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**S Kamaljit**

Department of Veterinary  
Surgery and Radiology, Nagpur  
Veterinary College, Maharashtra  
Animal and fishery Science  
University Seminary Hills,  
Nagpur, Maharashtra, India

**SV Upadhye**

Department of Veterinary  
Surgery and Radiology, Nagpur  
Veterinary College, Maharashtra  
Animal and fishery Science  
University Seminary Hills,  
Nagpur, Maharashtra, India

**SB Akhare**

Department of Veterinary  
Surgery and Radiology, Nagpur  
Veterinary College, Maharashtra  
Animal and fishery Science  
University Seminary Hills,  
Nagpur, Maharashtra, India

**BK Bhadane**

Department of Veterinary  
Surgery and Radiology, Nagpur  
Veterinary College, Maharashtra  
Animal and fishery Science  
University Seminary Hills,  
Nagpur, Maharashtra, India

**AM Kshirsagar**

Department of Veterinary  
Surgery and Radiology, Nagpur  
Veterinary College, Maharashtra  
Animal and fishery Science  
University Seminary Hills,  
Nagpur, Maharashtra, India

**Rajeshwar Khandare**

Indian Veterinary Research  
Institute, Izatnagar, Bareilly,  
Uttar Pradesh, India

**Corresponding Author:**

**AM Kshirsagar**

Department of Veterinary  
Surgery and Radiology, Nagpur  
Veterinary College, Maharashtra  
Animal and fishery Science  
University Seminary Hills,  
Nagpur, Maharashtra, India

## Comparative evaluation of locking compression plates and cuttable plates for long bone fracture repair in dogs

**S Kamaljit, SV Upadhye, SB Akhare, BK Bhadane, AM Kshirsagar and Rajeshwar Khandare**

**Abstract**

The study on comparative evaluation of locking compression plates and cuttable plates for long bone fracture repair in dogs was conducted on 12 clinical cases with diaphyseal fracture of long bones during the period December 2018 to July 2019 at TVCC of Nagpur veterinary college. The cases were divided into two equal groups of 6 dogs each with fracture stabilization by locking compression plates one group and cuttable plates in second by ORIF (Open Reduction and Internal Fixation). The cuttable plates were beneficial for fracture immobilization since they could be cut to desirable length, as against locking compression plate in small breeds and dogs below and up to 15 kg of weight.

**Keywords:** Johne's disease-goat-sirohi-biochemical

**Introduction**

Skeletal system is the frame work of the body providing support to muscle attachment and is an important part for locomotion when the animal is in motion, the skeletal system especially the bones are subjected to physiological and sometimes to supra physiological forces which leads to fractures of the bones therefore requiring repair of fracture is required for complete restoration of the limb. For this reason the study on comparative evaluation of locking compression plates and cuttable plates by ORIF (Open Reduction and Internal Fixation) for long bone fracture repair in dogs was conducted on 12 clinical cases with diaphyseal fracture of long bone fractures. Locking compression plates are routinely used for open reduction and internal fixation of fractures. Such plates allow for locking or non-locking screw placement in each hole (Goswami *et al.* 2011) <sup>[4]</sup>. Locking compression plate (LCP) has combination screw holes which make the use of implant in three different ways; as a pure internal fixator using locking head screws, as a conventional compression plate using compression screws, or as a hybrid using both conventional and locking screws (Halland *et al.* 2009) <sup>[5]</sup>.

After the introduction of cuttable plates in the veterinary sciences they have been used for fracture repair as a cheap alternative to expensive implants. Cuttable plates limit tearing forces on screws by increasing the elasticity of the plate between the screws. Elasticity was obtained by using long thin plates. Moreover, implant elasticity allows rapid formation of a large periosteal callus due to micromotion of the bone fragments (Sarrau *et al.* 2007) <sup>[10]</sup>. Cuttable plates allows placement of multiple screws in relatively short bone fragments on account of the large number of screws per unit length as compared with DCP, LC-DCP or LCP. Elasticity can be obtained by using a long cuttable plate alone. Cuttable plates can also be used in bridging construct for young dogs to reduce the stress applied to the points of the fixation (the screws and bone) and provide greater interfragmentary micromovements to stimulate a more voluminous callus (Vedrine and Gerard 2018) <sup>[12]</sup>.

**Materials and Methods**

The study was undertaken on 12 clinical cases of long bone fractures in dogs. Detailed neurological, orthopaedic and radiographic examinations were performed in all the 12 cases.

The patients which were free from any metabolic, infectious and neurological disease conditions were selected for the study. The dogs were divided into two equal groups with six dogs in each group and subjected to two different fracture repair techniques *viz.* locking compression plates and cuttable plates. Standard dose of dissociative anaesthesia with Xylazine-Ketamine-Diazepam were used for all the dogs of this study.

The selected patients for surgery were divided into two groups, 6 patients in each group. In group I fracture stabilization was achieved by 3.5 mm and 2.7 mm locking compression plate and in group II fractures were stabilized by 2.7mm cuttable plates.

Neurological examination was conducted in all the patients. Reflexes like conscious proprioception, tendon reflexes (patellar, biceps and triceps), and flexion reflexes, withdrawal reflexes and panniculus (cutaneous trunci reflex) were checked to ascertain any localized spinal cord injury. Such patients with neurological involvement were not considered for the study.

The radiographic assessment was done preoperatively and postoperatively *i.e.* Immediately after the surgery day 0 and on 15<sup>th</sup>, 30<sup>th</sup>, 45<sup>th</sup> day as per the schedule and also as per the requirements in between. Patients were evaluated according to Fracture Assessment Score (FAS) preoperatively for decision making and to gain a suitable prognosis, aid in treatment and post treatment assessment. The assessment score was calculated with 1-10 scoring system (Fossum, 2007) [3].

Post operatively Robert Jones bandage was applied on the operated limb and in some cases Thomas splint and splica splint was applied. Skin sutures were removed on 12<sup>th</sup> postoperative day. Tablet Tramadol @ 5 mg/kg body weight twice a day for five days and Tablet Amoxicillin and Clavulanic acid @ 25 mg/kg body weight twice a day for five days were given orally for five days.

## Results and Discussion

In all the patients under the study orthogonal radiographs (ventrodorsal and lateral) were taken pre and postoperatively after the surgery and subsequently on 15<sup>th</sup>, 30<sup>th</sup> and 45<sup>th</sup> day for assessment of callus formation, fracture line and stage of union. X-rays were taken immediately after the surgery to evaluate apposition, angulation and alignment of stabilized fracture with the implant.

In the study it was observed that maximum number of fractures were in age group of 6 to 12 months (41.93%), followed by age group of 12 months and above (38.70%). Patients with age of below 6 months were least affected (19.35%). Similar findings were observed by Braden *et al.* (1995) [1], Kumar *et al.* (2007) [7] and Minar *et al.* (2013) [8].

Breed wise highest incidence of fracture was recorded in non-descript dogs (55.91%) followed by Labrador retriever (13.97%), Pomeranian (12.90%), German shepherd (7.52%), Rottweiler (4.30%), Beagle and Pug (2.15%, each) and Doberman (1.07%). Similar findings have been observed by Dvorak *et al.* (2000) [2] and Uwagie-Ero *et al.* (2018) [11]. Males (69.89%) had higher incidence of fracture than females (30.10%).

The study revealed that major cause of fracture was automobile accident (81.7%) followed by fall from height (13.97%) and then bite injuries (4.30%).

In the study it was observed that the highest number of fracture were accounted in femur (56.98%) followed by radius & ulna (19.35%), tibia (17.21%) and lastly in humerus (6.45%). It was observed most common type of fracture was

transverse fracture (74.19%) followed by oblique and wedge type of fracture (17.20%, 8.60%).

Table 1 represents age, breed, sex, etiology, involvement of the bone and fracture type wise-distribution of fracture.

**Table 1:** Age, Breed, Sex, Etiology, involvement of the bone and fracture type wise– Distribution of fracture:

History		Number	Percent
Age	Upto 6	18	19.35
	6 – 12	39	41.93
	Above 12	36	38.70
Breed	Non- descript	52	55.91
	Labrador retriever	13	13.97
	Pomeranian	12	12.90
	German shepherd	7	7.52
	Rottweiler	4	4.30
	Beagle	2	2.15
	Pug	2	2.15
	Doberman	1	1.07
Sex	Male	65	69.89
	Female	28	30.11
Etiology	Automobile accident	76	81.7
	Fall from height	13	13.97
	Bite injuries	4	4.30
Bone involved	Humerus	6	6.45
	Radius & ulna	18	19.35
	Femur	53	55.79
	Tibia	16	17.21
Fracture type	Transverse	69	74.19
	Oblique	16	17.21
	Wedge	8	8.60

## Preoperative planning

Preoperative radiographical images were taken which aided in determining the size of plate and length of screws prior to surgery. The density and the size of the bones were measured in the radiographs and the size of the plate appropriate for the surgery was chosen. Age, breed, weight and temperament of the patient were also considered for the choice of implant. In this investigation, 2.7 mm cuttable plates and locking compression plates of 2.7 mm and 3.5 mm with screws ranging from 14mm to 28 mm of length were used which were found suitable for fracture immobilization.

## Patient preparation

The surgical site was shaved and aseptically prepared for aseptic surgery. The site was scrubbed with povidine iodine solution and spirit 5 times alternately in a scrubbing manner from centre to periphery to reduce the microbes at the surgical site and aiding in reduced infection at the site. Asepsis was obtained by the same manner by Johnson, (2014) [6].

Hanging leg technique with the use of IV infusion stand for anchoring accomplished for a period of 30 to 40 minutes after giving general anaesthesia helped in causing the muscles to fatigue and thereby giving satisfactory reduction of overriding and aided in alignment of the fractured ends.

## Surgical approach

A craniolateral approach was used to reach the diaphysis of the humerus during the surgery in this study. It was found easy to preserve the veins by this approach namely, the cephalic, axillobrachial and omobrachial veins. As the cranial surface of the bone is flat and complaisant for plate application this approach was used. The complete shaft of the humerus was easily accessible by this approach. Similar approach was used by Pozzi and Lewis, (2009) [9].

A craniolateral approach was used for the stabilization for the fracture of the femoral shafts. Skin incision was made on the craniolateral border of the femoral shaft from the greater trochanter to the patella. The biceps femoris muscle was reflected caudally and the vastus lateralis muscle and fascia lata are reflected cranially exposing the shaft of the femur.

### Postoperative care and management

After the surgery, Thomas splint if needed were applied to the affected limb along with orthopaedic bandaging of the limbs. As mentioned above patients were given a course of antibiotics, analgesics and anti-inflammatory drugs for a period of five days. This helped in keeping the surgical wound infection-free as there was no postoperative wound sepsis in any of the cases.

### Plate removal

The plates were removed as recommended by ASIF, as leaving the plate after complete healing would cause stress, osteomyelitis, pain on palpation of plate, and unexplained lameness.

### Comparative efficacy of both the plates

All the animals in group I represented grade V lameness preoperatively. All the cases in group I were treated with locking compression plate and showed weight bearing on the operated limb on 3<sup>rd</sup> day and grade I lameness was observed by 15<sup>th</sup>, 30<sup>th</sup>, and 45<sup>th</sup> day except in D1 which showed grade IV and grade V lameness throughout the observation period.

In group II cuttable plates were used for fracture fixation. The plates were cut by a pin cutter intra-operatively after putting the screws on one of the fractured segment. All the dogs showed grade I lameness by 30<sup>th</sup> day except for D12 which showed grade II due to slight bending of the plate on 30<sup>th</sup> day, post operatively.

Partial weight bearing was evident in both the groups for few days but complete weight bearing was achieved by 30<sup>th</sup> and 45<sup>th</sup> day. It was observed that the locking compression plate and cuttable plate sufficient stability to the fractured fragments and assisted in early soft callus formation. Both the techniques, i.e. locking compression plate and cuttable plates were easy to adopt and helped in early ambulation and complete weight bearing.

However cuttable plates were beneficial for fracture immobilization since they could be cut to desirable length depending upon the length of the bone, as against locking compression plate. Moreover cuttable plates provide an excellent and cheap implant as compared to expensive locking compression plate for small or miniature breeds of dogs and dogs weighing less than 15 kilogram of weight.

### Complications

**a. Non-healing of fracture and lameness:** In one case (group I, D1), grade V lameness was evident throughout the study period. The radiographic studies at scheduled intervals indicated no signs of healing, rather the radiograph on day 45 indicated sequestrum and no signs of osteogenic reaction. Thus this case was considered as non-union of the bones. In this case the plate was then removed on day 47 and wounds were lavaged with ample of povidone iodine. Splints were applied to the operated limb and Dressing of the wound was undertaken every third day. After removal of the plate and the broken chip of the bone soft callus was observed after 15 days of plate removal. However, the lameness of grade IV remained

throughout the observation period.

**b. Plate bending:** In group II wherein the fractures were stabilization using cuttable plates, one dog (D7) exhibited bending of plate post-operatively on 45<sup>th</sup> day when examined clinically and radiographically. Although clinical union of the fracture was achieved the weight of the dog and hyperactivity might have lead to bending of plate. The plate was removed and the case was discharged.

### Conclusion

This study highlights the effective use of orthogonal radiographs in monitoring fracture healing in dogs, revealing a higher incidence of fractures in young dogs aged 6 to 12 months, primarily due to automobile accidents. Non-descript dogs and certain breeds like Labrador Retrievers and Pomeranians were more prone to fractures. The research underscores the importance of preoperative planning and surgical approach in ensuring the proper alignment and stabilization of fractures, with a comparison between locking compression plates and cuttable plates. While both techniques facilitated early callus formation and ambulation, cuttable plates proved advantageous for smaller breeds due to their adaptability and cost-effectiveness. However, challenges such as non-healing fractures and plate bending were noted, emphasizing the need for careful postoperative monitoring and management to ensure successful outcomes. This study contributes valuable insights into the optimal care and treatment of canine fractures, highlighting the significance of tailored surgical strategies based on individual patient characteristics.

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