Indian J Anim Health (2025), 64(1): 134- 139
DOI: https://doi.org/10.36062/ijah.2025.14624

Research Article

Clinical evaluation of interlocking nail and locking compression plate for tibial fracture repair in dogs

G. Mehdi[1*], B. Bhagavantappa[1], Shivaprakash[1], D. Dilip Kumar[1], Venkatgiri[1], M. Vijay Kumar[2], N. M. Ramya[1], Pallavi[1], H. S. Pooja[1], Shreevani[1] and M. Sai Kiran[3]

[1]Department of Veterinary Surgery and Radiology, Veterinary College Bidar, Karnataka Veterinary Animal and Fisheries Sciences University, Bidar - 585 401, Karnataka, India; [2]Department of Veterinary Pharmacology and Toxicology, Veterinary College Bidar, Karnataka Veterinary Animal and Fisheries Sciences University, Bidar - 585 401, Karnataka, India; [3]Department of Veterinary Medicine, Veterinary College Bidar, Karnataka Veterinary Animal and Fisheries Sciences University, Bidar - 585 401, Karnataka, India

Abstract

The study evaluated the using interlocking nails and locking compression plates for tibial fracture repair in 12 dogs. Clinical, physical, physiological and radiographic examinations were conducted to diagnose tibial fracture in all dogs. Non-descriptive was the most commonly involved with 91.66% of cases followed by mudhole hound with 8.33% of cases. The major cause of tibial fracture was automobile accident in 66.66% cases, followed by pig fight in 16.66%, hit injury in 8.33% and fall from height in 8.33%. Tibial fractures were more common in males (75%) than females (25%). Early weight bearing at rest and while walking was observed in both groups. All dogs in LCP group achieved grade I lameness score while in ILN group, three dogs achieved grade I lameness score by 30th post-operative day. Radiographic evaluation showed progression of fracture healing characterized by less callus formation in locking compression plating (LCP) than interlocking nail (ILN) fixation. According to the findings of this study, both of the techniques were found effective in the treatment of transverse tibial fractures in dogs.

Keywords: Fracture and lameness, Interlocking nail, Locking compression plate.

Highlights

- Non-descriptive breed was the most commonly affected accounting for 91.66% of cases
- Radiographs showed better healing with less callus formation in LCP than in ILN
- LCP with combination holes enables both internal fixation and dynamic compression
- Early weight bearing was observed in both ILN and LCP groups post-surgery
- All LCP group dogs achieved the grade I lameness by the 30th postoperative day

INTRODUCTION

In dogs long bone fractures are a major concern in small animal practice (Allah *et al.*, 2009). Tibial fractures were frequently observed among dogs. These fractures account for 20% of all long bone fracture cases observed in dogs (Ilker, 2020). Diaphyseal fractures account for approximately 73% of all tibial fractures (Van der Elst *et al.*, 1999). In treating tibial and fibular fractures in animals, various methods are employed depending on the severity of the injury. For uncomplicated fractures with intact skin, closed reduction and external fixation using Robert Jones bandages or Gypsona/fiber glass materials are common. In more severe cases, open reduction and internal fixation may be necessary, utilizing techniques such as intramedullary pins, bone plates, plate rods, or ILN. The choice of method depends on factors like fracture location, nature, and the surgeon's expertise (El-shafey *et al.,* 2022).

Interlocking nails have been utilized in human medicine for fracture fixation since the 1950s, usually inserted with a close technique aided by fluoroscopy. In veterinary practice, interlocking nails emerged in the 1990s, employing an open insertion method facilitated by a jig to locate the nail holes. The concept of the interlocking nail in the treatment of long bone fracture evolved from the intramedullary nail and later "detensor" nail designed by Kuntscher in the 1940s and late 1960s (Dejardin *et al.*, 2012). In the 1970s, Huckstep developed the first true interlocking nail to treat femoral fractures in humans. The introduction of interlocking nails in veterinary medicine, with innovations emerging independently from Dueland in the USA and Durall and Díaz-Bertrana in Europe. These

*Corresponding Author, E-mail: ghulammehdi037@gmail.com

pioneers independently developed prototypes and instruments tailored for clinical use. Interlocking nails can be utilized in both static and dynamic modes (Georgiadis *et al.*, 1990). Interlocking nails (ILN) emerge as a promising option for minimally invasive fracture management, serving as an appealing alternative to standard bone plates, particularly in addressing comminuted diaphyseal fractures (Arican *et al.*, 2017). The emergence of ILN heralded a paradigm shift in fracture management, offering a minimally invasive yet highly effective alternative. By leveraging intramedullary stabilization principles, ILN minimizes surgical trauma, preserves periosteal blood supply, and facilitates biological fracture healing. The design of ILN allows for precise anatomical reduction and multiplanar stability, thereby optimizing fracture alignment and promoting early functional recovery. Moreover, ILN boasts superior biomechanical properties, including enhanced resistance to torsional, bending, and shearing forces. This translates into improved fracture stability and reduced risk of implant failure, thus enhancing long-term clinical outcomes. Additionally, ILN mitigates complications associated with conventional fixation methods, such as infection, delayed union, and implant failure, further underscoring its clinical utility. Interlocking Nail Fixation (ILN) is particularly well-suited for addressing comminuted fractures because it effectively withstands bending, axial, and torsional forces while also serving as a form of biological fracture treatment (Gatineau and Plante, 2010; Arican *et al.*, 2017).

The evolution of the plating technique, initiated by Sherman in 1912, has followed a developmental trajectory. The formation of the Association for Study of Internal Fixation (ASIF) in 1958 marked a pivotal moment, leading to innovations such as the dynamic compression plate (DCP) (Maritato, 2019). Subsequent developments focused on reducing bone-plate contact, resulting in the introduction of the least contact dynamic compression plate (LC-DCP) and point contact fixators (PC-Fix). The development of locked compression plates (LCP) was a collaborative effort involving clinicians, researchers, and industry. In 1998, Prof. Dr. Michael Wagner pioneered the use of threaded screws alongside standard screws for the first time. Clinical application of LCP commenced in March 2000, with its introduction in veterinary medicine taking place in 2005 (Frigg, 2003) The introduction of the locking compression plate (LCP) marked a significant advancement, combining two distinct anchorage technologies within a single implant. Drawing from the experiences with PC-Fix and Less Invasive Stabilization Systems (LISS), the LCP principle revolutionized fracture treatment. Unlike previous systems, the LCP's combination holes offer surgeons versatility, enabling the application of internal fixation and dynamic compression principles tailored to the fracture site. Depending on the patient's circumstances, the LCP can function as a compression plate, locked internal fixator, or a hybrid of both approaches (Niemeyer and Sudkamp, 2006). The study was thereby planned to evaluate the two rigid fracture fixation techniques viz. intramedullary interlocking nailing and locking compression plating for management of tibia bone fracture in dogs.

MATERIALS AND METHODS

The study was done to compare the interlocking nail and locking compression plate for tibial fracture repair in 12 dogs (11 Non-Descript and 1 Mudhol Hound) presented to the Department of Veterinary Surgery and Radiology, Veterinary College, Bidar. Clinical, physical, physiological and radiographic examinations were conducted to diagnose the fractures. Fractures were immobilized by open reduction and internal fixation using ILN and LCP. Six cases of tibial fractures were observed in group I. These cases varied in age, sex, and etiology of the fracture, including automobile accidents (4), hit injuries (1), and pig fights (1). For normograde interlocking nailing, the entry point was established at the medial tibial condyle using a bone awl. A Steinmann pin was used to create a guide tract in the medullary cavity. An interlocking nail of 5 mm diameter of lengths 140 mm, 160 mm and 180 mm along with transcortical screw of 2 mm thickness of lengths 14, 16, 18, 20 and 24 mm were secured using an aiming device. Screw holes were drilled, and locking screws were placed in static mode. Stability was confirmed before detaching the aiming device (Fig. 1). The fractures affected three right and three left tibia. The screw placement typically involved one screw in the proximal fragment and one or two screws in the distal fragment. The ILN diameter was determined by measuring the intramedullary cavity at the isthmus region of the tibia. In group II, cases presented similar diversity in terms of etiology, ranging from pig fights (1), automobile accidents (3) falling from height (1) and bike accidents (1). The fractures involved four right and two left tibia. A 3.5 mm LCP with eight holes was used in five cases, while a six-hole plate was used in one case. Following manual fracture reduction or stabilization with bone-holding forceps, a preoperatively selected LCP of appropriate length was positioned on the medial aspect of the tibia. Self-tapping locking head cortical screws (3.5 mm) ranging from 14 to 24 mm in length were used for fixation (Fig. 2). Pre-operative radiographs were taken in orthogonal views (Fig. 3). The dogs were preanesthetized with atropine sulfate (@0.045 mg/kg IM), sedated with dexmedetomidine (@10 μg/kg IV), and general anesthesia with propofol (@3 mg/kg IV). Maintenance of general anesthesia was achieved with 2 to 3% isoflurane.

Post-operatively injection amoxicillin-sulbactam was administered @ 10 mg/kg intravenously twice a day for 5 days and tab. carprofen @ 4 mg/kg orally for 3 days to control infection and inflammation. Lameness grading was carried out on the pre-operative day and post-operative on 15th, 30th and 60th day based on the weight-bearing nature during stance and while walking. Weight-bearing was graded as given by Vasseur *et al.* (1995). The radiographs were obtained pre-operative and post-operative operation on 15th, 30th and 60th day to assess the progress of bone healing and complications. Based on the status of the implant, callus formation and union of fragments fracture healing was determined.The data obtained were tabulated and statistically analysed using the student's t-test as outlined by Snedecor and Cochran (1994).

RESULTS

In group I the mean age was 13±1.36 months and the mean body weight of 18.66 ±1.11 kg. In group II mean age of the dogs was 10.33±1.96 months and the mean body weight was 15.83±2.57. All 12 dogs underwent radiographic examination revealed that 4 dogs had transverse proximal fracture and 8 dogs had transverse mid diaphyseal fracture.

In group I partial Weight-bearing of the operated limb during walking was seen as early as the 1st post-operative in two dogs, 3rd post-operative day in one dog, 7th post-operative day in two dogs and 10th post-operative day in one dog. In group II partial weight-bearing of the operated limb during walking was seen as early as the zero post-operative day in two dogs, 3rd post-operative day in two dogs, 8th post-operative day in one dog and 12th post-operative day in one dog. Lameness grading according to Vasseur *et al.* (1995) at various intervals postoperatively is given in (Table 1).

Immediate post-operative radiographs confirmed proper placement of the interlocking nail and screws, with correct alignment and apposition of fracture fragments in all six dogs in Group I (Fig. 4). Follow-up radiographs on the 15th postoperative day confirmed proper alignment of fracture fragments in all cases, with visible radiolucent fracture lines and evident periosteal reactions (Fig. 5). By the 30th day, bridging callus formation was noted, with the fracture line diminishing in four cases and remaining faint in twocases. Slight screw bending was observed in one case but did not affect stability (Fig. 6). On the 60th day, dense bridging callus was present, and remodeling of the callus was noted, but continuity of the medullary canal was not restored (Fig. 7).

Table 1. Post-operative lameness grading of dogs under study

Groups	Case No.	Pre-operative	Day 0	Day 15	Day 30	Day 60
	1	V	IV	II	I	I
	2	V	III	III	II	I
	3	V	IV	III	II	II
II LN	4	V	IV	II	I	I
	5	V	IV	II	I	I
	6	V	IV	III	II	I
	1	V	IV	II	I	I
	2	V	II	I	I	I
II LCP	3	V	III	II	I	I
	4	V	III	I	I	I
	5	V	IV	II	I	I
	6	V	II	II	I	I

Grade I–Normal weight bearing on all limbs at rest and while walking
Grade II–Normal weight bearing at rest, favors affected limb while walking
Grade III – Partial weight bearing at rest and while walking
Grade IV– Partial weight bearing at rest; does not bear weight on affected limb while walking
Grade V– Does not bear weight on limb at rest or while walking

In Group II, all six dogs exhibited correct alignment of fracture fragments with the implant following surgery (Fig. 8). Post-operative 15th day radiograph showed appropriate alignment of the fracture fragments. The radiolucent fracture line was still evident with noticeable periosteal reaction at the fracture site (Fig. 9). Post-operative 30th day progressive bridging callus was noted at the fracture line, which appeared faint (Fig. 10). Radiographs on postoperative day 60th the callus remodeling suggested progressive union of the fragments with the locking compression plate (LCP) (Fig. 11).

DISCUSSION

The mean age was 13±1.36 and 10.33±1.96 months in group I and group II respectively, dogs aged up to 12 months had the highest occurrence of fracture with 66.66% (n=8) and dogs aged above 12 months to 18 months had 33.33%(n=4). Fracture occurrence was highest in young ones (up to 1 year). Similar observations have been reported by Eyarefe and Oyetayo (2016), and Abo-Soliman *et al.* (2020). The study revealed that tibial fractures were more common in males (75%) than in females (25%). The findings were in agreement with Kumar *et al.* (2020), and Abo-Soliman *et al*. (2020). Non-descriptive was the most commonly involved with 91.66% of cases (n-11) followed by Mudhole hound with 8.33% of cases (n-1). Similar findings of the highest fracture incidence in non-descriptive dogs have been reported by Kumar *et al*. (2020) and Abo-Soliman *et al.* (2020).

In group I six dogs with transverse diaphyseal fractures of the tibia were repaired using static ILN. Similar static fixation was reported by Endo *et al.* (1998), and Duhautois (2003). This technique provided good realignment of fracture fragments and the union of fractures resulted in early functional weight bearing and prevented muscle atrophy. This was in accordance with Asif *et al.* (2010). In group II six dogs with transverse diaphyseal fractures of the tibia were repaired with LCP which provided excellent angular stability and rigid fixation of fracture fragments, which was also reported by Gardner *et al*. (2004), and Ramesh *et al.* (2015). Anatomical contouring of LCP to the bone surface was not performed as the locking head screws provided excellent stability of the fracture fragments with sufficient screw purchase. This was in accordance with Filipowicz *et al*. (2009), and Uhl *et al*. (2013).

The post-operative progression of lameness in both groups revealed significant insights into the efficacy of both surgical stabilization methods for canine fractures. In Group I, all dogs initially presented with grade V lameness. Post-surgery, significant improvements were observed, with the majority showing partial weight-bearing within the first week. By day 15, lameness had improved considerably, and by day 60, five out of six dogs achieved grade I and one dog exhibited grade II lameness on the 60th post-operative day. Findings align with studies by Asif *et al.* (2010), Raghunath *et al.* (2012), Abhishek *et al.* (2022), and Gracias (2022) (Table 1).

In Group II, dogs also began with grade V lameness but showed faster improvement post-operatively compared to Group I. By day 15, most dogs progressed to grade II or I lameness, and by day 30, all achieved grade I lameness. These results are consistent with findings by Uhl *et al.* (2013), and Beale and McCally (2020), indicating the stabilization method in Group II might better resist mechanical stresses, facilitating quicker recovery. This is further supported by Schwandt and Montavan (2005), Sahu *et al.* (2017), Garcia *et al.* (2020), and Namreen *et al.* (2022) (Table 1). Attributed to the ILN's lower resistance to torsional loads compared to plating, as noted by Glyde and Arnett (2006), ILN may not be optimal for fractures exposed to high torsional forces.

All six dogs exhibited correct alignment of fracture fragments post-operatively with static ILN. By the 30th post-operative day, bridging callus was present at the fracture site and showed increased density by the 60th day. Remodeling of the callus was noted, but continuity of the medullary canal was not restored. These findings were in accordance with Raghunath and Singh (2002), Aikawa *et al*. (2018), Macri *et al*. (2021), and Abhishek *et al.* (2022).

Static intramedullary nailing (ILN) neutralizes all forces at the fracture site but, compared to plating, results in greater callus formation, indicating less effective force neutralization and extended healing time. This is attributed to the tibia's anatomy, transitioning from a proximal triangular shape to a twisted, cylindrical form distally, which reduces ILN stability and promotes increased callus formation.

In Group II, all six dogs exhibited correct alignment of fracture fragments with the implant following surgery. By the 30th post-operative day, bridging callus was observed at the fracture site, and by the 60th day, callus remodeling suggested progressive union of the fragments with the locking compression plate (LCP). Findings were in accordance with Garcia *et al.* (2020) and Beale and McCally (2020). Healing was achieved within 6–8 weeks, with minimal callus formation as comparedto ILN.

In group I, in case 1, off-site placement of the screw occurred in the distal fragment, a piece of bone fragment split from the proximal fragment, later

Fig. 1. Completion of Normograde insertion of the interlocking nail in both the fragments

Fig. 2. Completion of 3.5 mm 8 holed Locking Compression plate application

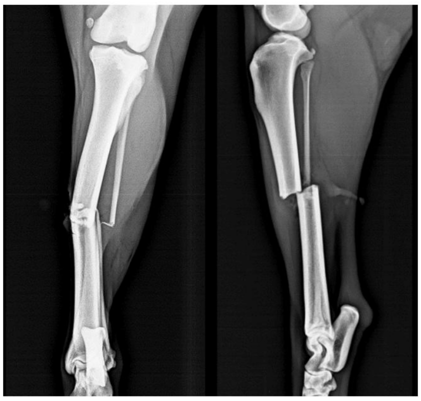

Fig. 3. Pre-operative orthogonal radiograph of group I case 5

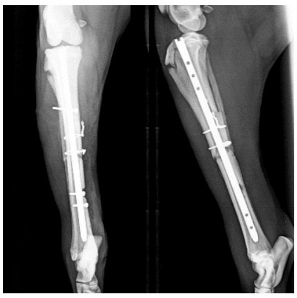

Fig. 4. (Day zero)

Fig. 5. (Day 15)

Fig. 6.(Day 30)

Fig. 7. (Day 60)

Fig. 4 to 7. Post-operative radiograph case 2 group I (orthogonal view)

Fig. 8(Day zero)

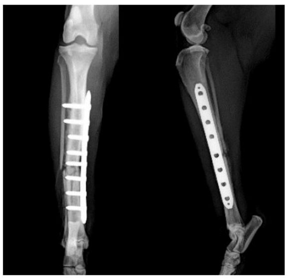

Fig. 9 (Day 15)

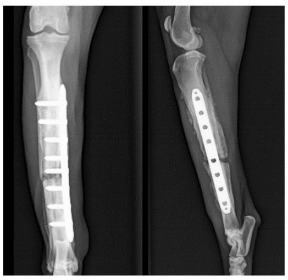

Fig. 10 (Day 30)

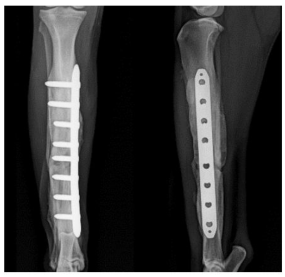

Fig. 11(Day 60)

Fig. 8 to 11. Post-operative radiograph case 2 group II (orthogonal view)

fixed with two cerclage wires. Similar complications were recorded by Duhautois (2003), McLaughlin (1999), Bellon and Mullon (2011), and Arican *et al.* (2017). In group I, slight bending of the proximal screw occurred on the 30th post-operative day in one case. Similar post-operative findings were recorded by Wheeler *et al.* (2004). In group II, there was no post-operative complication.

In conclusion ILN and LCP in dogs for tibial fracture repair provided stable fixation, However, LCP was slightly better than ILN. Early weight bearing was observed in LCP compared to ILN. Radiographic evaluation showed progression towards fracture healing characterized by minimal callus formation in LCP than ILN fixation for tibial fracture repair. Both techniques were found to be effective in the treatment of transverse tibial fractures in dogs.

Conflict of interest: The Authors have no conflict of interest.

Author's contribution: GM, BB: Conception and designing the research and conducted the research work; GM, S: Result interpretation; GM, DD: Result interpretation and statistical analysis; MV: Revising the manuscript and technical support; V, P: Technical support; NMR: Revising the manuscript; HP, S, MS: Technical support.

Data availability statement: The author confirms that the data supporting the findings of this study are available within the article.

Ethical statement: Research work was conducted on clinical cases.

ACKNOWLEDGEMENT

The authors are thankful to the Department of Veterinary Surgery and Radiology and the Dean of Veterinary College Bidar for allowing us to conduct this research work and the authors are also thankful to the Department of Teaching Veterinary Clinical Complex (TVCC), Veterinary College Bidar.

REFERENCES

Abhishek B, Reddy JMK, Sekhar CEL, Rao RRJ and Rajendranath N, 2022. Clinical study on repair of tibial fractures using intramedullary interlocking nailing in dogs. J Pharm Innov, 11(11S): 1755-1761

Abo-Soliman AAM, Ahmed AE and Farghali HAMA, 2020. Incidence of appendicular bone fracture in dogs and cats: retrospective study at veterinary hospital of Cairo University and some private clinics in Egypt. World Vet J, 10(4): 638-652, doi: 10.54203/scil.2020.wv77

Aikawa T, Miyazaki Y, Shimatsu T, Iizuka K and Nishimura M, 2018. Clinical outcomes and complications after open reduction and internal fixation utilizing conventional plates in 65 distal radial and ulnar fractures of miniature-and toy-breed dogs. Vet Comp Orthop Traumatol, 31 (3): 214-217, doi: 10.1055/s-0038-1639485

Allah SMG, Fargali H and Magdy A, 2009. Combined different fixation system for reconstruction of comminuted diaphyseal femoral fracture in dogs. Vet Med J Giza, 57(4): 525-541, doi: 10.21608/vmjg.2011.368029

Arican M, Alkan F, Altan S, Parlak K and Yavru N, 2017. Clinical experience of interlocking nail stabilization of long bone fractures in dogs–a retrospective study of 26 cases. Isr J Vet Med, 72(2): 45-50

Asif MA, Dilipkumar D, Shivaprakash BV, Usturge SM, Kasaralikar VR *et al.*, 2010. Clinical evaluation of static and dynamic veterinary intramedullary interlocking nailing technique for femoral fracture repairs in dogs. Indian J Vet Surg, 32(2): 94-98

Beale B and McCally R, 2020. Minimally invasive fracture repair of the tibia and fibula. Vet Clin North Am Small Anim Pract, 50(1): 183-206, doi: 10.1016/j.cvsm.2019.08.008

Bellon J and Mulon PY, 2011. Use of a novel intramedullary nail for femoral fracture repair in calves: 25 cases (2008-2009). J Am Vet Med Assoc, 238(11): 1490-1496, doi: 10.2460/javma.238.11.1490

Dejardin LM, Guiot LP and von Pfeil DJ, 2012. Interlocking nails and minimally invasive osteosynthesis. Vet Clin North Am Small Anim Pract, 42(5): 935-962, doi: 10.1016/j.cvsm.2012.07.004

Duhautois B, 2003. Use of veterinary interlocking nails for diaphyseal fractures in dogs and cats: 121 cases. Vet Surg, 32(1): 8-20, doi: 10.1053/jvet.2003.50008

El-shafey S, El-Mezyen AEM, Behery A and Abd El Raouf M, 2022. Tibial and fibular fractures in dogs and cats: retrospective study. Zagazig Vet J, 50(1): 37-51, doi: 10.21608/zvjz.2022.111997.1168

Endo K, Nakamura K, Maeda H and Matsushita T, 1998. Interlocking intramedullary nail method for the treatment of femoral and tibial fractures in cats and small dogs. J Vet Med Sci, 60 (1): 119-122, dio: 10.1292/jvms.60.119

Eyarefe OD and Oyetayo SN, 2016. Prevalence and pattern of small animal orthopaedic conditions at the Veterinary Teaching Hospital, University of Ibadan. Sokoto J Vet Sci, 14(2): 8-15, dio: 10.4314/sokjvs.v14i2.2

Filipowicz D, Lanz O, McLaughlin R, Elder S and Werre S, 2009. A biomechanical comparison of 3.5 locking compression plate fixation to 3.5 limited contact dynamic compression plate fixation in a canine cadaveric distal humeral metaphyseal gap model. Vet Comp Orthop Traumatol, 22(04): 270-277, doi: 10.3415/vcot-08-05-0042

Frigg R, 2003. Development of the locking compression plate. Injury, 34(Suppl 2): 6-10, doi: 10.1016/j.injury.2003.09.020

Garcia J, Yeadon R and Solano MA, 2020. Bilateral locking compression plate and transcondylar screw fixation for stabilization of canine bicondylar humeral fractures. Vet Surg, 49(6): 1183-1194, doi: 10.1111/vsu.13429

Gardner MJ, Helfet DL and Lorich G, 2004. Has locked plating completely replaced conventional plating, Am J Orthop (Belle Mead NJ), 33(9): 439-446

Gatineau M and Planté J, 2010. Ulnar Interlocking Intramedullary Nail Stabilization of a Proximal Radio Ulnar Fracture in a Dog. Vet Surg, 39(8): 1025-1029, doi: 10.1111/j.1532-950x.2010.00731.x

Georgiadis GM, Minster GJ and Moed BR, 1990. Effects of dynamization after interlocking tibial nailing: an experimental study in dogs. J Orthop Trauma, 4(3): 323-330, dio: 10.1097/00005131-199004030-00015

Glyde M and Arnett R, 2006. Tibial fractures in the dog and cat: options for management. Ir Vet J, 59(5): 290-295

Gracias R, 2022. Comparative evaluation of intramedullary pinning and modified intramedullary interlocking nailing techniques for the repair of tibial fractures under fentanyl-ketamine induction and isoflurane maintenance in dogs. PG. thesis, Karnataka Veterinary Animal Fisheries Sciences University, Bidar, Karnataka, India, https://krishikosh.egranth.ac.in/handle/1/5810204055

Ilker ŞEN, 2020. Treatment of tibial fractures with the use of interlocking nail and acrylic external fixator combination in dogs. Turk Vet J, 2(1): 1-6

Kumar BB, Sharma AK, Reetu PK, Kumar C and Kumar R, 2020. Study on incidence of fractures with respect to breed, age, sex, type and location of fractures and bone involved. J Entomol Zool Stud, 8 (2): 21-24

Macri F, Angileri V, Russo T, Russo MT, Tabbì M *et al.*, 2021. Evaluation of bone healing using contrast-enhanced ultrasonography in non-operative treatment of tibial fracture in a puppy dog. Animals, 11(2): 284, doi: 10.3390/ani11020284

Maritato KC, 2019. A Brief History of Veterinary Locking Plates Applications. In: Locking Plates in Veterinary Orthopedics by Barnhart MD and Maritato KC. 1st edn., John Wiley and Sons., pp 1-5, dio: 10.1002/9781119380139.ch1

McLaughlin R, 1999. Internal fixation: intramedullary pins, cerclage wires, and interlocking nails. Vet Clin North Am Small Anim Pract, 29(5): 1097-1116, dio: 10.1016/S0195-5616(99)50104-6

Namreen N, Reddy JMK, Sekhar CEL and Rajendranath N, 2022. A clinical study on the use of locking t-plate in radius-ulna fractures in dogs. Pharma Innov, 11(12): 4253-4260

Niemeyer P and Sudkamp NP, 2006. Principles and clinical application of the locking compression plate (LCP). Acta Chir Orthop Traumatol Cech, 73(4): 221-228

Raghunath M and Singh SS, 2002. Intramedullary interlocking nailing (IIN) for long bone fracture fixation in dogs using indigenously designed equipment. Indian J Vet Surg, 23(2): 89-91

Raghunath M, Bishnoi AK, Singh SS, Singh M, Sharma A *et al.*, 2012. Management of segmental fractures of tibia and femur by static intramedullary interlocking nailing in twelve dogs. Int J Appl Res Vet Med, 10(3): 264-275

Ramesh R, Ayyappan S, Jayaprakash R and Geetha R, 2015. Open reduction and internal fixation with linear locking compression plates for the stabilisation of unstable diaphyseal fracture of femur in dogs. Ind J Vet Anim Sci Res, 11(1): 36-41

Sahu S, Pathak R, Shah MA, Reetu, Jayalekshmi S *et al.*, 2017. Evaluation of locking compression plate in wedge and complex fractures of long bones in dogs. Indian J Vet Surg, 38(2): 81-85

Schwandt CS and Montavon PM, 2005. Locking compression plate fixation of radial and tibial fractures in a young dog. Vet Comp Orthop Traumatol, 18(03): 194-198, dio: 10.1055/s-0038-1632946

Snedecor GW and Cochran WG, 1994. Statistical Method. 8th edn., IOWA state university press. Ames, lowa, USA

Uhl JM, Kapatkin AS, Garcia TC and Stover SM, 2013. Ex vivo biomechanical comparison of a 3.5 mm locking compression plate applied cranially and a 2.7 mm locking compression plate applied medially in a gap model of the distal aspect of the canine radius. Vet Surg, 42(7): 840-846, dio: 10.1111/j.1532-950X.2013.12063.x

Van der Elst M, Klein CPAT, de Blieck-Hogervorst JM, Patka P and Haarman HTM, 1999. Bone tissue response to biodegradable polymers used for intra medullary fracture fixation: a long-term in vivo study in sheep femora. Biomaterials, 20(2): 121-128, dio: 10.1016/S0142-9612(98)00117-3

Vasseur PB, Johnson AL, Budsberg SC, Lincoln JD, Toombs JP *et al.*, 1995. Randomized, controlled trials of the efficacy of carprofen, a non-steroidal anti-inflammatory drug in the treatment of osteoarthritis in dog. J Am Vet Med Assoc, 206: 807-811

Wheeler JL, Lewis DD, Cross AR, Stubbs WP and Parker RB, 2004. Intramedullary interlocking nail fixation in dogs and cats: clinical applications. Compendium, 26(7): 531-543

Received - 14.11.2024, Accepted - 12.05.2025, Published - 18.05.2025(Online), 01.06.2025 (Print)
Section Editor: Prof. S. K. Nandi, Associate Editor