

MANAGEMENT OF A CLOSED COMPLETE OBLIQUE DISTAL ONE-THIRD TIBIA FRACTURE IN A NIGERIAN INDIGENOUS BITCH USING MODIFIED CROSSED PIN-IN-FIBERGLASS CAST TECHNIQUE: CASE REPORT

*¹Emmanuel, E.G., ²Mailafia, A.G., ³Mana, H.P., ⁴Bada, A.A., ⁵Ahmad, U.S. & ⁶Hassan, A.Z.

¹Veterinary Teaching Hospital, Ahmadu Bello University, Zaria, Nigeria ²Veterinary Clinic, Sabon Tasha, Ministry of Agriculture, Kaduna, Nigeria ³Veterinary Teaching Hospital, University of Maiduguri, Borno State, Nigeria ⁵Department of Veterinary Surgery and Radiology, Usmanu Danfodiyo University, Sokoto, Nigeria ⁴Department of Veterinary Surgery and Radiology, Ahmadu Bello University, Zaria, Nigeria

*Correspondence: echiobie@gmail.com; +2348034266454

ABSTRACT

This is a case of an indigenous Nigerian breed of adult female dog that had a closed, full oblique distal one-third fracture of her right tibia. The purpose of the patient's presentation was to treat the non-weight-bearing lameness. It is well known that the tibia, especially its distal third, suffers non-union and healing issues. Radiographic and clinical indications of fracture healing were used to assess the effectiveness of a modified cross pin-in-fiberglass cast approach used to manage the case. The patient received epidural anesthesia at the lumbosacral region (L7-S1) while recumbent dorsally on a surgical table. The fractured leg was suspended from a drip stand to provide traction and prevent fractures. Using an electrical bone drilling machine and 2.5 mm non-threaded Steinman pins, transfixation was carried out in accordance with Permattei's procedure. From the most proximal to the most distal pin, a fiberglass cast material (pure cast®) was put to the leg after being submerged in room temperature water. Results showed minimal soft tissue swelling and periosteal reaction, an early attempt at weight-bearing within 7 days post-surgery, and complete fracture healing observed at week 8 based on clinical and radiographic evidence. The patient returned to full ambulation with excellent limb function 8 weeks post-management. Cast sore was the only complication observed. This method is therefore recommended for the management of distal tibia fractures.

Keywords: Oblique distal one-third tibia fracture, Nigerian indigenous bitch, modified crossed pin-in-fiberglass cast, fracture management

INTRODUCTION

A considerable percentage of long bone injuries in small animal orthopaedics are canine tibial fractures, which frequently occur after traumatic incidents including falls, car crashes, or blunt force trauma (Kumar *et al.*, 2022). Being a primary weight-bearing bone with a subcutaneous medial edge, the tibia is anatomically predisposed to fracture quite easily (Bourne *et al.*, 2023). A number of intrinsic anatomical and biomechanical variables make treating fractures involving the distal region of the tibia particularly difficult (Joveniaux *et al.*, 2010). Relatively little soft tissue coverage, a reduced vascular supply, and the fracture's close proximity to the tarsocrural joint make reduction and

stabilization more difficult in this area (Corr, 2012). The management of such fractures aims to achieve anatomical reduction, provide rigid stabilization to facilitate uninterrupted bone healing, and allow for early return to functional ambulation (Candela- Andrade *et al.*, 2012). Numerous osteosynthesis techniques have been described, including intramedullary pinning, bone plating, and external skeletal fixation (ESF) (Bada *et al.*, 2016; Mana *et al.*, 2023; Sherman *et al.*, 2023). While open reduction and internal fixation (ORIF) with plates and screws is often considered the gold standard for providing absolute stability, it is a technically demanding procedure that requires extensive surgical exposure, which can further compromise the

tenuous blood supply and increase the risk of iatrogenic infection (Oeding *et al.*, 2022). Furthermore, in resource-constrained settings, the high cost of plating equipment and the necessity for specialised operating theatre infrastructure can be prohibitive.

By reducing soft tissue damage and maintaining the fracture hematoma, closed reduction and percutaneous fixation procedures provide an efficient surgical substitute that encourages biological osteosynthesis (Field & Törnkvist, 2001). One well-established method for stabilizing distal femoral and humeral fractures is the crossed-pin technique, which involves percutaneously inserting positive-profile pins transversely through the proximal and distal fracture segments. This technique has also been described for tibial fractures (Corr, 2005; Karantana *et al.*, 2005).

This case report details how a modified crossing pin-in-fiberglass cast approach was used to successfully treat a closed, complete, oblique fracture in the distal one-third of the tibia in a Nigerian indigenous bitch. It describes the surgical process, the postoperative care, and the clinical result, emphasizing the value of this economical and minimally invasive method as a workable surgical substitute in an environment with limited resources.

CASE PRESENTATION AND PATIENT EVALUATION

A 6-month-old Nigerian indigenous bitch was brought to the Veterinary Teaching Hospital's small animal department at Ahmadu Bello University in Zaria in August 2019.

After being struck by a bystander, the patient's right hind limb was non-weight-bearing and showed signs of lameness and oedema. Upon physical examination, the affected limb showed signs of discomfort, oedema, crepitus, and non-weight-bearing posture. A closed, full, oblique fracture of the distal portion of the tibia was verified by a lateral radiography image (Figure IA).

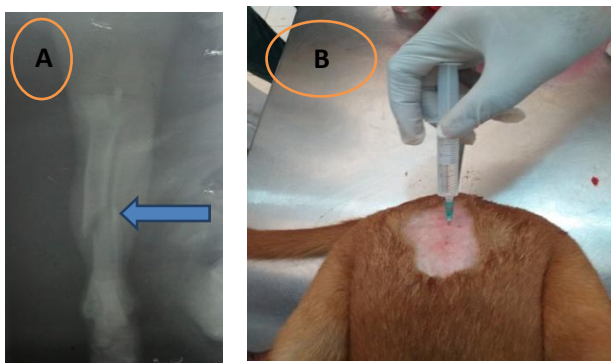


Figure I
A: Cranio-caudal view radiograph pre-operation showing visible fracture line (arrow)

B: Epidural anaesthesia with 2% lidocaine hydrochloride using the lumbosacral region

SURGICAL MANAGEMENT

Immediately after the dog was anaesthetized, it was moved to the surgical table and was properly restrained on dorsal recumbency with the affected limb suspended on a drip stand to achieve traction and reduction (Figure IIA). The surgical site was then swabbed with 0.05% chlorhexidine gluconate before draping. The foot and foot pads were covered with sterile gauze to reduce contamination of the surgical field.

The transfixation was carried out as described by Permattei *et al.* (2006). The fractured site was noted to avoid placement of transfixative pins into the fracture line. Four stab incisions were made (2 at the distal segment and 2 at the proximal segment of the fractured bone) through the skin for insertion of 2.5 mm non threaded Steinman pins, using an electrical bone drilling machine. The pins were drilled at a low speed (less than 150 rotations/minute). The first pin was drilled into the most distal stab incision on the proximal fracture segment of the tibia in a cranio-caudal direction until the pin passed through the cortices of the tibia. Once the pin was about to exit the skin on the opposite side a stab incision was then made to allow the pin to penetrate the skin and exit to the opposite side of the bone (Figure IIB). The fourth pin was drilled into the most proximal stab incision on the distal fracture segment latero-medially, then the second middle pins were drilled into the second incision on the distal fracture segment medio-laterally and the third pin drilled into the proximal fracture segment in a cranio-caudal direction which penetrated the skin and came out of the opposite side (Figure IIIA). After insertion of all the four pins the projecting pins were cut into equal length with a pin cutter A gauze bandage was wrapped around the limb fenestrating the pins, then povidone iodine was applied around each pin site using a syringe (Figure IIIB).

While the limb was still suspended, supportive foam pads were applied between the pins and secured with gauze to prevent the limb from sagging (Figure IVA). A transparent polythene bag was then placed over the foam to prevent the fiberglass cast from adhering to it (Figure IVB). The fiberglass cast material (Pure Cast®) (Jiangsu Senolo medical Technology Co., Ltd, FDA) was immersed in room-temperature water for three seconds to activate it and was then applied to the limb. The cast extended from the most proximal pin to the most distal pin and was fenestrated at the points where the pins protruded (Figure VA). The cast was allowed to set for 10–15 minutes. Afterwards, the supportive foam and polythene bag were removed, leaving a space between the fiber glass cast and the skin; the cast itself did not make contact with the limb (Figure VB). This cast material served as an external frame to maintain pin position and fracture reduction. Next, two rectangular shapes were drawn on the medial and lateral aspects of the cast to create windows for easy skin-pin site care (Figure VC). These shapes were then cut out using a cast cutter (Figure VD). Immediately after surgery, a compression bandage was applied to the operated limb to minimize postoperative swelling.



Figure II
A: Hanging limb traction technique.
B: First Steinman pin drilled cranio-caudally into the proximal stab incision in the distal fracture segment (Arrow)

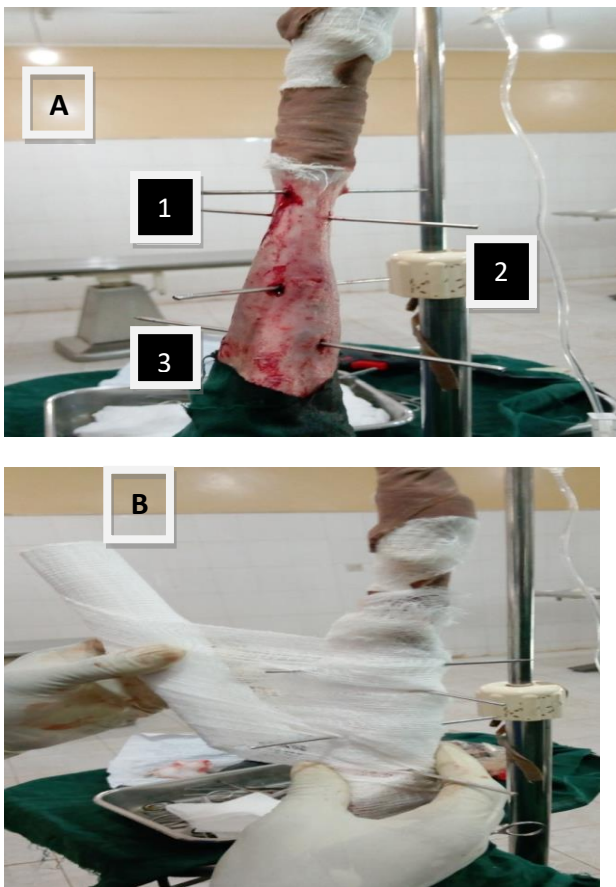


Figure III:
A: The four Steinman transfixative pins drilled into the fractured tibia segments (second pin drilled latero-medially, third cranio-caudally and the fourth latero-medially).
B: Bandage was applied to the limb which fenestrated all the pins and overlaying the skin.
C: Povidone iodine was applied to the entire pin-skin interface (Arrow).



Figure IV:
A: Supportive foam was applied
B: Secured with polythene bag before the application of fiberglass cast (Arrows)

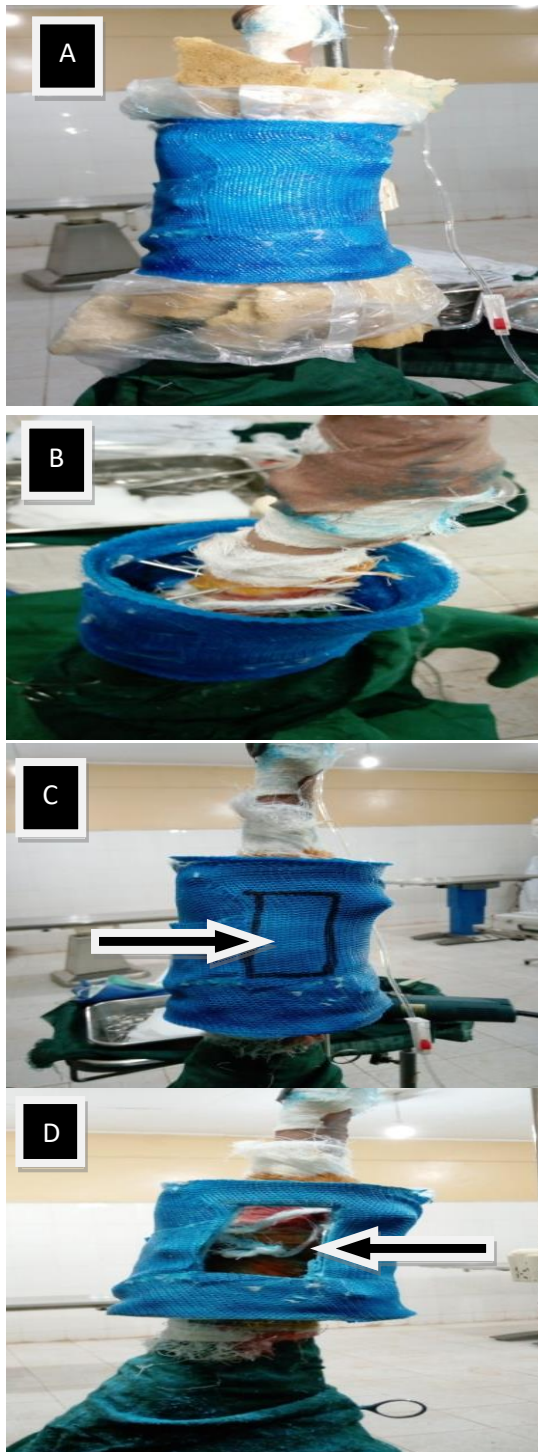


Figure V: (A) Fiberglass cast was applied around the limb extending from the knee to the tarsus. The cast fenestrated the pins all through. (B) Fiber cast was allowed to set and the supporting forms and the polythene bags were removed (C) a marker was used to draw 2 rectangular shapes at the cranial and caudal surface of the cast (D) a cast cutter was used to cut out the shapes creating windows at the cranial and caudal surface of the cast (Arrows).

RADIOGRAPHIC EXAMINATION

Radiographic assessment demonstrated the sequential stages of fracture healing. At week two, the fracture site showed no appreciable changes (Figure VI). There was very little periosteal reaction by week four. At the six-week evaluation, a reduced fracture line and increased callus formation were noted (Figure VII A and B). By week eight, radiographs showed an incomplete disappearance of the fracture line with a decrease in callus size (Figure VIII A and B). The apparatus was removed at this time. Final radiographs taken at week ten confirmed that healing had occurred, with bone remodelling ongoing (IX A and B).

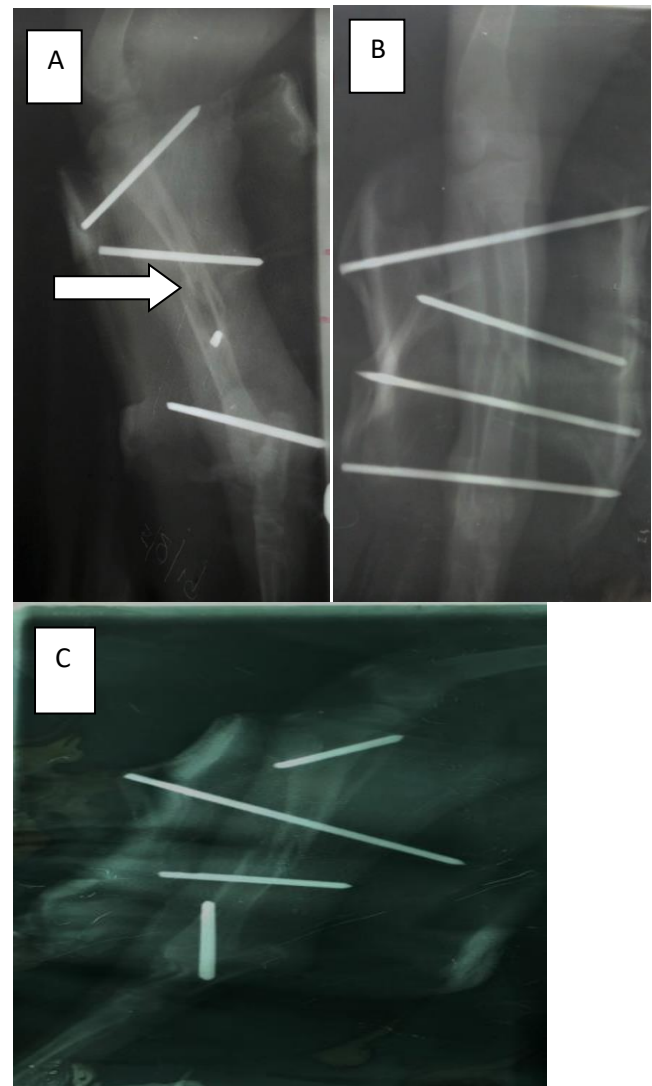


Figure VI: A medio-lateral view radiograph at 2 weeks post-operation with minimal soft tissue swelling and no observable bone reaction. B: Cranio-caudal (B) and (C) medio-lateral view radiographs A at week 4 with minimal periosteal tissue reaction

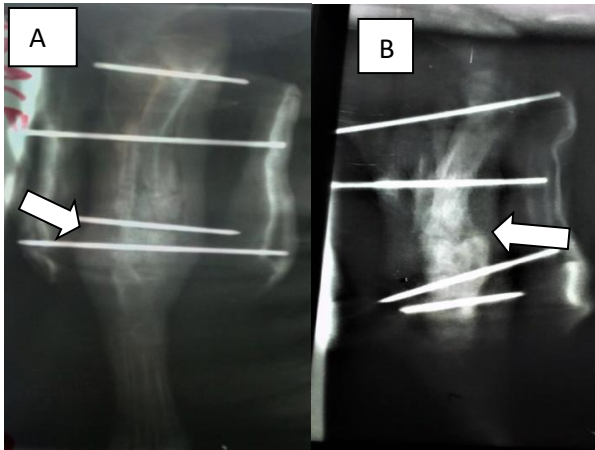


Figure VII: (A) Cranio-caudal and (B) medio-lateral view radiographs at week 6 showing diminishing fracture line with increased callus size

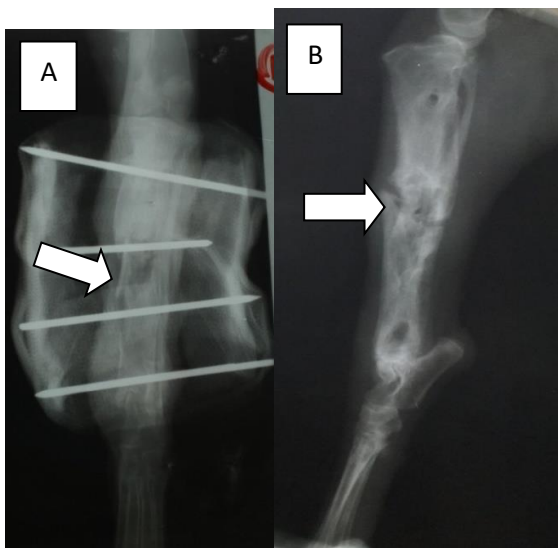


Figure VIII: (A) Cranio-caudal and (B) medio-lateral view radiographs at week 8 showing incomplete disappearance of fracture line with restoration of bone continuity

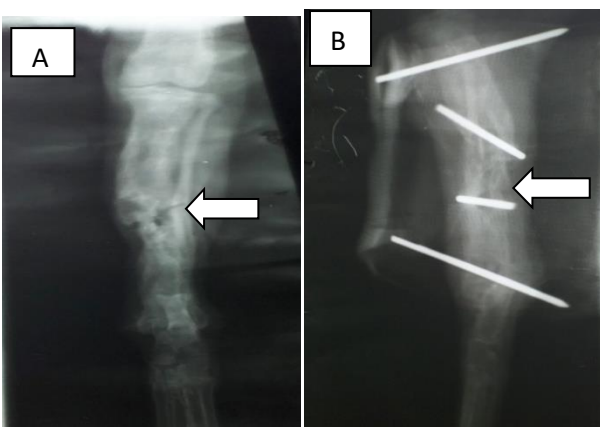


Figure IX: (A) Medio-lateral and (B) cranio-caudal view radiographs at week 10 after removal of cast and pin, showing good fracture healing and remodelling

POST-OPERATIVE AND PAIN MANAGEMENT

The bitch was placed on ceftriaxone 20 mg/kg x 2/52 (intramuscular), Diclofenac 2 mg/kg x 5/7 (intramuscular). Wound dressing and bandaging was done daily for the first one week and 48 hours interval in the second week using 10% povidone iodine and gauze bandage. Meanwhile, an Elizabethan collar was fixed on the neck to prevent the bitch from tampering with the bandaging. The bitch was kept in a cage to restrict movement and a short leash was used to allow for toileting at the third and fourth week. Gradual return to activity was noticed thereafter. Fracture healing was monitored both clinically and radiographically. Clinical assessment revealed ambulation at the third week, while radiographic image showed bridging of fracture gap at the 4th week (Radiographic monitoring was done at two-two weeks intervals). Physiotherapy was done from two weeks post-operation by a leash walk and low range of motion of the joints (this was to avoid muscle atrophy and stiffness from disuse). The bitch was maintained on owner's diet ad libitum.

DISCUSSION

A pin-in-fiberglass cast technique for closed complete oblique distal one-third tibia fractures usually offers a better outcome between non-operative casting and more invasive internal or external fixation. It can also enhance fracture stability, reduce displacement, provide good healing and return to function (Kaneps *et al.*, 1989). In this case, there were very slight variations between the pre-operative baselines and the post-operative mean values of vital markers. Two days following surgery, there were variations in the mean pulse and respiration rates as well as a brief increase in the mean rectal temperature to 39.3°C. According to Slatter's (1985) research, these abnormalities are regarded as a typical physiological finding after surgical trauma and are probably caused by the anticipated inflammatory processes. The dog was unable to bear weight on the operated limb for the first 24 hours after the procedure; this incapacity lasted for seven days after the procedure. According to Bada *et al.* (2016) and Keri, *et al.* (2018), the transfixation pin and cast system's superior load-sharing capability and ideal stability are responsible for the eventual attainment of weight-bearing, albeit with a minor lameness, after this time. In the first two weeks following surgery, there were no early problems, such as severe edema, which indicates that the device was applied appropriately. The initial swelling might have been avoided in part by applying a Robert Jones bandage. However, three weeks after surgery, cast sores and pin loosening—complications common to external coaptation, were noted. This discovery coincides with the results of Bada *et al.* (2016) and also Wilson and Vanderby Jr (1995) in their study on the pin-in-

fiberglass cast application process. The modified crossed pin-in-fiberglass cast technique used here proved its practical applicability, lower cost implication and demonstrated biological fixation with early weight bearing in a clinical case. The technique is therefore, recommended in small animal clinical practice.

CONCLUSION

All of the vital markers, clinical and radiological results pointed to a straightforward and successful fracture healing procedure. The documented criteria, such as the duration of weight-bearing, the radiographic progression of callus formation, and temporary alterations in vital signs, are in line with the anticipated postoperative results and findings documented in the literature for this kind of orthopedic stabilization. The use of modified pin-in-fiberglass cast technique proved to be effective, economical and practicable in dogs. The technique provided sufficient fracture stability to allow early weight-bearing and satisfactory functional limb recovery without major complications. Radiographic evaluation confirmed progressive callus formation and complete union within acceptable healing period. This technique offers an excellent alternative to conventional internal fixation, especially in cases where surgical cost, equipment availability or soft tissue considerations limit the use of plates or full external skeletal fixators.

REFERENCES

- Bada, A.A., Hassan, A.Z., Awasum, C.A., Emmanuel, E.G., Bappah, M.N., Lawal, M. & Ochube, G.E. (2016). Comparative evaluation of pin-in-fiberglass cast and Kirschner-Ehmer external fixative in the management of radius-ulna fractures in dogs. *Sokoto Journal of Veterinary Science*, 15(4), 36-45.
- Bourne, M., Sinkler, M.A. & Murphy, P.B. (2023). Anatomy, bony pelvis and lower limb: Tibia. StatPearls Publishing. Retrieved February 27, 2025, from <https://www.ncbi.nlm.nih.gov/books/NBK526053/>
- Candela Andrade, M., Petereit, F., Slunsky, P., de Rus Aznar, I. & Brunnberg, L. (2025). Healing of comminuted fractures of long bones in dogs. *Animals*, 15(3), 413.
- Corr, S. (2012). Complex and open fractures: a straightforward approach to management in the cat. *Journal of Feline Medicine and Surgery*, 14(1), 55–64.
- Corr, S.A. (2005). Practical guide to linear external skeletal fixation in small animals. *In Practice*, 27(2), 76–85.
- Field, J. & Törnkvist, H. (2001). Biological fracture fixation: A perspective. *Veterinary and Comparative Orthopaedics and Traumatology*, 14(4), 169–178.
- Joveniaux, P., Ohl, X., Harisboure, A., Berrichi, A., Labatut, L., Simon, P., Mainard, D., Vix, N. & Dehoux, E. (2010). Distal tibia fractures: management and complications of 101 cases. *International Orthopaedics*, 34(4), 583–588.
- Kaneps, A. J., Schmotzer, W. B., Huber, M. J., Riebold, T. W., Watrous, B. J., & Arnold, J. S. (1989). Fracture repair with transfixation pins and fiberglass cast in llamas and small ruminants. *Journal of the American Veterinary Medical Association*, 195(9), 1257-1261.
- Karantana, A., Handoll, H.H. & Sabouni, A. (2020). Percutaneous pinning for treating distal radial fractures in adults. The Cochrane Database of Systematic Reviews, 2(2).
- Keri, L.T., James, L.C., Waden, D.B., Hanieh A. & James, D.J (2018). In vitro mechanical evaluation of three transfixation pin–cast constructs applied to equine forelimbs. *American Journal of Veterinary Research*. 1287(1), 1-11.
- Kumar, P.R., Prasad, V.D., Sreenu, M., Naidu, G.V. & Raju, N.K.B. (2022). Incidence, occurrence and classification of long bone fractures in dogs: A retrospective study. *Indian Journal of Animal Research*. Advance online publication.
- Mana, H.P., Hermon, W. & Mutah, A.A. (2023). Effect of prolonged administration of caffeine during fracture repair progression in rats. *International Journal of Veterinary Sciences and Animal Husbandry*, 8(1), 44–48.
- Oeding, J.F., Bockman, S., Chiu, H., Hua, C., Connor, J. & Slocum, A. (2022). A novel approach to open reduction and internal fixation of distal radius fractures utilizing a multi-degree-of-freedom traction and stabilization device. *Journal of Medical Devices*, 16(2).
- Piermattei, D.L., Flo, G.L. & DeCamp, C.E. (2006). *Small Animal Orthopedics and Fracture Repair* (4th edition). St Louis, Missouri: Saunders Elsevier.
- Sherman, A.H., Kraus, K.H., Watt, D., Yuan, L. & Mochel, J.P. (2023). Linear external skeletal fixation applied in minimally invasive fashion for stabilization of non-articular tibial fractures in dogs and cats. *Veterinary Surgery*, 52(2), 249–256.
- Slatter, D.H. (1985). External skeletal fixation. In: Slatter, D.H. (ed.) *Textbook of small animal surgery* (Vol. 2, pp. 1972-1988). Philadelphia: W.B. Saunders Company.

- Smith, G.K., Newton, C.D. & Nunamaker, D.M. (1985). Biomechanics pertinent to fracture etiology, reduction, and fixation. In: Newton, C.D. & Nunamaker, D.M. (eds.) Textbook of small animal orthopedics. Philadelphia: J.B. Lippincott, pp. 195-230.
- Wilson D.G. & Vanderby Jr R. (1995). An Evaluation of fiberglass cast application Techniques. *Veterinary Surgery PubMed*, 24 (2): 118-121.