



Clamp-rod internal fixation (CRIF) for immobilisation of spiral fracture of distal tibial diaphysis in a bullmastiff dog[#]

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Abstract

A bullmastiff dog was presented with the concern of non-weight bearing lameness of right hindlimb. The condition was diagnosed as fracture of distal tibia. Open reduction followed by internal fixation using Clamp-rod internal fixator (CRIF) was performed under general anaesthesia. Clinical, physiological, haemato-biochemical and radiographic evaluations were conducted at two weeks interval for up to eight weeks. Physiological and haematological values were within normal range but level of serum alkaline phosphatase was elevated preoperatively, which gradually decreased to normal by eighth postoperative week. Grades of lameness, weight bearing and functional usage of limb returned to pre-fracture levels by fourth postoperative week itself. Cortical union was noticed by sixth postoperative week with minimum amount of periosteal and endosteal callus. The fracture healed without any complications or fracture diseases.

Keywords: Fracture, Tibia, CRIF, Cortical union

Fractures are breaks in the continuity of hard tissue and are accompanied by varying degrees of soft tissue injuries, including compromised blood supply and reduced locomotory function of injured part (De Camp *et al.*, 2016). Long bone fractures are common orthopaedic conditions encountered in young dogs and the most frequent cause for a fracture are road traffic accidents and fall from height (Shakir, 2022). Aim of any fracture fixation is to regain structural integrity and functional limb usage at the earliest. The primary considerations to be taken into account when planning fracture repair are anatomical fracture reduction, stable fracture fixation, preservation of blood supply to the bone and surrounding soft tissue, and early ambulation of the affected part and the patient (Schatzker, 2005). Clamp-rod internal fixator is a unique system that can comply with each one of these primary requirements, as well as provide flexibility in the length and shape of rod and also the number of screws and their positions (Gamper *et al.*, 2006). It also minimises the risk of fracture diseases like osteoporosis, articular diseases and muscle contractures.

A female bullmastiff dog aged 10 months and weighing 34 kg was brought with non-weight bearing lameness of right hindlimb after it was hit by a motorbike. Clinically the dog was active, alert and in excellent body condition, however carried the limb while walking (Fig. 1). The physiological parameters were within the normal range. Orthopaedic

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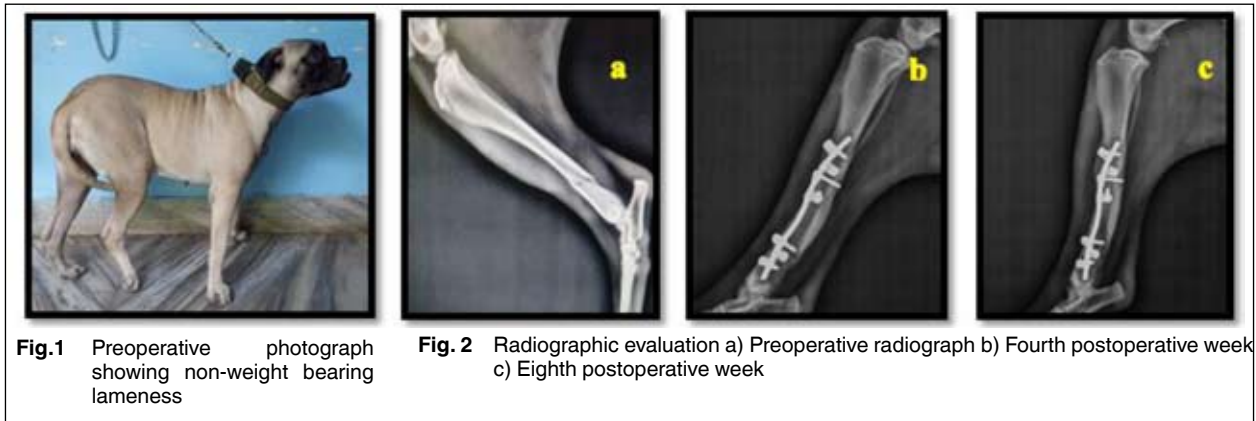


Fig.1 Preoperative photograph showing non-weight bearing lameness

Fig. 2 Radiographic evaluation a) Preoperative radiograph b) Fourth postoperative week c) Eighth postoperative week

examination, revealed pain on palpating the distal one-third of right tibia. There was swelling, crepitus and abnormal mobility at that site and the limb reflexes were sluggish. A distal diaphyseal spiral fracture of right tibia was confirmed from radiographs (Fig.2a). Haematological values were in the normal range while serum alkaline phosphatase value was much elevated (311.8 IU/L). The limb was temporarily immobilised with modified Robert - Jones bandage and surgical correction with clamp-rod internal fixator (CRIF) was planned. Clamp-rod internal fixator was a versatile system consisting of a rod, clamps and screws, which could be used in fractures of small animals (Florin *et al.*, 2005).

The dog was positioned on lateral recumbency with the fractured limb below and the tibial diaphysis was approached through a craniomedial skin incision (Zahn and Matis, 2004; Sylvestre, 2019). Anatomical alignment of fracture fragments was attained with minimum manipulations in this case. The size of implants were chosen based on preoperative radiographs as well as the body weight of the animal (Piermattei and Flo, 1997). A 4.0 mm Steinmann pin as rod, 4.0 mm locally fabricated 316L stainless steel clamps and 3.5 mm self-tapping standard orthopaedic cortical screws were selected. The pre-contoured rod of suitable length loaded with sufficient number of clamps (four for proximal and two for distal fragments), was positioned over the aligned bone. Additional contouring was carried out in multiple axes with a roller-type plate bender to produce gradual curves that suited the shape of tibia in its medial aspect. The clamps were moved to the precise positions needed. Holes were predrilled with a 2.7 mm drill bit through the screw hole of the clamp across the diaphysis of fractured tibia, using an electric drill. The length of the screws, determined from radiograph, was verified during the procedure using a depth gauge. Clamps were tightened alternatively in proximal and distal fragments using a torque-limiting 3.5 mm hexagonal screwdriver and till the tapering end of the screw came out through the trans-cortex. The incision was closed routinely. The surgical seam was covered with a povidone iodine dressing pad, and the limb was supported with a plaster of Paris cast. Antibiotics and analgesics were administered

postoperatively. The skin sutures and plaster of Paris cast were removed on second postoperative week. Following surgery, owners were instructed to limit the movement of the animal by cage rest for 14 days, after which it could be walked on a leash.

Postoperative clinical, physiological, haemato-biochemical, orthopaedic, neurological and radiographic examinations were done on second, fourth, sixth and eighth weeks. The animal appeared clinically active and the physiological as well as haematological parameters were within normal range throughout the observation period. The serum alkaline phosphatase level was high till second postoperative week and it gradually decreased to normalcy (Sharat *et al.*, 2022). Orthopaedic examination did not evince pain on palpation from second week onwards and the neurological reflexes returned to normal. Normal weight bearing and functional usage of limb was noticed by fourth postoperative week itself. Radiograph showed excellent apposition and alignment without angulation (Shakir *et al.*, 2022). By second postoperative week, minimum amount of both endosteal as well as periosteal callus formation was noticed (Vijay, 2022). Cortical union was evident by sixth week but the radiolucent fracture line was faintly identifiable. On eighth postoperative week, complete closure of fracture gap was noticed Fig.2(b-c). Preoperative and postoperative values for both physiological and haematological parameters did not differ, indicating that they were unaffected by surgery or postoperative management. The high cost of commercial CRIF systems and the non-availability of CRIF in Indian market were overcome by using Steinmann pin as rod together with locally fabricated 316L stainless steel clamps and standard orthopaedic screws. Vijay (2022) also reported developing and customising clamps with locking pitch for fracture fixation in dogs using CRIF system. The implant sizes were determined from preoperative radiographs and they proved to be adequate in size and provided sufficient stability (Joshi, 2021; Shakir, 2022). Pre-contouring of rod and loading it with clamps in advance, helped reduce the duration of the procedure (Zahn and Matis, 2004). Roller-type plate bender was a great tool for the precise contouring of the rod. In this

case, three screws were placed in the proximal fragment and two in the distal. According to Zahn and Matis (2004) and Joshi (2021), 2-4 bicortical screws are necessary to ensure enough stability for fracture healing and complete weight bearing. Placing two screws in the short distal fragment was possible only because of the mouldability of the rod along with positioning of clamps on either side of the rod. Additionally, the alternating placement of adjacent clamps reduced the probability of stress fracturing at the sites of screw insertion (Zahn and Matis, 2024). The minimal amount of callus formation, early weight bearing and fast healing indicate that the clamp-rod internal fixator offered good stability. Joint function was unaffected and an early return to functional usage prevented muscle atrophy from disuse. Complete range of motion was observed at the end of the monitoring period, which was contrary to the findings of Vijay (2022) where 50 per cent of the animals had reduced range of motion. There were no complications noticed during the healing process.

Summary

The clamp-rod internal fixator was found to be effective in management of diaphyseal fracture in tibia of dogs. It ensured early weight bearing, excellent functional outcome of limb usage and minimum complications.

Conflict of interest

The authors declare they have no conflict of interest.

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