as slight obliquity of an intended lateral radiograph [3]. In the large series evaluating Hoffa fractures in the setting of distal femoral intraarticular fractures, initial AP and lateral radiographs were considered diagnostic in only 66 of 95 cases of unicondylar Hoffa fracture. In 10 cases without preoperative computed tomographic (CT) evaluation, the Hoffa component of the injury was only discovered during intraoperative inspection [5]. In the presented case, subtle cortical disruption at the posterior shaft-condylar junction is questionably identified, even in retrospect. Oblique radiographs may provide additional opportunity to more optimally profile the fracture plane. The diagnosis is much more readily apparent with CT or magnetic resonance imaging (MRI).

Although the patient in our presented case was successfully managed conservatively with knee bracing and protected weight-bearing, loss of anatomic alignment of non-displaced Hoffa fractures treated with non-operative management exclusively is well-described. This was the case in 3 of 7 patients in one series, and one of five patients in another. The remainder of the fractures in each of these two series were treated operatively [1,3]. Hoffa fractures are typically reduced and fixed with anterior-to-posterior oriented cancellous screws [1,3,4,9,10,11]. When there is metaphyseal extension of the fracture, the fixation is supplemented with a lateral buttress plate [10,11]. Operative repair lateral condylar Hoffa fractures may be accomplished without violating the articular surface by performing an osteotomy of Gerdy's tubercle and reflecting the iliotibial band to provide adequate visualization [12]. Recently, the durability

of posterior-to-anterior screw fixation was compared with anterior-to-posterior fixation in cadaveric femora in which osteotomies had first been performed to simulate Hoffa fractures. The authors showed that those condyles fixed with posterior-to-anterior directed screws showed less displacement when subjected to vertical force compared with anterior-to-posterior screw fixation [11].

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