Les fractures coronales du condyle fémoral, appelées fractures de Hoffa, sont rares. En l’absence de traitement chirurgical ou en cas d’ostéosynthèse instable, elles peuvent évoluer vers la pseudarthrose encore plus rare. Le traitement de ces pseudarthroses est encore controversé en rapport avec la voie d’abord, l’ostéosynthèse, la direction des implants et la rééducation postopératoire. Nous rapportons deux cas de pseudarthrose d’une fracture de Hoffa (une interne et une latérale). Après traitement chirurgical, consistant en un débridement, greffe osseuse dans un cas et ostéosynthèse par deux vis antéropostérieures perpendiculaires au foyer de fracture, les deux pseudarthroses ont consolidé. Au dernier recul, les deux patients avaient une excellente fonction et n’ont signalé aucune douleur.

Mots clés : Fractures uni-condyliennes ; Fracture de Hoffa ; Fractures coronales ; pseudarthrose

SUMMARY

The coronal fractures of femoral condyles, known as Hoffa fractures, are a rarity. Conservative management or unstable fixation often lead to nonunion even rarer. The treatment is still controversial in view of the surgical approach, osteosynthesis, direction of implants and postoperative rehabilitation. We describe two cases of nonunion of a Hoffa fracture (one medial and one lateral). After operative treatment, consisting of debridement, liberal use of bone graft and fixation with two anteroposterior screws perpendicular to the fracture, both nonunions healed. At latest follow-up, both patients had excellent function and reported no pain.
Keywords: Unicondylar fracture; Hoffa fracture; Coronal fracture; Nonunion.

INTRODUCTION
Unicondylar fractures of the femur in the coronal plane, also known as “Hoffa” fractures, are intra-articular fractures in which the distal fragment behaves like a large loose fragment in the joint [1]. Lateral fractures are more common than medial fractures.

Few reports were reported on nonunion of Hoffa fractures in the literature and none of them mentioned the diagnostic and therapeutic difficulties with these injuries. The treatment is still controversial in view of the surgical approach, osteosynthesis, direction of implants and postoperative rehabilitation.

We describe two cases of nonunion of a Hoffa fracture (one medial and one lateral) both operated by two different surgical approaches and discuss the diagnostic and therapeutic features of this injury.

CASES REPORT

Case 1
A 29-year-old female consulted in our structure for chronic pain and intermittent swelling in her left knee.
She has a history of trauma in her left knee following a motor vehicle accident 12 years ago. Radiographs of the knee had been interpreted as normal. She had been treated conservatively. The knee joint was immobilized in the extended position for 10 days. Since then, she reported persistent, intermittent knee pain, swelling, and frequent falling.

Physical examination showed medial knee joint line tenderness. There was no effusion of the knee joint. The range of motion was 0-0-100° limited by pain. The prominence translated posteriorly with extension. There was no varus and valgus instability and patella was stable as well. Neurovascular examination was normal.

Radiographs of the knee showed nonunion of a coronal fracture of the medial femoral condyle (Fig.1).

Fig 1: Preoperative lateral radiograph shows the medial Hoffa fracture nonunion.

To better assess the injury, a computed tomographic scan of the knee joint was obtained, which indicated a coronal plane fracture of the posterior part of the medial femoral condyle (Fig.2a, b).
The patient was operated under spinal anesthesia and tourniquet control. Medial subvastus approach was chosen. The patella was not dislocated but everted to the side to respect anatomical tissue elements. Fracture area was exposed by sharp dissection over the condyles after removal of adhesions and fibrosis (Fig.3). The cruciate ligaments were intact. The nonunion site was debrided, prepared and reduced. Guidewires for screw placement were inserted just proximal to the patellofemoral joint with direction perpendicular to the fracture line. The wires were taken out at the articular surface of posterior part of the cartilage. Screw length was measured and the screws were made paralleled. The 3.5 mm cannulated cancellous screws were used for compression. No bone graft was necessary.

Postoperatively, the knee was immobilized by a splint for 2 weeks followed by knee rehabilitation was started without load. The total weight bearing was allowed at 3 months. At 15 months follow-up, the mobility increased to 135 ° of flexion without pain. X-rays showed consolidation of the fracture (Fig 4). The KSS score [2]
was 170 over 200 points at the final follow-up.

CASE 2
A 36-year-old male patient had a motor vehicle accident 8 years ago. Plain radiography of left knee showed a lateral condylar Hoffa fracture. Treatment comprised a left knee lateral incision with open reduction and internal fixation achieved visually. Reduction of the lateral condylar Hoffa fracture was followed by fixation with one Cancellous bone screws 4, 5 mm. Physiotherapy including controlled knee movement was started 3 weeks postoperatively, and in the 6th postoperative week partial weight bearing was allowed. The patient was lost to follow-up and reconsulted after 9 months for persistent pain in his knee and swelling associated with intermittent instability. Physical examination revealed the scar of the old lateral approach of the knee, clean, without signs of infection. The range of motion was 10 to 100 degrees. Flexion was limited by pain. The knee joint was lax, and the anterior drawer test was positive. The Lachman test was positive. There was no varus–valgus instability. Radiographs of the left knee indicated a nonunion of a fracture of the lateral femoral condyle (fig 5).
Under spinal anesthesia and after recovery of the old incision and removal of old osteosynthesis material, exploration showed a mobile nonunion fragment of the lateral femoral condyle without cartilage damage. Both cruciate ligaments and both menisci were intact. The nonunion site was debrided. Iliac crest bone graft was used and after reduction of fragment, fixation

Fig 4: Radiograph aspects on lateral view

Fig 5: Preoperative lateral radiograph shows the lateral Hoffa fracture nonunion.
was achieved with two cannulated cancellous screws 6, 5 mm-diameter directed perpendicular to the fracture line (fig. 6). The fixation did not harm the articular cartilage. The patient was mobilised touch weightbearing for six weeks, followed by a further six weeks of partial weight-bearing. There was no postoperative infection.

At 4-year follow-up, patient had no complaints related with his left knee with radiological evidence of union (fig. 7). Range of motion of knee joint was 0–130 with Knee Society score 173 out of 200 points at the final follow-up.

**Fig 6:** Radiograph aspects on lateral X ray view

**DISCUSSION**

Unicondylar coronal fractures of femur, also called as Hoffa fractures, are extremely rare intraarticular injuries in adults [3]. The fractures are classified by OTA as 33-B3. Lateral fractures are more common than medial fractures. Letenneur et al. [4] reported on twenty of these fractures in adult patients and provided a classification illustrating three types of fracture. In cadaver studies, Type I and Type III Hoffa fractures have been shown to have soft tissue attachments providing blood flow to the fracture fragment. However, Type II fractures are completely free in the joint without any soft tissue attachments making this fracture susceptible to nonunion [5]. According to this classification, our patients had a Type III fracture.

Weight bearing and knee movements lead to high shear forces along the fracture line. The pull of the gastrocnemius and popliteus also contributes to the instability [6]. Thus the results of nonoperative management in displaced fractures are unpredictable and evolve either towards to
the malunion or nonunion and the surgical treatment is necessary [7, 8].

The knee roentgenograms should be carefully examined. The fracture might be easily missed in anteroposterior X rays since the unfractured condylar part of femur prevents the fractured condyle. In addition to that, the fracture cannot be seen in cases of undisplaced Hoffa fractures. That is why the investigation with computerized tomography should be done in suspicious cases [5].

The rate of nonunion of Hoffa fracture is not known because only a few cases of primary nonunion are reported till date [5, 6, 8, 9].

Although the long-term natural history of this nonunion is unknown, chronic pain, disability, and early degenerative arthritis might be expected as with any intra-articular nonunion involving a weight-bearing joint.

In neglected Hoffa fractures, there is a risk of overlooking accompanying ligamentous and intra-articular injuries. These nonunions are complex injuries; movement of the fragment makes it difficult to distinguish meniscal and ligamentous injuries with physical examination. The valgus stress test may yield false-positive findings because of fragment movement or a real medial collateral ligament injury [10]. Moreover, false-positive anterior and posterior drawer tests are expected because of the movement of the nonunion fragment as the case with our two patients.

X-rays can show nonunion, while CT and arthroscopean can provide more information on the line, displacement, and cartilage damage [5].

Surgical approach has great importance. It must allow not only the reduction but also the proper establishment of osteosynthesis [7, 11]. Standard lateral and medial approaches are used. Lewis et al. [12] reported on seven of these fractures in adults. Four were treated by early open reduction and internal fixation. They used either a medial parapatellar arthrotomy or a direct lateral approach between the iliotibial band and the biceps tendon to expose the fracture. In the study of Bel et al [8], posterior surgical approaches have been used for posterior B3 fractures and secondary necrosis by devascularization were correlated, in agreement with other series [13]. Liebergall et al [14] described a lateral approach to the knee, using an osteotomy of Gerdy’s tubercle, in the treatment of a lateral coronal condylar fracture, but did not offer any outcome data on this single case. The authors argued that the osteotomy permits improved visualization for open reduction and internal fixation. In our second observation, the external lateral approach was sufficient for exposure, reduction and internal fixation of the lateral condyle.
The lag screw provides interfragmentary compression and is reportedly stable enough in normal bone without comminution. At least two screws should be used to provide rotational stability. In our second case, the initial fixation was performed by a single screw and was probably unstable which progress to nonunion. The direction of screw insertion may also vary; a biomechanical study found the posteroanterior (PA) manner of screw insertion superior to anteroposterior insertion in addition to the compressive effect [15].

A lateral or posterior surgical approach is necessary when using the PA direction. Countersinking of screws has to be beneath the articular surface with disruption of the cartilage in PA direction of screws. This medial subvastus approach allowed us to easily visualisation of fracture, nonunion site and articular surface without necessity of dislocation of the patella for achieving a perfect anatomic reduction and exposure to compress and rigidly fix the fracture with 4.5 mm lag screws. The buttressing of the fragment requires screw placement on the posterior aspect just above the fragment to prevent superior migration but the parapatellar approach provides limited access.

In the study of Bel et al [8], displacement of fragments were associated with the use of small screws: this is confirmed by biomechanical tests that showed the superiority of multiple screwing with screws large diameter 6.5 mm versus those of small diameter 3.5 mm [16]. In our study, two screw diameters 3.5 mm and 6.5 mm were used to obtain consolidation in both cases without disassembly.

The fixed fragment is continuously exposed to shear stress in sagittal plane during flexion and extension and varus and valgus stress in coronal plane. Thus a varied period of posterior splintage is reported for 3-6 weeks so as to tighten the posterior capsule to act as splintage for posterior femoral condyle.

All patients in the series of Ajay Pal Singh [6] received a bone graft and internal fixation along with knee arthrolysis. Locking reconstruction plates in addition to screw fixation were used in two cases. Union was achieved in all patients at mean 16 weeks.

Displacement of fracture fragments and reoperation are reported due to poor screw fixation and biplanar stresses during rehabilitation. Thus the stability of the construct should be checked intraoperatively.

Arthroscopy before open reduction and internal fixation gives additional information and changes the surgical protocol for these fractures and nonunions. Such lesions associated meniscal lesions,
chondral or ligaments can be diagnosed and treated as usual.

Through our two observations, we conclude that the medial subvastus and lateral approach offer better exposure of the nonunion home and the articular surface for stable and rigid fixation.

CONCLUSION
Unicondylar coronal fractures of femur, also called as Hoffa fractures, are extremely rare intraarticular injuries in adults. The treatment is still controversial in view of the surgical approach, osteosynthesis, direction of implants and postoperative rehabilitation.

REFERENCES