TREATMENT OF HOFFA (TANGENİTAL PLANE) FRACTURES ENCOUNTERED İN THREE DOGS

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ABSTRACT

Fracture of the distal femoral condyle on the coronal plane (Hoffa fracture) is rare. It can involve either femoral condyle but is more common on the lateral side. A bicondylar type of this fracture is even more rare. This study was carried out on three dogs, which brought to Ankara University, Faculty of Veterinary Medicine, Orthopedics and Traumatology Clinic. Two unicondylar medial and one bicondylar Hoffa fracture were diagnosed radiographically. After clinical and radiological examinations open reduction was performed and the fractured fragments were fixated with cortical screws. After two month the screws were removed.

Key Words: *Coronal Plane, Dog, Fracture, Hoffa.*

Introduction

The ‘‘Hoffa’’ fracture is a rare injury where there is a Coronal (Tangenital) plane fracture in the femoral condyle. (1,4,6,7,8,9,11,12). Coronal fractures of the distal femur, commonly referred to as ‘Hoffa’ fractures, represent coronal fracture lines in the lateral or medial femoral condyle (5,11,12). This was first described by Friedrich Busch in 1869 and than by Albert Hoffa in 1904 (1,4,6,7,8,9,11,12). The Hoffa fractures are classified by Orthopaedic Trauma Association (AO/OTA) as 33-B3 (1,5,10,13,14). Type B1 fractures are in the sagital plane of the lateral condyle (Figure 1), B2 fractures are similar fractures of the medial condyle. Type B3 (or Hoffa fractures) are fractures in the coronal plane of either condyle (4,10,13,14). A high energy trauma is always the cause of the injury, and capsular, ligamentous and bony injuries are frequently associated (3,5,6,9). An oblique or lateral force against the lateral condyle with the knee flexed results in the coronal fracture (3,5,6,12). The fracture occurs with a combination of forces; direct trauma, possibly with an element of abduction (3,5,6,8,12). The ground reaction is transmitted through the tibial plateau (3,5,6,8,12). Axial compression on a flexed knee concentrates the force in the posterior half of the femoral condyles (3,5,6,8,12). In flexion of the lateral condyle is the leading part of the knee to receive the impact (3,5,6,8,12). Although the Hoffa fracture may occur in either condyle, the preponderance of lateral condylar fractures suggests an anatomic-biomechanical vulnerability due to the physiological valgus (3,5,6,8,12). The coronal orientation of the fracture lines makes it difficult to diagnose in the initial X-rays, especially if the fracture is undisplaced (5,9,12). Up to 30% of coronal plane fractures were missed on plain radiographs of distal femoral fractures, often necessitating the use of computerized tomography for identification and preoperative planning (5, 9, 12). Open reduction and internal fixation is necessary for good long-term results.(1,3,5,6,7,8,9,12). Applying cancellous screws through anterior cortex to the Hoffa fragment (AP screw insertion), provides a satisfactory stability. Some authors stated that, applying cortical screws through Hoffa fragment to the anterior cortex (PA screw insertion), instead of anterior-posterior fixation, has it's advantages of the mechanical sense (4,5,9). To prevent cartilage damage and osteoarthritis in PA fixation, headless screws should be used (5, 9, 12). Unlike humans, dogs develops osteoarthritis in a very short period of time (2,4). Hoffa fragment has either minimal-none or residual soft-tissue attachments. Therefore, interruption of the blood supply leads to avascular necrosis and to destruction of the articular surfaces (5). The use of 3.5 cortical screws instead of larger screws for articular reconstruction has been described recently particularly with regard to the tibial plateau (1,6). The 3.5 mm screws are recognised to have equal pullout strength to larger screws and allow multiple screw positions without major damage to bone stock (1,6).

Material and Method

Material of this study were three dogs, which was brought to Ankara University, Faculty of Veterinary Medicine, Orthopedics and Traumatology Clinic. The first case was two years old female Golden Retriever with a complaint of lameness. Due to minimal displacement of the fractured fragment, no lesion was diagnosed on any of physical examination (except a minimal crepitation in the left stifle joint) and routine radiography. With suspicion of Ligamentum Crutiatum Anterior rupture, a radiograph in Tibial Compression was taken and fracture of the medial Condyle in the Coronal plane was diagnosed (Figure 2). In case two and three, displaced fractures fragments were clearly seen in the latero-lateral view of the radiograph. Case two was a three years old female anatolian shepherd dog with a unicondylar medial coronal plane fracture in the right femur caused by motor vehicle accident (Figure 3). Case three was a 5 years old male anatolian shepherd dog with a bicondylar coronal plane fracture in the right distal femur caused by gunshot and high-velocity injury (Figure 4). A skin incision with a lateral parapatellar arthrotomy was used for open reduction and internal fixation on each case. Headed cortical screws (3.5mm) were used and the screw insertion direction was from posterior fragment (Hoffa fragment) to anterior cortex in all three cases. Screw insertion was performed in hyperflexed knee (Figure 5). Care was taken, as much as possible, to protect the fat pad, joint cartilage, meniscal attachments and intraarticular ligaments. In cases two and three, clinical and radiological follow-up couldn't performed routinely.

Result

Two unicondylar medial (Cases one and two) and one bicondylar (Case three) Hoffa fractures were diagnosed radiographically. After clinical and radiological examinations, open reduction was performed and the fractured fragments were fixated with cortical screws in Posterior-Anterior direction. The first case was followed up for 5 month postoperatively. There was no loss of reduction or fixation. The screw was removed after two month and the patient had mild to moderate osteoarthritis (Figure 6). However, functional recovery was achieved. In case two, the clinical and radiological examinations could not be made regularly in first two months after surgery and due to avascular necrosis, the stifle joint developed stiffness and severe osteoarthritis (Figure 7). The proposal of a total knee replacement was not accepted by the owner of the dog. The third case was not brought by his owner to the routine examinations and therefore could not followed up (Figure 8).

Discussion

Isolated coronal plane fractures of the femoral condyles are unusual high velocity injuries (5, 6, 7, 8,). Importance of the flexed knee position at the time of impact was based on the fact that four of their seven patients reviewed sustained their injury in a motorcycle accident (7, 8, 9, 11). If minimally displaced, the lesion may also be difficult to define in lateral views. Oblique radiography and CT have been recommended as facilitating diagnosis. In four of the eight cases reported in the world literature, the injury was missed on initial imaging. Hoffa fractures are rare and considering the plane and location of fracture, it is not surprising that they are often overlooked on conventional radiography (5, 6, 7, 8, 9, 11, 12). All of the patients in this study had high-energy injuries. In our first case, on anteroposterior and laterolateral views of radiographs, the fracture could be easily missed but the radiograph (Figure 2) , which was taken under tibial compression, shows a significant displaced medial condyle fracture. Because of the bone instability as well as the pull of the gastrocnemius, popliteus and due to poor soft tissue attachment of Hoffa fractures, tibial compression test could be useful to diagnose of non displaced fragments in dogs.

Most authors conclude that non-operative treatment of these complex injuries leads to malalignment, rotational deformities, loss of knee movement, joint contractures and subsequent osteoarthritis(5, 6, 7, 8, 9, 11, 12). The best treatment for most of these lesions is open reduction and internal fixation, although technical skill is essential for a satisfactory result. Anatomical

reduction is the goal of the technique and fixation is generally achieved using screws in varying configurations (5, 6, 7, 8, 9, 11, 12). A midline incision with a medial/lateral parapatellar arthrotomy is the most common approach was reported. Direct lateral approach with or without osteotomy of the Gerdy tubercle and posterior-based approaches have also been described (5, 12). In all cases in this study, lateral parapatellar approach, open reduction and internal fixation was performed. Experience of the surgeon is important, due to the difficulty of approach to the fractured fragment. Reduction and fixation should be performed in hyperflexed knee.

Hoffa fractures are inherently unstable, due to the bony instability as well as the pull of the gastrocneimus and popliteus. In some fractures, the posterior capsule may be the only soft tissue attachment, and therefore they are prone to avascular necrosis. Due to these factors, the recommended treatment is open or arthroscopic reduction and internal fixation (3, 5, 12). Radiological signs of necrosis usually appear within the first few months. We would advise that X-rays and clinical evaluation should be sought 1 year after the operation (3). In one case occurred avascular necrosis due to poor soft tissue attachment.

PA screws showed less displacement than AP screws when subjected to vertical loads. The PA screws need to be countersunk, which causes cartilage damage. The use of headless screws for Hoffa fractures has been described previously in a case report. The drawback with the headless screws is their small size and length and more than two screws are required for stable fixation (3, 5, 12). In all cases in our study, we used headed screw which were directed from Hoffa fragment to anterior cortex. To prevent cartilage damage and to provide a rigid fixation, we applied one headed screw instead of two or more headless screws. However osteoarthritis could not be prevented but functional recovery was achieved in case one.

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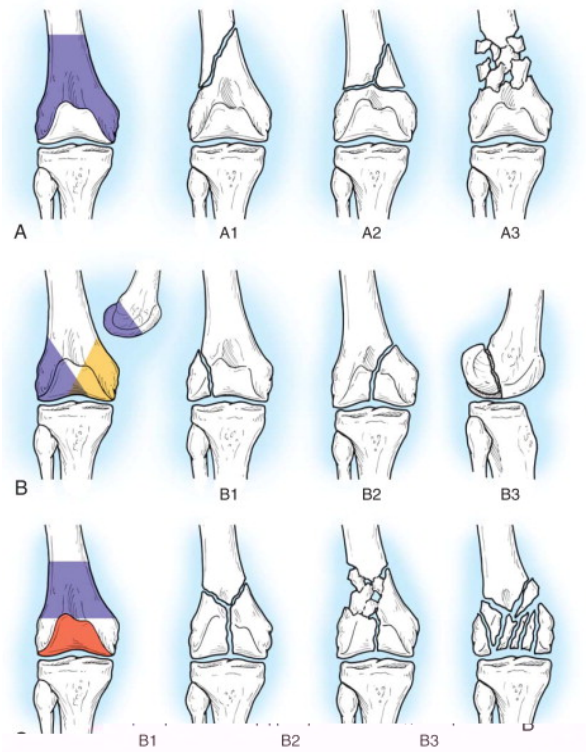

Figure 1. Classification of fractures of distal femur (Muller et al., 1990).

Figure 2. Lateral view of the knee under tibial compression shows displacement of medial femoral condyle

Figure 3. The view of Coronal Plane Fracture on Medial condyle.

Figure 4. Lateral view of bicondylar Coronal fracture in distal femur.

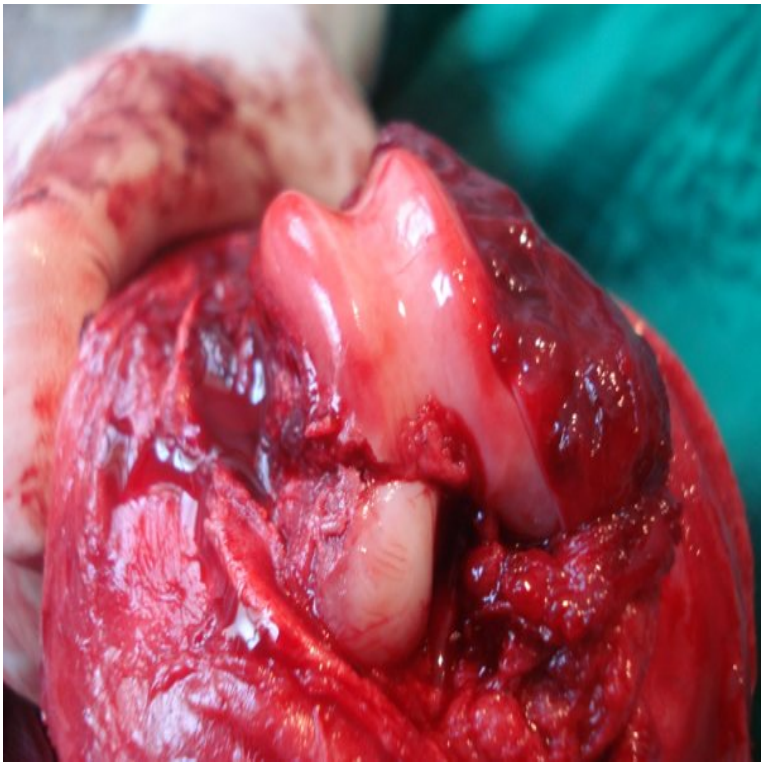

Figure 5. Intraoperative photograph of case 1. The appearance of the fracture fragment in hyperflexed Knee.

Figure 6. Final follow up radiograph before screw removal in case one.

Figure 7. The radiographic view of osteonecrosis (AVN) in case 2.

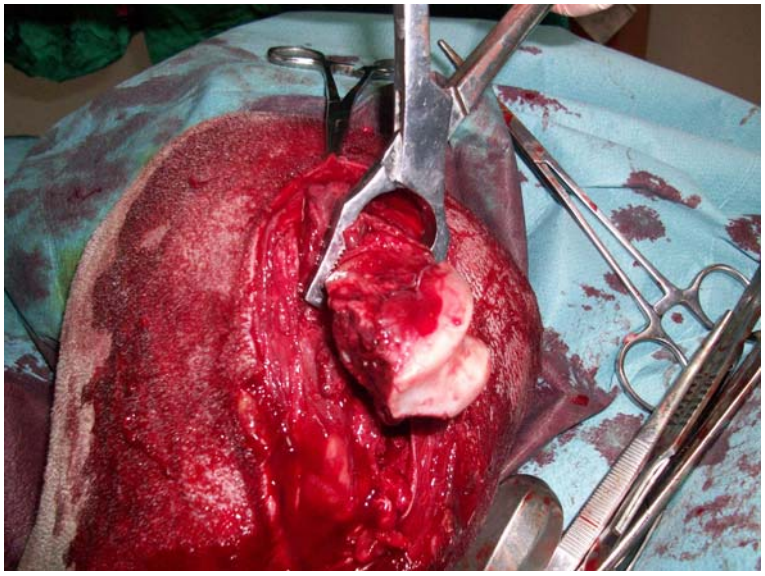

Figure 8. Intraoperative photograph of case 3 showing Bicondylar Coronal plane fracture of distal femur.