



Internal Fixation for Distal Fracture of Long Bones in Dogs

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ABSTRACT

The present study was undertaken with the objective, to stabilize distal fracture of long bones using open reduction and internal fixation (ORIF) with evaluation of appropriate implant in dogs. The study was conducted on twelve dogs, irrespective of breed, sex and body weight, presented with a distal fracture of long bone to the Veterinary Clinical Complex (VCC), Jabalpur. All the fractures were stabilized using open reduction and internal fixation with supracondylar plate or locking T- plate. Clinical parameters like degree of exudation were assessed postoperatively on day 3, 7 and 15 showing a significant ($p<0.05$) difference and indicating progressive improvement in wound healing by the 15th postoperative day. Assessment of weight-bearing was carried out on day 0, 7, 28, 45 and 60 post-operatively, a significant ($p<0.05$) improvement in weight bearing grades was observed in dogs from day 0 to day 45 post-operatively. Thereafter, a continued and progressive improvement was recorded on day 45 and 60. Assessment for the radiographic healing was carried out on the day of presentation and on day 14, 28, 45, 60 postoperatively. The complete union of fracture segments with disappearance of the radiolucent line was observed by 60th postoperative day. This study concluded that Supracondylar (J) plate fixation was effective for surgical management of distal femur fracture in dogs, particularly in fracture with limited distal bone segment and caudal femoral curvature. The T-plate provided rigid fixation, adequate screw purchase in small distal segments of radius-ulna and maintained proper fracture alignment throughout the healing period.

HIGHLIGHTS

- Use of supracondylar plate for femur fracture repair in dogs.
- Use locking T- plate of for radius-ulna fracture repair in dogs.

Keywords: Distal fracture, internal fixation, T- plate, supracondylar femur fracture, supracondylar plate

Management of fractures of long bone extremities in dogs is technically difficult and challenging in comparison to diaphyseal fractures. Orthopaedic surgeons preferred different surgical techniques for the repair of metaphyseal, physeal and epiphyseal fractures on the basis of type of fracture involved. Stable internal fixation is widely employed for the treatment of distal metaphyseal fractures, as it provides sufficient mechanical support for bone healing while allowing early return of limb function. The metaphysis represents the transitional region between the diaphysis and the physis, where the anatomical boundaries are not distinctly defined (Lakshmi *et al.*, 2007).

The use of reconstruction plates and L-plates for distal metaphyseal fracture fixation may result extension of plate beyond the condyle margin during fixation. This overhang can interfere with proper closure of the joint capsule during surgery, increase the risk of inadvertent articular injury, and contribute to postoperative joint stiffness, thereby reducing the overall effectiveness of the fixation technique (Kumar, 2017).

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The supracondylar plate is an anatomically contoured orthopaedic implant designed to conform to the lateral aspect of the canine distal femur. Its pre-shaped configuration improves implant-to-bone adaptation, facilitates accurate fracture stabilization, and allows the insertion of multiple screws into the distal bone fragment, thereby enhancing fixation stability. In addition, the locking T-plate has emerged as an effective option for the management of distal diaphyseal and simple metaphyseal fractures in dogs. The locking screw-plate interface provides angular stability and improves fixation strength, particularly in regions where the distal bone fragment offers limited screw purchase.

MATERIALS AND METHODS

Ethical approval

The study was approved by the Institutional Animal Ethics Committee, College of Veterinary Science and A.H., Jabalpur, M.P., India.

Animals

The study was conducted for six months from November 2025 to April 2026 in which twelve adult dogs irrespective of sex, breed and body weight having distal fracture of long bones. Clinical examination like limb palpation and pre-operative radiographs of fractured bone and the contralateral intact bone were evaluated to obtain the required anatomical measurements for selecting the appropriate size of the supracondylar plate or locking T-plate, as well as the corresponding screw dimensions for fracture fixation.

Patient preparation and anaesthesia

The animals were kept off- feed for 12 hours and off -water for 6 hours prior to surgery. All the surgical procedures were performed under general anaesthesia. General anaesthesia was induced using inj. Atropine sulphate @ 0.04 mg/kg b.w. IM, inj. Butorphanol @ 0.2 mg/kg b.w. IM, inj. Diazepam @ 0.5 mg/kg b.w. I/V as preanaesthetic, followed by inj. Propofol @ 4 mg/kg b.w. slow IV. Maintenance was done by inj. Propofol @ 4 mg/kg b.w. IV.

Surgical procedure

The fracture site was accessed using standard surgical techniques by skin incision, followed by carefully separating the muscle bellies along their anatomical planes. The muscles were retracted with the aid of muscle retractors to provide clear visualization of the fracture site. The bone segments were aligned to restore normal anatomical positioning. Supracondylar plate for femur and locking T plate for radius-ulna fracture was chosen and adjusted to the desired length. The plate was then placed over the bone such that the fracture line was approximately centered between the two ends of the supracondylar plate. It was held in position with suitable bone-holding forceps and at least two holes on both the proximal and distal segments were drilled before inserting screws of appropriate size and length. The muscle and fascia layers were sutured separately in a continuous pattern using absorbable suture material to minimize dead space, while the skin was closed by using non-absorbable suture material.

Post-operative management

Anti-septic dressing of wound was done using povidone iodine 5% and the affected limb was bandaged using Robert-Jones technique immediately after surgery to restrict movement and parenteral administration of inj. Cefquinome sulphate @ 2 mg/kg twice daily for 7 days and inj. Meloxicam @ 0.2 mg/kg for 5 days postoperatively. Passive range-of-motion (PROM) exercises were conducted twice weekly.

Parameters of study

Assessment for the radiographic healing was done on day 0, 14, 28, 45 and 60 postoperatively in table 1 as per Hayashi *et al.* (2008). Degree of exudation of wound was assessed on day 3, 7 and 15 postoperatively in table 2 using score card as per Bhowmick *et al.* (2013). Assessment of weight-bearing was carried out on day 0, 7, 28, 45 and 60 post-operatively to evaluate functional recovery of the affected limb. Weight bearing was graded in table 3 as per (Vasseur *et al.*, 1995). Three ml of blood was collected aseptically from the saphenous or cephalic vein for estimation of haematological and biochemical parameters on the day of presentation and on day 7, 14,

28, 45 postoperatively. The parameters estimated total leukocyte count (TLC), haemoglobin (Hb) (g/dL), total erythrocyte count (TEC) ($\times 10^6/\mu\text{L}$), packed cell volume (PCV) (%), calcium (mg/dL), serum phosphorous (mg/dL), serum alkaline phosphatase (U/L), serum creatinine (mg/dL), blood urea nitrogen (mg/dL).

Table 1: Score card for radiographic interpretation

Scores	Radiographic interpretation
0	Presence of recent fracture with no bone formation
1	Irregularity at segment lines of fracture site
2	Initial/ discrete periosteal proliferation
3	Exuberant/ organized periosteal proliferation
4	Exuberant osseous callus in evolution with presence of periosteal proliferation
5	Exuberant osseous callus in evolution and discrete radiolucent line at gap between the fracture segments
6	Exuberant osseous callus and absence of radiolucent line

Table 2: Score card for assessment of degree of exudation

Exudation	Grade	Score
Nil	–	0
Mild	+	1
Moderate	++	2
Marked	+++	3

Table 3: Grading for weight bearing

Grades	Weight bearing
1	Normal weight bearing on all limbs at rest and while walking
2	Normal weight bearing at rest, favors affected limb while walking
3	Partial weight bearing at rest and while walking
4	Partial weight bearing at rest, does not bear weight on affected limb while walking
5	Does not bear weight on limb at rest or while walking

RESULTS

During the study period, parameters assessed are given as follows.

Degree of exudation

Quantification of the degree of exudation was assessed on postoperative day 3, 7 and 15. The median value ranged from 2.0 (2.0 - 3.0), 1.5 (1.0 - 2.0) and 0.0 (0.0 -1.0) respectively. On the 3rd day, the median exudation score was highest, which gradually decreased over time and reached the lowest value by day 15. A significant ($p < 0.05$) difference was observed within group, indicating progressive improvement in wound healing, as evidenced by minimal or complete absence of exudation by the 15th postoperative day.

Radiographic evaluation of fracture healing

Assessment for the radiographic healing was done on day 0, 14, 28, 45 and 60 postoperatively. The median value of the radiographic score ranged from 0.0 (0.0 – 0.0) to 5.0 (4.0 -5.0) respectively. The median value increased significantly ($p < 0.05$) from day 0 to day 45. On 14th postoperative day, slight periosteal reaction was observed with remarkable activity followed by traces of periosteal callus formation. On 28th postoperative day, apparent callus formation was reported. The progression of callus formation from day 14 to day 28 exhibited a significant ($p < 0.05$) difference, characterized by the presence of bridging callus and distinct periosteal proliferative responses, indicative of superior secondary bone healing. At day 45 postoperatively, a significant ($p < 0.05$) increase in radiographic score was observed. The radiographs were having a discrete radiolucent fracture line. By the 60th postoperative day, the highest median grade value of 5.0 (5.0–5.0) was recorded. A significant ($p < 0.05$) difference was observed compared to day 0, indicating complete union of the fractured segments with absence of a radiolucent line. A non-significant difference was observed between day 45 and day 60 shown in table 4 and Fig. 1.

Table 4: Radiographic score in dogs (n=12) at different time intervals

Sl. No.	Day	Radiographic score (Median)
1	0	0.0 ^d (0.0 – 0.0)
2	14	2.0 ^c (2.0 – 2.0)
3	28	3.0 ^b (3.0 – 3.0)
4	45	5.0 ^a (4.0 – 5.0)
5	60	5.0 ^a (5.0 – 5.0)

Median values bearing different superscripts within a group (a, b, c and d) differ significantly ($p < 0.05$).

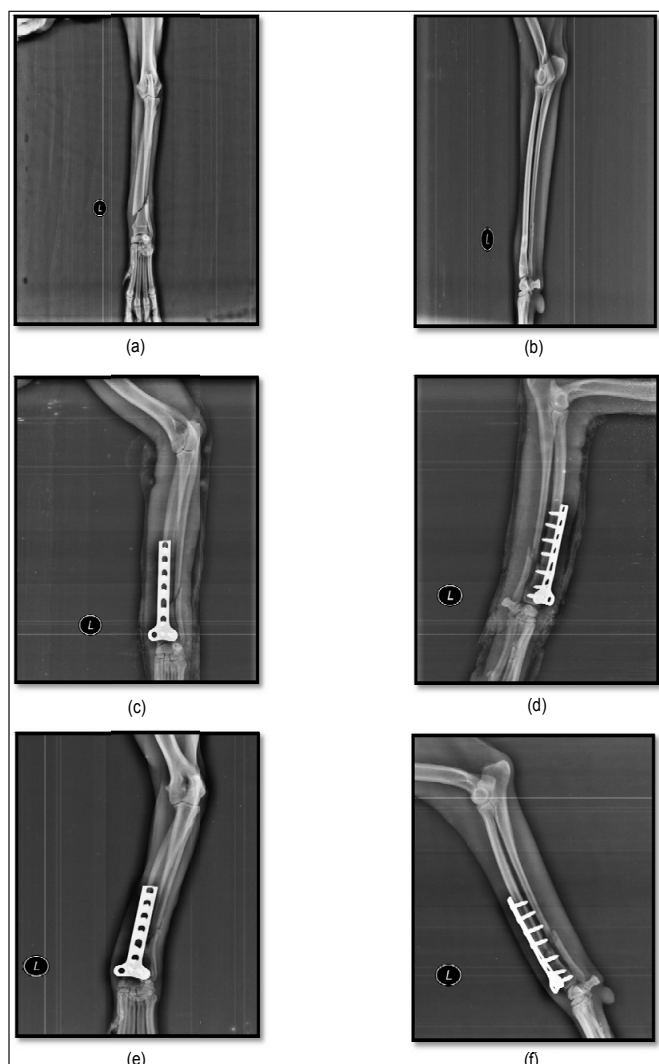


Fig. 1a: Radiographs of dogs; (a) and (b) at day 0, (c) and (d) at day 14, (e) and (f) at day 28

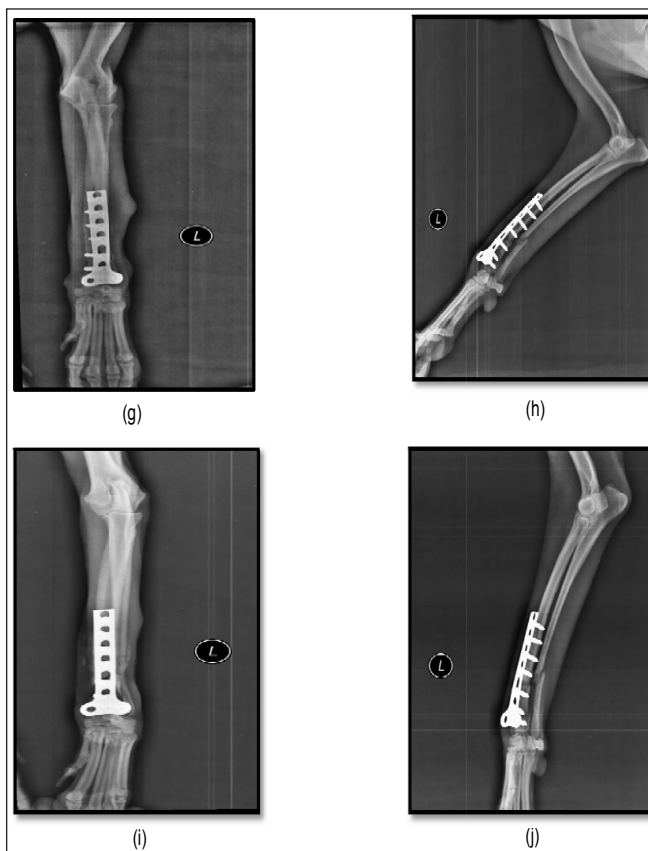


Fig. 1b: Radiographs of dogs; (g) and (h) at day 45, (i) and (j) at day 60

Weight bearing on affected limb in dogs

Assessment of weight-bearing was carried out on day 0, 7, 28, 45 and 60 post-operatively to evaluate functional recovery of the affected limb. The details of lameness grading (Vasseur *et al.*, 1995) were presented in Table 3. The median weight bearing score ranged from 1.0 (1.0 - 1.0) to 5.0 (5.0 - 5.0). A significant ($p < 0.05$) improvement in weight bearing grades was reported in dogs from day 0 to day 45 post-operatively. Thereafter, a continued and progressive improvement was recorded on day 45 and 60 as shown in table 5 and Fig. 2.

Table 5: Median values for weight bearing grade in dogs (n=12) at different time intervals

Sl. No.	Day	Weight bearing grade (Median)
1	0	5.0 ^a (5.0 - 5.0)
2	7	4.0 ^b (4.0 - 4.0)
3	28	2.0 ^c (2.0 - 3.0)
4	45	1.0 ^d (1.0 - 1.0)
5	60	1.0 ^d (1.0 - 1.0)

Median values bearing different superscripts within a group (a, b, c and d) differ significantly ($p < 0.05$).



Fig. 2a: Weight bearing in dogs with radius-ulna fracture on (a) day 0, (b) day 7, (c) day 28, (d) day 45 and (e) day 60

Hematological findings

Haemato-biochemical parameters

Haemato-biochemical parameters were evaluated on day 0, 7, 14, 28 and 45 postoperatively. The serum calcium values increased non-significantly from 7th to 28th day postoperatively, followed by a subsequent decrease; however, all values remained within the physiological range. Serum blood urea nitrogen and serum creatinine also showed a non-significant difference at different time intervals Bhargav *et al.* (2025).

DISCUSSION

Degree of exudation were assessed postoperatively on day 3, 7 and 15 indicating progressive improvement in

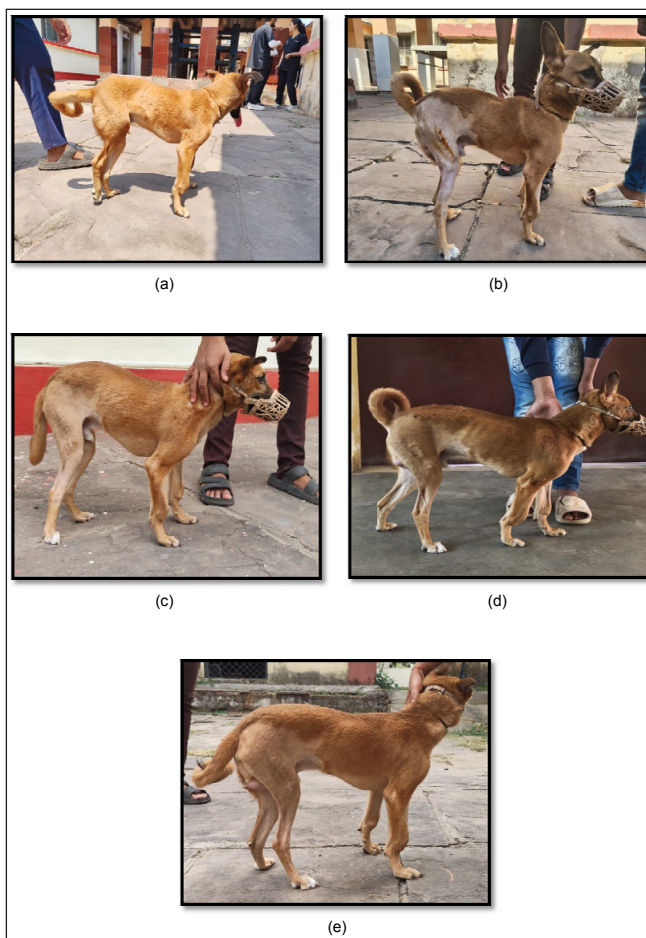


Fig. 2b: Weight bearing in dogs with femur fracture on (a) day 0, (b) day 7, (c) day 28, (d) day 45 and (e) day 60

wound healing by the 15th postoperative day Baderiya *et al.* (2021). Early weight bearing observed in dogs may be due to improved fracture healing resulting from proper contouring to bone segments and apposition, early pain resolution and sufficient callus formation, all of which are supported by the greater stability provided by supracondylar plate and T plate in distal femur and radius-ulna respectively Pravalika *et al.* (2023) and Rajavardhan *et al.* (2024).

Radiographic evaluation revealed that median value increased significantly ($p < 0.05$) from day 0 to day 45. On 14th postoperative day, slight periosteal reaction was observed with remarkable activity followed by traces of periosteal callus formation. By the 60th postoperative day, the highest median grade value of 5.0(5.0–5.0) was recorded. A significant ($p < 0.05$) difference was observed



compared to day 0, indicating complete union of the fractured segments with absence of a radiolucent line (Sran et al. (2021).

Supracondylar (J) plate fixation was effective for surgical management of distal femur fracture in dogs, particularly in fracture with limited distal bone segment and caudal femoral curvature. The T-plate provided rigid fixation, adequate screw purchase in small distal segments of radius-ulna and maintained proper fracture alignment throughout the healing period. The Supracondylar plate and T plate can be evaluated for fracture fixation of distal fracture of long bones in combination with other implants and in other species.

GENERATIVE AI DECLARATION

The author(s) confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript, and no images were manipulated using AI. The authors developed and verified all scientific content, data analysis, interpretation of results, and conclusions. The authors take full responsibility for the accuracy, integrity, and originality of the work presented, and no AI tool was listed as an author.

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REFERENCES

- Baderiya, A., Singh, R., Jawre, S., Gupta, N., Das, B., Shahi, A. and Vandre, R. 2021. Clinical and radiographic evaluation of intramedullary interlocking nailing for fracture repair in dogs. *J. Anim. Res.*, **11**(3): 401–408.
- Bhargav, G.N., Mahesh, R., Rao, Ch.M., Suresh, K. and Rambabu, K. 2025. Haemato-biochemical parameters in healing of femur diaphyseal fracture stabilized with locking compression plate and autologous cancellous bone graft in canines. *J. Livest. Sci.*, **16**(1): 698–703.
- Bhowmick, D., Bhargava, M.K., Jawre, S., Shahi, A. and Singh, R. 2013. Efficacy of low-level laser therapy on healing of clinical open wounds in calves. *Indian J. Vet. Surg.*, **34**(1): 13–15.
- Hayashi, A.M., Matera, J.M., Stermann, F.A., Muramoto, C. and Cortopassi, S.R.G. 2008. Evaluation of electroacupuncture in bone healing of radius-ulna fracture in dogs. *Braz. J. Vet. Res. Anim. Sci.*, **45**(5): 339–347.
- Kumar, S.J. 2017. Bio-mechanical and clinical outcome of supracondylar plate in the management of supracondylar fractures of femur in dogs. M.V.Sc. Thesis, Tamil Nadu Veterinary and Animal Sciences University, Chennai, India.
- Lakshmi, N.D., Ganesh, T.N., Ayyappan, S., Shafiuzama, M.D. and Sureshkumar, R. 2007. Management of a distal metaphyseal radial fracture in a dog with a mini T-plate. *Vet. Rec.*, **161**(23): 791–792.
- Pravalika, E., Reddy, K., Latha, C., Rao, T.M. and Purshotham, G. 2023. A clinical study on the use of supracondylar plate in the treatment of distal femoral fractures in dogs. *Indian J. Anim. Res.*, **57**(9): 1168–1176.
- Rajavardan, K., Chandrasekhar, E., Raghavender, K. and Purushotham, G. 2024. Evaluation of the mini T-plate for fixation of distal radial fractures in puppies and small breed dogs. *Indian J. Vet. Surg.*, **45**(2): 114–116.
- Sran, T.K., Devi, N.U., Singh, S.S. and Mohindroo, J. 2021. Use of locking T-plate for repair of distal third radius-ulna fractures in 12 dogs. *Indian J. Vet. Surg.*, **42**(2): 100–105.
- Vasseur, P.B., Johnson, A.L., Budsberg, S.C., Linwin, J.B., Toombs, J.P., Whitehair, J.G. and Lentz, E.L. 1995. Randomized, controlled trial of the efficacy of carprofen, a non-steroidal anti-inflammatory drug in the treatment of osteoarthritis in dogs. *J. Am. Vet. Med. Assoc.*, **206**(6): 807–811.