COMPARATIVE EVALUATION OF DCP AND LCP TECHNIQUES FOR REPAIR OF FEMORAL FRACTURES IN CANINES

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The study was conducted in 16 clinical cases of femoral fracture in dogs aged between 3 months and 3 years. The main etiology for all the fractures was automobile accidents. The types of fractures were short oblique (4), transverse (5), long oblique (1), spiral (2) transverse dentate (3) and comminuted (1). These cases were divided into groups I and II consisting of eight dogs in each group and were treated with dynamic compression plate andlocking compression plate respectively based on the type of fracture. Follow up of the animals was done upto 3 months. Based on clinical, haematological, biochemical and radiological observations it was concluded that, DCP technique was found superior for repair of short oblique or transverse or transverse without dentate fractures and LCP technique for long oblique or spiral or transverse dentate or comminuted femoral fractures in canines respectively.

**Key words:** Bone healing, Dogs, Dynamic Compression plate, Femur fracture, Locking compression plate.

The most common orthopaedic affections encountered in dogs are long bone fractures. Among the long bones, femur is reported to be the commonly fractured bone (Harasen, 2003). Diaphyseal femoral fracture constitutes about 63.88 per cent of total femoral fractures (Aithal et al., 1999). The incidence of diaphyseal fracture is almost 20 to 25 per centand higher than any other long bone fractures in the body. Raghunath et al. (2007) found that majority of fractures were due to automobile accidents (56 %), followed by falling (34 %), abuse (9 %) and crushing (1 %).

Bone plates effectively resist the axial, bending and torsional forces acting on fractured bones and minimize interference with blood supply. DCP is a universally accepted technique for repair of femur fractures. However, these plates are susceptible to repeated bending stresses because of the plate’s eccentric location in relationship to the long axis of the bone. Implant fatigue failure occurs when the opposite cortex is not reconstructed and fails to bridge with bone early enough to protect the plate. Plate holes concentrate stress, and failure generally occurs in this area. To overcome these problems, new plates have been designed with locking screw i.e., Locking compression plate (LCP). The screw head locks into the plate hole, allowing the plate and screws to act mechanically as a single unit. Additionally, it will not create undue stress in the bone because it is in a neutral position. It has combination plate hole that can accept either standard screws or locking screws. Additionally, locking plates have threaded holes that accept and lock with the locking head screw that must be accurately inserted perpendicular to the plate hole for the threads to match and secure the screw. Hence, the present study reports comparison of Dynamic Compression Plating (DCP) and Locking Compression Plating (LCP) techniques for repair of femoral fractures in dogs.

**Materials and Methods**

Sixteen dogs from 3 months to 3 years presented to the Department of Surgery and Radiology, Veterinary College, Bidar were divided into group I and II consisting of eight dogs in each group and were treated with DCP (Fig. 1) and LCP (Fig.2) respectively based on the type of fracture. Clinical symptoms included non-weight bearing, swelling on thigh region, evincees crepitating sound, pain on palpation and limping. Out of

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16 dogs, 4 dogs had short oblique, 5 had transverse, 1 had long oblique, 2 had spiral, 3 had transverse dentate and remaining 1 had comminuted fractures.

The dogs were administered with amoxycillin sodium and cloxacillin sodium injection @ 20 mg/kg b/wt I/M and meloxicam injection @ 0.5 mg/kg b/wt I/M. The dogs were premedicated with atropine sulphate injection @ 0.045 mg/kg b/wt I/M, followed by triflupromazine injection @ 1 mg/kg b/wt I/V. After 15 minutes, anaesthesia was induced with 2.5 % thiopental sodium injection I/V at dose rate of 12.5 mg/kg b/wt. Anaesthesia was maintained using thiopental sodium in incremental doses to effect.

The animals were positioned in lateral recumbency and the femur was approached by cranio-lateral incision. Fracture reduction was made mechanically by traction and manipulation. Post-operatively, amoxycillin sodium and cloxacillin sodium injection @ 20 mg/kg b/wt I/M and meloxicam injection @ 0.5 mg/kg b/wt I/M for 8-10 days were administered. Daily surgical wound was dressed and antiseptic cream applied; the skin sutures were removed 10-14 days after surgery.

In group I, 6 hole and 8 hole 3.5 DCP was applied in 7 animals and 8 hole 2.7 DCP in a Doberman. 2.7 mm and 3.5 mm of diameter and 22 mm to 28 mm long cortical and cancellous screws were used. In group II, 6 hole and 8 hole of 3.5 LCP was applied in 6 animals and 6 hole of 2.7 LCP in 1 animal and six hole of 3.5 LCP was used as a neutralization plate with lag screw for oblique fracture in 1 animal. 2.7 mm and 3.5 mm of diameter and 22 mm to 30 mm long locking screws were used.

The two techniques were compared by clinical, haematological, biochemical and radiographical observations before operation, immediately after operation, 30th day, 60th day and 90th day post-operatively. Clinically, respiration rate (breaths/min), heart rate (beats/min), rectal temperature (F), weight bearing (functional outcome and lameness grade) were recorded.

Packed cell volume (%), haemoglobin (g/dL), total erythrocyte count (10⁶ /μL) and total leukocyte count (10^3 / μL) and differential leukocyte count (%) were carried out using automated haematology cell counter. Serum calcium (mg/dL), inorganic phosphorus (mg/dL) and alkaline phosphatase (IU/L) were estimated by using ARTOS biochemical analyzer using respective diagnostic kit.
Medio-lateral and cranio-caudal views including hip joint and stifle joint were taken before operation and after surgery for implant position, callus formation and fracture healing. Statistical analysis was done by using Student’s t-test as per the standard procedure.

Results and Discussion

Respiratory rate, heart rate and rectal temperature showed bradypnoea, bradycardia and hypothermia on post-operative days respectively. However, they were within normal physiological range in both groups. The elevated physiological parameters on operative day could be attributed to stress on the animal due to fracture, anaesthesia and surgery as also reported by Kelly (1974).

DCP group showed partial weight bearing immediately after operation and complete weight bearing was observed on 3rd day. The DCP technique offered rigid stabilization of fracture against all the forces that acts on the bone as reported by Milton and Newman (1985) also. Whereas LCP group showed complete weight bearing immediately after operation. The results are in agreement with the findings of Christoph et al. (2003), who found that the LCP acted as extramedullary fixator and offered better counter action and withstanding ability against the forces acting on the fracture site. The stability and the strength provided by LCPs were evidently due to the presence of threads on the screw heads that converted LCP system in to a rigid construct that strengthened fracture fixation as also mentioned by Uhl et al. (2013).

On 90 days, 4 animals (50%) in DCP group showed excellent weight bearing, 2 good, 1 fair and 1 with poor weight bearing respectively. Whereas, LCP group showed 5 animals (62.50%) had excellent weight bearing, 2 good and remaining 1 with fair weight bearing respectively. Similar results were reported by Ramesh et al. (2015) who treated unstable or comminuted diaphyseal fractures of femur in dogs with LCP and concluded that LCP technique provided adequate apposition, stable fixation and promoted early weight bearing of the traumatised limb, by acting as a single beam construct which increased the stiffness of the implant.

Progressive increase in packed cell volume, haemoglobin and total erythrocyte count on post-operative days in both groups indicating erythropoisis. Physiological leucocytopenia, neutropenia with relative lymphocytosis were seen on post-operative days suggestive of gradual decrease in inflammatory reaction. Similar observations were recorded by Tembhurne et al. (2010) and Hansda et al. (2012).

Slight hypercalcimia, hyperphosphatemia and progressive decrease in serum alkaline phosphatase were observed on post-operative days. The elevated serum alkaline phosphatase level before operation in both groups was in agreement with Sahay et al. (1988) and Vasanth (1991). The elevated alkaline phosphatase level could be attributed to proliferation of osteogenic cells and maximum contribution from periostium of destructed bone which is a rich source of serum alkaline phosphatase.

Radiographs taken immediately after fracture repair in animals with DCP, showed excellent reduction of fracture fragments and well positioned implants. On day 30th, implants were in situ and showed correct fragment alignment with progression towards healing, moderate callus formation and presence of radiolucent line was visible at the fracture site. On day 60th, implants were well positioned and fragments correctly aligned, slight callus formation and obliteration of fracture line in all the animals was seen. On day 90th, implants were well positioned with correct fragment alignment, periosteal bridging callus and cortical continuity was seen. A similar radiographical finding was seen in animals with LCP except negligible callus and minimal periosteal reaction on 30th day, minimal callus and obliteration of fracture line on 60th day and periosteal bridging of fracture line and cortical continuity was seen on 90th day respectively.

Based on clinical, haematological, biochemical and radiological observations for a period of 3 months, it could be concluded that, DCP technique was found superior for
repair of short oblique or transverse without dentate fractures and LCP technique for long oblique or spiral or transverse dentate or comminuted femoral fractures in canines respectively. The LCP with combi hole for the use of locking and nonlocking screws could be used both as a compression plate or a buttress plate to achieve a stable fixation.

References


