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Surgical management of femur fracture by stack pinning in a calf

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Abstract
An eight-month-old Kangeyam female calf was presented to the Veterinary Clinical Complex, Veterinary College and Research Institute, Namakkal, with a history of falling during grazing on the previous day, resulting in difficulty walking. Orthopedic examination of the right hind limb revealed non-weight-bearing lameness, swelling in the femoral region, pain on palpation, and crepitation at the midshaft. Radiographic examination confirmed an unstable comminuted fracture of the right femur. Due to significant swelling in the thigh region, medical management was initiated on the day of presentation with Flunixin Meglumine (@ 1.1 mg/kg body weight, intramuscularly) for pain relief. Once the swelling subsided, retrograde stack pinning was planned and performed under general anesthesia. Postoperatively, the calf was administered antibiotics, NSAIDs, and antihistamines, and the surgical wound was regularly dressed with antiseptic ointments until complete healing. Sutures were removed on the 14th day, and the pin was removed on the 35th day. The calf exhibited an uneventful recovery.

Keywords: Femur fracture, stack pinning, kangeyam calf

Introduction
A fracture is defined as a break in the continuity of bone or cartilage. Various types of long bone fractures have been reported in cattle, with diaphyseal femoral fractures being more common in calves, especially during early life (Trostle SS, 2004) [10]. The femur is a long bone located in the thigh, extending from the hip joint to the knee joint. It articulates proximally with the hip joint and distally with the tibia and patella. The femur develops from 4-5 ossification centers, beginning around 3-4 months of fetal life, with rapid growth occurring during the first 6-12 months after birth. The epiphyseal plates close between 12 and 18 months of age. The incomplete closure of growth plates during early life predisposes young animals to fractures. Compared to adult cattle, calves have proportionally shorter and more slender bones, smaller trochanters, and thinner cortical bones, making them more vulnerable to fractures. Treatment options for fractures include both surgical and non-surgical approaches. This report describes the surgical management of a comminuted midshaft femoral fracture in a calf.

History and Observation
An eight-month-old Kangeyam female calf was presented to the Veterinary Clinical Complex, Veterinary College and Research Institute, Namakkal, with a history of falling during grazing the previous day. The calf was unable to walk properly and exhibited noticeable swelling in the right hind limb. Orthopedic examination revealed non-weight-bearing lameness, swelling in the right femoral region, pain on palpation, and crepitation at the midshaft of the femur. Radiographic examination confirmed an spiral/oblique fracture of the right femur is shown in (Fig. 1). The diagnosis was established as a midshaft oblique femoral fracture.

Treatment
The treatment plan included two primary considerations: reducing the swelling at the fracture site and stabilizing the fracture.

Due to considerable swelling in the thigh region, initial medical management was implemented on the day of presentation. The calf was administered Flunixin Meglumine (1.1 mg/kg body weight, intramuscularly) for pain relief. The following day, retrograde stack pinning was planned. Pre-operative blood parameters were within normal limits.

General anesthesia was induced using a combination of premedications (Xylazine @ 0.1 mg/kg i.m.), induction agents (Diazepam @ 0.2 mg/kg i.m. and Ketamine @ 2 mg/kg i.m.), and maintenance with Ketamine (1 mg/kg i.v.). The surgical procedure was performed under aseptic conditions after proper positioning of the animal. The muscle over the bone was incised to expose the fracture site. A craniolateral surgical approach to the femur was adopted. Two intramedullary pins (2.5 mm diameter, 120 mm length) were inserted in a retrograde manner and advanced across the fracture line. The pins were placed in a slightly divergent orientation to improve stability (Fig. 2). The surgical wound was closed using a simple interrupted cross-mattress suture pattern with cotton thread.

Postoperatively, the calf received antibiotics, NSAIDs, and antihistamines. The surgical wound was regularly dressed with antiseptic ointments until complete healing. The pins were removed after confirmation of fracture healing based on radiographic evidence of callus formation and clinical signs such as weight bearing without lameness. Sutures were removed on the 14th day, and the pin was removed on the 35th day. The calf showed an uneventful recovery.

Discussion

A fracture is a complete or incomplete break in the continuity of bone or cartilage. It is often accompanied by varying degrees of injury to surrounding soft tissues, including blood supply disruption and locomotor function impairment. Neonatal fractures commonly involve greenstick fractures and trauma to the epiphyseal growth plate (Salter RB *et al*., 1963). Fractures are classified as incomplete (greenstick, splintered, fissured, sub-periosteal, and deferred fractures) or complete (single, double, and comminuted fractures). Most literature on bovine orthopedics describes these classifications along with age-independent fracture types (Ferguson JG, 1990; Crawford WH, 1985; Ferguson JG, 1982) [4, 2, 3]. Accurate fracture classification based on radiographs is crucial in determining treatment options (Mahajan *et al*., 2015) [5].

The general principles of fracture treatment include reduction, retention, and immobilization of fracture fragments. Radiographs taken at orthogonal views are essential for accurate diagnosis and selection of appropriate treatment methods. Fracture fixation methods include external coaptation techniques, external fixators, and internal fixators. Intramedullary (IM) pins are widely used for diaphyseal fractures of the humerus, femur, tibia, ulna, metacarpal, and metatarsal bones. However, IM pins are contraindicated in radial fractures due to interference with the carpus. Biomechanically, IM pins offer resistance to bending loads but provide limited resistance to axial or rotational forces and lack bone fixation. However, complications such as pin migration, delayed union, or rotational instability may occur (Mohiuddin *et al*., 2018) [6]. There are two primary IM pinning techniques: normograde and retrograde pinning.

Fracture healing occurs in four stages: (1) hematoma formation, (2) soft callus formation, (3) primary bone callus formation, and (4) secondary bone callus formation. Healing depends on various factors, including age, fracture severity, treatment method, overall health, and nutrition. Typically, healing takes 4-20 weeks. Neonatal calves are prone to postoperative complications such as pin migration and inadequate pin fixation due to their bones' low density and thin cortices. There is limited literature on surgical and medical management of diaphyseal femoral fractures in cattle (Ames NK, St-Jean G *et al*., 1992) [8]. The present case demonstrates that retrograde stack pinning is an effective treatment for comminuted femoral fractures in young calves, resulting in successful recovery.

Fig 1: Right Midshaft fracture of femur

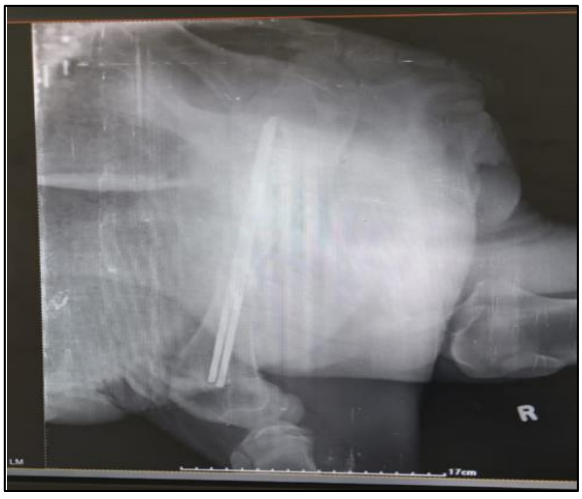

Fig 2: Intramedullary stack pinning

Fig 3: Under I/V anaesthesis

Fig 4: Positioning of animal

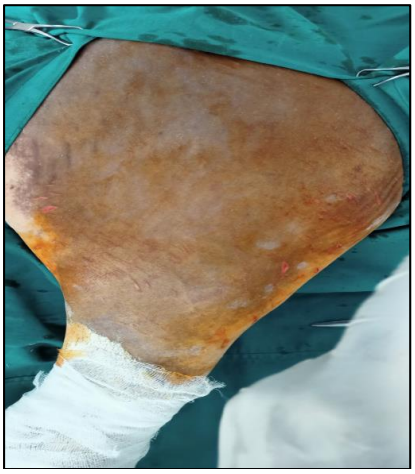

Fig 5: Aseptic preparation of surgical site

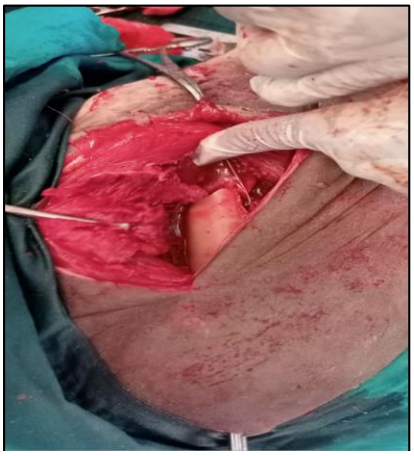

Fig 6: Exposing of muscle

Fig 7: Exposing of fractured ends

Fig 8: Insertion of pin

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