

Case Report

The management of intra-articular lateral femoral condyle (Hoffa) fracture of the knee using arthroscopy-assisted fixation: a case report

I. G. N. Wien Aryana, Trimanto Wibowo*

Department of Orthopaedic and Traumatology, Faculty of Medicine Udayana University-Sanglah General Hospital, Denpasar, Bali, Indonesia

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***Correspondence:**

Dr. Trimanto Wibowo,

E-mail: trimantow.tmt@gmail.com

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ABSTRACT

A Hoffa fracture is a type of supracondylar distal femoral fracture with fracture line located in the coronal plane. It is a rare injury consisting of tangential (coronal shear) fracture of distal femoral condyles. Unicondylar knee fractures are rare and present some diagnostic difficulties due to poor visibility on standard X-ray and are especially harder to identify in non-displaced fracture. A fifty-four-year-old male presented to our emergency room with a chief complaint of pain over his right knee that started 10 months prior. He previously was involved in a motor vehicle accident and underwent open reduction and internal fixation with plate and screws. Physical examination revealed swelling and tenderness over the right knee with limited range of motion. Plain X-ray showed union of tibia plateau fracture with plate and screws and no evidence of distal femoral fracture. A magnetic resonance imaging of the right knee was performed and revealed an intraarticular lateral condyle femur fracture with transverse configuration that was previously missed on plain X-ray. Arthroscopy-assisted reduction and internal fixation using antero-posterior and postero-anterior oriented screws were performed and good reduction was achieved. Diagnosis of this type of fracture is challenging and require some experience. Awareness of such entity and strong clinical suspicion are essential for diagnosis because most of the time the standard X-rays may appear normal. Arthroscopy-assisted fracture fixation using antero-posterior and postero-anterior oriented screws for Hoffa fracture offers many advantages and allows for early mobilization postoperatively without any loss of reduction.

Keywords: Arthroscopy, Hoffa fracture, Intra-articular, Lateral femoral condyle fracture

INTRODUCTION

A Hoffa fracture is a type of supracondylar distal femoral fracture, characterized by a fracture line in the coronal plane.¹ It was first described by Friedrich Busch (1844-1916) and not as always assumed by Albert Hoffa in 1904.² It is a rare injury consisting of tangential (coronal shear) fracture of distal femoral condyles.³ Unicondylar knee fractures are rare lesions and it presents some difficulties in diagnosis due to its poor visibility on

standard X-ray and is harder to identify in non-displaced fracture.²

Hoffa fracture generally results from severe high-energy trauma secondary to motor vehicle accidents or a fall from a height. The specific mechanism of injury that produces Hoffa fractures remains unknown. Lewis et al, suggested that axial load to the femoral condyle when the knee is flexed to $>90^{\circ}$ produces posterior tangential fractures. Since the lateral femoral condyle has a greater anteroposterior (AP) dimension and the knee has a

physiologically valgus orientation, the lateral condyle is more commonly involved.⁴

CASE REPORT

A 54-years-old male presented to our emergency department with a chief complaint of pain over his right knee. He had a 10-months history of motor vehicle accident where he was riding a motorcycle and fell to his right side while trying to avoid an incoming traffic. He bumped his right knee against the asphalt and was taken to the hospital where he underwent open reduction and internal fixation using plate and screws. Physical examination revealed swelling and tenderness over the right knee with limited range of motion due to pain. An anteroposterior and lateral knee X-ray was done and revealed union of tibia plateau fracture post ORIF and absence of fracture at the distal femur (Figure 1).

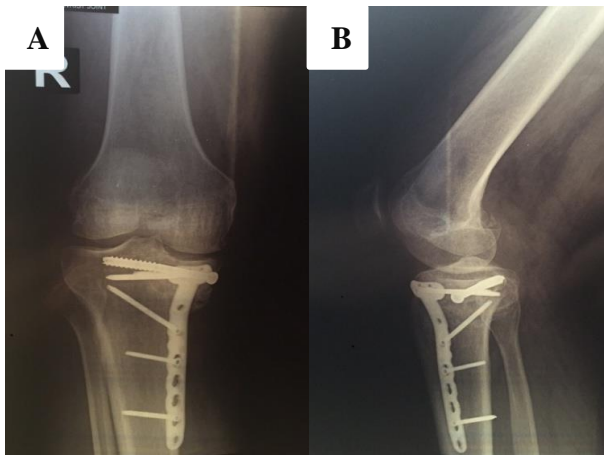


Figure 1: Plain x-ray. A) X-ray of right knee ap. B) X-ray of right knee lateral view showing no sign of distal right femur fracture.

Ten-months post fixation using plate and screws, he still experienced constant pain on his right knee and a magnetic resonance imaging (MRI) was performed (Figure 2). The MRI revealed an intraarticular fracture of the lateral condyle femur with transverse configuration that was previously unseen with the plain X-ray series.

An arthroscopy-assisted reduction and internal fixation using screw was performed on the patient. Arthroscopy-assisted surgery provides minimal soft-tissue damage and excellent intra-articular evaluation with enlarged and clear visualization. Another advantage of arthroscopy is the ability to evaluate other intraarticular structures at the same time.

Under arthroscopic visualization, a diagnostic arthroscopy was performed and both menisci and cruciate ligaments were found to be normal. The knee joint was irrigated and a diagnosis of posterior translated lateral Hoffa fractures was made (Figure 3).

The coronal horizontal Hoffa fracture was held with a Kirschner wire and a reduction of the fracture was attempted (Figure 4). Reduction was achieved by holding down the Kirschner wire to elevate the fracture. We had augmented our fixation using cannulated screws in multiple directions along with the compression screws to prevent displacement (Figure 5).

Following this, anterior to posterior, 6.5mm cannulated cancellous screws with washers were inserted over the guide wires. This allows us to mobilize the knee in the early postoperative period without fear of loss of reduction. Reduction and fixation were confirmed arthroscopically. A post-operative plain X-ray was taken to confirmed the position of the screws (Figure 6).

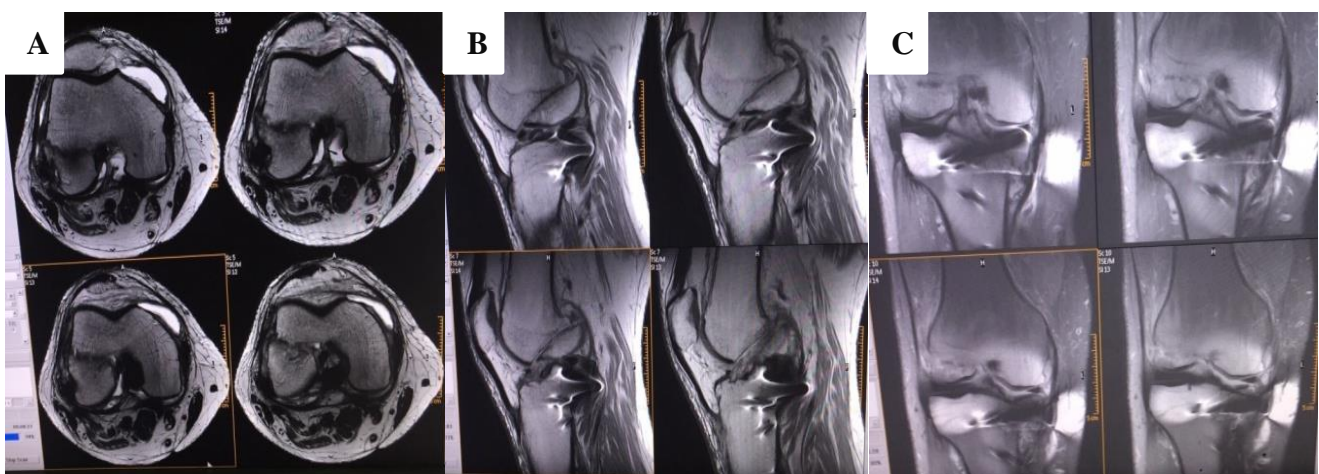


Figure 2: Right knee MRI. A) Right knee MRI from axial. B) Right knee MRI from Sagittal. C) Right knee MRI from coronal view showed there is coronal fracture of the lateral lateral condyle of the right femur.

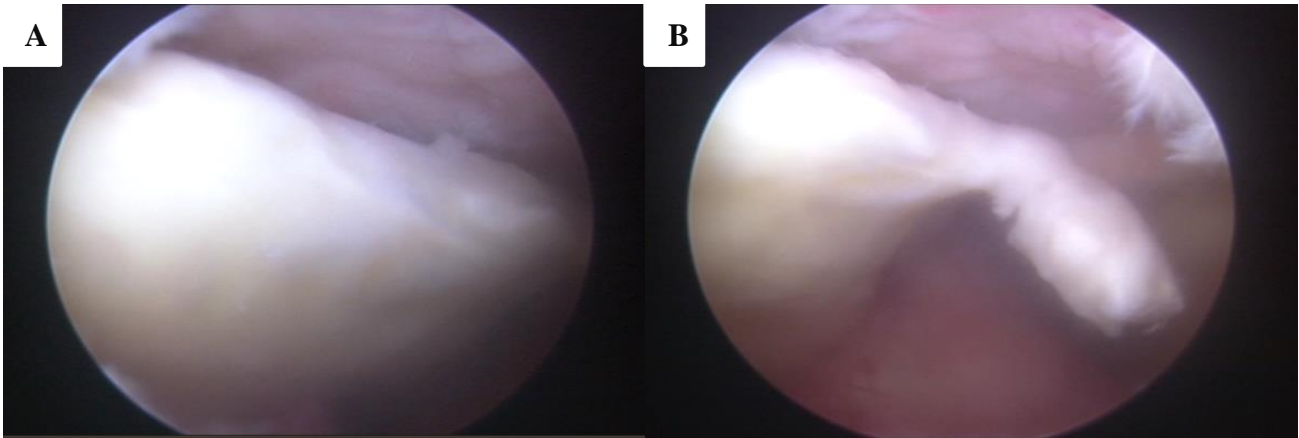


Figure 3: A) Arthroscopic visualization. B) The coronal fracture of the lateral condyle of right femur.

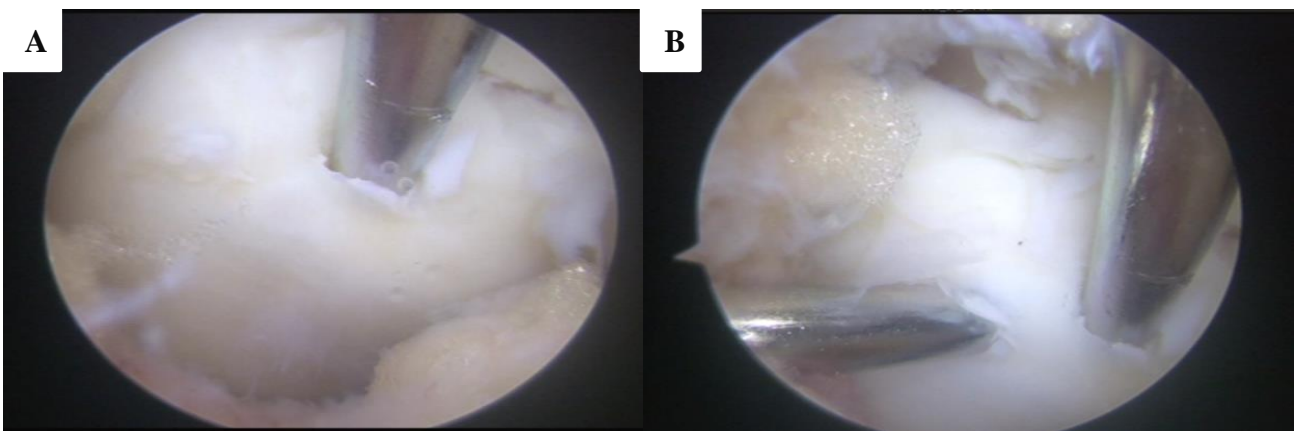


Figure 4: A) Coronal horizontal Hoffa fracture. B) Coronal horizontal Hoffa fracture held with a Kirschner wire to attempt the reduction.

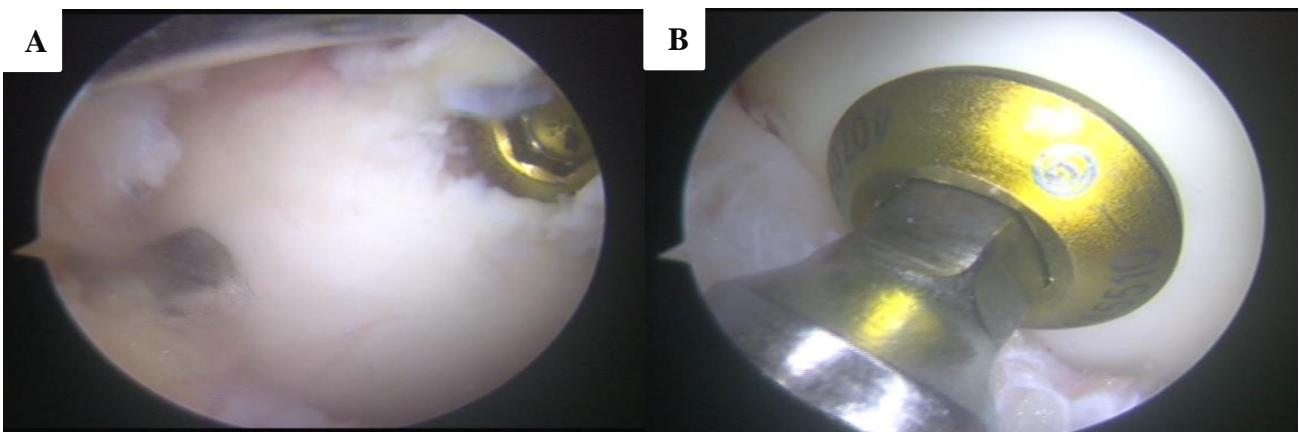


Figure 5: A) Arthroscopy-assisted reduction. B) Internal fixation (ARIF) using posteroanterior placement of 3.5mm cannulated screw followed by anteroposterior placement of 6.5mm cannulated cancellous screws with washers.

DISCUSSION

Hoffa fractures are rare injuries, and lateral fractures are more common than medial fractures by a ratio of 3:1.

They usually occur as an isolated injury to the involved femur, but bilateral and unilateral bicondylar Hoffa fractures have been reported.⁵

Diagnosis of this fracture is challenging and needs strong suspicion. Awareness of such entity and strong clinical suspicion are essential to diagnose such fractures because most of the time the standard X-rays may seem apparently normal. In cases of isolated fracture without any associated fractures of the knee, diagnosis should be based on physical examination of skin lesions, edema, effusion and careful radiological evaluation especially oblique views which may reveal a minimally displaced fracture. Even in the existing literature regarding such fractures, initially missed diagnosis is considered to be one of the most common reasons for nonunion of such fractures. Nork et al, recommended CT scan to diagnose such coronal fractures in case of high-energy distal femoral fractures especially those associated with open injuries. A CT is also needed to describe the coronal fractures as they can be easily overlooked on conventional radiography.⁶ In this case the diagnose was delayed because the X Ray appeared normal.



Figure 6: Plain X-ray of the right knee (lateral view) post arthroscopic-assisted reduction internal fixation.

The mechanism of injury of this fracture pattern is controversial. Most of these injuries are a result of motor vehicle accidents. The Hoffa fracture is an intra-articular fracture of the knee analogous to the capitulum fracture of the elbow. The fracture results from a combination of forces: direct trauma, possibly with an element of abduction. The ground reaction is transmitted through the tibial plateau. Axial compression on a flexed knee concentrates the force in the posterior half of the femoral condyles. In flexion the lateral condyle is the leading part of the knee to receive the impact.^{7,8}

According to the AO/OTA classification they are categorized into 33-B3. As intraarticular fractures, they are considered to be fractures of essentiality and internal fixation is considered to be the immediate treatment.⁶ Letenneur et al, classified three types of Hoffa fractures. Type-1 fractures occur vertically and include the entire condyle parallel to the posterior cortex of the femur, type-2 fractures vary in size and are horizontal to the condyle base, and type-3 fractures are located oblique to the femoral axis.⁹

Depending on the patient's clinical examination and the characteristics of the fracture, treatment may be either nonsurgical or surgical.⁹ Conservative treatment of displaced Hoffa fracture with plaster cast was reported to lead to nonunion or deformity, joint contracture, and subsequent osteoarthritis. Most authors recommend open reduction to restore normal condylar anatomy and rigid internal fixation, allowing functional recovery.¹⁰

When the Hoffa fragment is a component of a supracondylar or intercondylar distal femur fracture, the approach may be modified to ensure access to the Hoffa fragment. Lateral, anterolateral (Swashbuckler) or midline approaches can be used for lateral fragments, but access to a medial Hoffa fragment is difficult from a direct lateral approach. Generally, the surgical approach to isolated fractures is guided by the Letenneur classification. Lateral type I and III fractures are amenable to reduction through lateral or anterior midline approaches. Isolated medial fractures may be best approached through a medial parapatellar arthrotomy or subvastus approach. Smaller type II fractures may warrant a posterior approach, however, care must be taken to avoid injury to the popliteal vessels or neuropraxia.¹¹

The severe contusion of the soft tissues due to the compressive nature of trauma complicate this case. The timing of surgery in such cases is controversial. In order to prevent a possible soft tissue problem and avoid secondary knee stiffness, arthroscopy-assisted techniques were chosen. Arthroscopy-assisted techniques have been described for femoral condyle fractures and retrograde femoral nailing.¹ In the present case, the surgical plan was to start with the most difficult fracture (Hoffa) and to continue with the rest with a minimally invasive technique.

In this case we performed arthroscopy-assisted procedure. Arthroscopy-assisted reduction and internal fixation (ARIF) of these fractures is a novel technique with minimally invasive procedure.⁵ Arthroscopy-assisted surgery provides minimal soft-tissue damage and excellent intra-articular evaluation with enlarged and clear visualization. Another advantage of this method is the ability to evaluate other intraarticular structures at the same time. Large fracture displacement, osteoporotic bone, and insufficient surgeon experience may limit the advantages of arthroscopy-assisted surgery. The choice of implant, the choice of surgical approach, and preoperative planning all considerably affect the functional results after repair of the fracture.⁹

Arthroscopy-assisted fracture fixation has many advantages, such as superior visualization, limited soft tissue dissection, better evaluation of associated chondral and ligamentous injuries, and reduced morbidity. Limitations include the need for more experience, risk of fluid extravasation and the need for special equipment.¹

The main disadvantages of arthroscopy-assisted fixation are limited fixation alternatives with time-consuming and technically demanding procedures; additionally, this type of fixation should be performed by a surgeon with substantial experience. As with other intra-articular fractures, accurate reduction and stable fixation is the main goal in treating Hoffa fractures. Displaced fractures and osteoporotic bone can cause challenges with this technique.⁹

Complications related to arthroscopy-assisted surgery are vascular or neurological injury, articular cartilage injury, hemarthrosis, deep vein thrombosis, infection, compartment syndrome, and loss of reduction.⁹

No consensus has been reached on the fixation method in terms of the anterior/posterior direction of screw insertion and type/number of screws to use. Although Hoffa fractures are typically fixed with AP-oriented screws, Jarit et al, showed that fixation with posteroanteriorly-(PA-) oriented lag screws was biomechanically superior to AP oriented lag screws when subjected to vertical loads.⁴

The standard method of fixing these fractures is using cannulated screws in compression mode. However as these are shear fractures, the parallel screw configuration sometimes leads to fixation failure. The parallel screw configuration perpendicular to the fracture line provides compression however it is not able to resist shear in comminuted fractures.¹⁰ We had augmented our fixation using extra screws in multiple directions along with the compression screws to prevent displacement. This allows us to mobilize the knee in the early postoperative period without fear of loss of reduction.

Hoffa fractures are typically fixed with screws placed from anterior to posterior due to ease of approach, visualization, and placement. However, posterior to anterior screws may be more biomechanically favorable. Intra-articular screw placement requires that the screw heads be recessed beneath the articular surface. The effects of the cartilage defects created are not known. Many reports include the use of 3.5mm screws, although partial-thread 6.5- and 7.0mm cancellous screws have also been used successfully. Some authors have reported the use of a buttress plate to provide additional stability, but this comes at the expense of additional soft tissue dissection along the posterior femur.¹² The 4.5 mm Herbert screws/cannulated cancellous screws (CCS) were used for compression. For smaller articular fragments, 2.7mm mini screws/Herbert screws were used. Reconstruction plates contoured on posteromedial non articular surface.¹³

PA screw fixation requires the recession of the screw heads beneath the articular surface, which creates a large cartilage defect (i.e., >8.0mm for a 6.5mm cancellous screw). Headless compression screws can reduce the degree of required cartilage damage. Lee et al, used six

(three per fragment) Acutrak headless compression screws in the deep flexion position at the posterior articular surface directing anteriorly perpendicular to the fracture plane. The screws we used were conical, with a minimal diameter of 4mm and a maximum diameter of 5mm. One advantage of using these screws is that compression along the entire length of the screw can be achieved, possibly resulting in improved stability compared with a conventional lag screw.⁴

CONCLUSION

Diagnosis of a Hoffa fracture is challenging and needs strong suspicion. Awareness of such entity and strong clinical suspicion are essential to diagnose such fractures because most of the time the standard X-rays may seem apparently normal. CT is needed to describe the coronal fractures as they can be easily overlooked on conventional radiography. Conservative treatment of displaced Hoffa fracture with plaster cast was reported to lead to nonunion or deformity, joint contracture, and subsequent osteoarthritis. Open reduction to restore normal condylar anatomy and rigid internal fixation, allows for good functional recovery. No consensus has been reached on the fixation method in terms of the anterior/posterior direction of screw insertion and type/number of screws to use. Arthroscopy-assisted fracture fixation offer many advantages for these types of fractures, such as superior visualization, limited soft tissue dissection, better evaluation of associated chondral and ligamentous injuries, and reduced morbidity.

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