Int.J.Curr.Microbiol.App.Sci (2022) *11*(07): 99-107

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 11 Number 07 (2022)**
Journal homepage: http://www.ijcmas.com

Case Study https://doi.org/10.20546/ijcmas.2022.1107.011

Repair of Unilateral Femur and Tibia Fracture in a Dog Using Locking SOP Plate

Kartik Bidari*, Doddamani Jahangirbasha, B. Bhagavantappa and D. Dilipkumar

Department of Veterinary Surgery and Radiology, Veterinary College, Bidar, Karnataka, India

**Corresponding author*

Keywords

String of pearls plate, Femur fracture

Article Info

Received:
02 June 2022
Accepted:
29 June 2022
Available Online:
10 July 2022

A B S T R A C T

A 2 year old non-descript male dog presented with unilateral short oblique diaphyseal right femur and tibial fracture was stabilised with 3.5mm SOP plate. The plate acted as butrress system and minimal callus was noticed. The radiographic union was achieved by post-operative day 60 and complete remodelling was observed by the end of one year. Weight bearing was noticed by post-operative day 15. Implant related complications were not observed.

Introduction

Fracture of long bones is a common orthopaedic condition encountered in dogs. Open reduction internal fixation using bone plates give a perfect reduction, neutralizing the axial loading, bending and torsional forces acting on the fractured bones and allows anatomical reconstruction of the bone, thereby bringing early mobilization as opined by Johnson, (2013). SOP plate is a newer generation bone plate designed for veterinary orthopedic. The SOP plate consists of a series of cylindrical sections (internodes) and spherical components (pearls). In the locking plate systems locking of screws in to the plate forms a single beam construct thereby providing axial and angular stability to the construct. The principle of biological osteosynthesis together with rigid stability provided by the plate results in good to excellent functional outcome. The present paper reports a case of successful repair of unilateral femur and tibial fracture in a mongrel dog using locking type string of pearls plate.

Case presentation and surgical procedure

A 2 year old non-descript male dog was presented with history of hit injury and non weight bearing lameness, dangling of limbs, abnormal angulation of the limb, swelling, pain and crepitation on palpation at the fracture site (Figure1). Radiographic evaluation of femur revealed short oblique overriding diaphyseal fracture (figure 2A) and evaluation of tibia revealed short oblique diaphyseal fracture (figure 2B). Pre-operatively inj. amoxicillin-cloxacillin[1] @ 10 mg/kg i/v was administered. The right hindlimb was prepared and scrubed as per the standard surgical procedure. Balanced anaesthesia was achieved using inj. atropine sulphate[2] (@0.04mg/kg bwt, i/m), butorphanol[3] (@0.2mg/kg bwt, i/v), xylazine HCl[4](@1mg/kg bwt, i/v), thiopental sodium[5] (@12.5mg/kg bwt, i/v) and maintained using isoflurane[6] (@1-2%).

The dog was restrained in lateral recumbancy. An incision was made on cranio-lateral aspect of the thigh extending from greater trochanter to the stifle joint. Skin and fascia were incised to expose the bellies of vastus lateralis, biceps femoris, and semi-membranous muscles to expose the fractured bone fragments (Figure 3A). Soft tissues were separated from the fractured fragments and these fragments were brought into opposition to align the fragments (Piermattei and Johnson, 2004). Fractured fragments were exposed and reduced manually. Plate was fixed using 3.5mm sop locking plate with 3.5mm self tapping locking cortical screws. The plate was placed on the lateral surface of the femur.

All the screw holes were purchased alternatively using screws of length 24mm-30mm (figure 3C). One screw hole at the fractured line was left unpurchased. The muscles were sutured with poliglecaprone-25 size 0 in lockstitch pattern (Figure 3D) and skin was sutured with polypropylene size 1 in cross –mattress pattern (Figure 3E).

The tibia was approached through a cranio-medial approach. An incision was made extending from the stifle proximally close to the hock distally. The skin and fascia were separated and muscles were exposed (Figure 4A). The bellies of tibialis anterior and flexor digitorum profundus were retracted to expose the fracture fragments and reduced manually and fixed using 3.5mm SOP plate as an internal fixator. The plate was placed on the medial surface of the tibia and a similar procedure as applied for femur was followed for tibia. The screws length needed for tibia was 22mm-26mm. The hole at the fractured line was left unpurchased.

The dog was administered inj. amoxicillin-cloxacillin @ 10 mg/kg i/v up to the 10th post-operative day and inj. butorphanol @ 0.2 mg/kg body weight up to post-operative day 5. Antiseptic dressing was done daily until healing of the wound. Robert Jones bandage was applied up to two weeks following implant fixation. Skin sutures were removed on 15th post-operative day.

Results and Discussion

In the present study, the use of 3.5 mm locking SOP plate system provided good fracture stability and the plates were found to be useful for stabilization of unilateral fracture of femur and tibia. The foot-print of plate was flat, round and small at the pearls (nodes) and narrower at the internodes (string). Being applied as an internal fixator the plate was in contact with bone surface only at the nodes thus providing a minimal bone to plate contact. The flat under-cut surface of the plate provided easy handling and application of the plate as it did not move or slip during the SOP plate application procedure. The shape of SOP plate provided easy visualization, alignment, assessment of the fracture fragments, with regard to the position of the plate, placement of the screws and in deciding as to which holes near the fractured site should be left un-purchased intra-operatively. Maritato (2018) opined that clinically, a decrease in plate footprint and better preservation of bone vascularity should be associated with better healing and a smaller risk of refracture following removal.

The SOP plate was found to be thicker in profile. Contouring of the plate was not necessary as the plate applied as internal fixator using principle of biological osteosynthesis in order to preserve the periosteal blood supply and prevent cortical osteoporosis. These findings were similar with Mills (2009); Ness (2009); Scrimgeour and Worth (2011); Kraus and Ness (2014); Malenfant and Sod (2014); Benamou *et al.,* (2015) and Grand (2016).

Post-operative edema, inflammatory soft tissue swelling and warmth at the surgical site were noticed immediately after surgery. However, the dog beared weight while standing and able to get up with caution. The joint mobility and function was normal. On day 15 dog was relatively more comfortable while sitting and getting up. However, manipulation of the joints revealed slight discomfort and pain.

By day 30 normal weight bearing was noticed, got up with ease and pain free movements of the joints and limbs were noticed. On day 60 full functional weight bearing was observed while standing, walking and running. Pain free movements were observed while sitting and getting up or during manipulation of the joints.

Fracture healing was a process of bone regeneration and divided into well documented stages: inflammatory, connective tissue and fibro-cartilage formation (Aron, 1995). Radiographic evaluation was carried out on day before operation and post-operative day 0, 15, 30 and 60 to assess the status of fracture healing. A thorough assessment of the radiographs was aided by considering the 'four As' - apposition, alignment, angulation and apparatus as recommended by Langley-Hobbs, (2003).

Immediate post-operative radiographic evaluation confirmed proper placement of the plate and screws, good apposition and alignment of the fracture fragments. The plate length, size and position were appropriate. Screw length, size and position were considered appropriate in both the bones.

On post-operative day 15, initiation of periosteal callus and presence of traces of callus at the fracture site were noticed. The fracture line was distinct in both femur and tibia. Mild to exuberant periosteal callus was observed all along the length of the bone at trans-cortex especially at the points where the screws were fixed. Singh *et al.,* (2006) reported that first evidence for increased rate of osteoblastic proliferation was detected about eight hours after occurrence of fracture and reached a peak by 24 hours. Initially the increased periosteal activity had generalized nature extending to the whole bone and later it got localized to the fracture site.

By post-operative day 30 the fracture line was less visible, was becoming hazy and was fading. Apparent bridging of the fracture line could be observed. The amount of periosteal callus appeared to be more extensive, dense and homogenous. Traces of callus infiltration on the bone plate were observed. These craniocaudal findings correlate with report of Umarani and Ganesh (2002) and Singh *et al.,* (2008), who reported complete union of the fracture site with obliteration of fracture line, ossification and bridging of cortex from 4^{th} - 8^{th} week, post casting. Reems *et al.,* (2003) reported that the bridging callus was expected in 3 to 5 weeks in immature patients and 4 to 6 weeks in mature patients.

By post-operative day 60 the fracture line was completely obliterated with massive radio-dense callus completely filling the fracture site. The fracture line was not visible indicating achievement of radiographic union. However, callus was more in tibia as compared to femur. Morgan (1972) opined that the callus formation was proportional to the rigidity of fracture fixation. The callus was more in tibia indicating that plate on tibia was more rigid. The callus was smoothening and becoming uniform in density. Early cortico-medullary remodelling was evident indicating early clinical union. Anderson *et al.,* (1995) stated that the earliest follow-up in which fracture gap was filled primarily with uniting endosteal callus was indication of radiographic union. Denny and Butterworth (2000) reported that callus formation started within two weeks and in ideal condition it was completed within six weeks with the establishment of clinical healing.

At post-operative day 360 the complete remodeling was occurred, newly formed soft bone was replaced by laminar bone, thus restoring the original bone structure and stability (). The biochemical parameters *viz.* serum calcium, serum phosphorous and serum alkaline phosphaatase showed a significant rise up to post-operative day 30 followed by a gradual decrease by 60 post-operatively. However, the values fluctuated within normal physiological range.

Fig.1 Non-weight bearing of the fractured limb

Fig.2A: short oblique overriding fracture of femur
B: short oblique overriding fracture of tibia

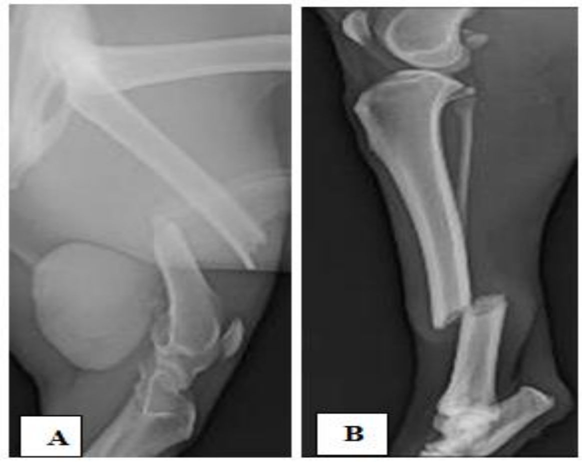


Fig.3A. Bone fragments were exposed through cranio-lateral approach.**B**. Drilling of hole through locking drill sleeve with 3.0mm drill bit using bateray operated power drill. **C**. Application of locking head screws using hexagonal screw driver. **D**. Bone after plate application. **E**. muscle suture **F.** skin suture

Fig.4A. Medial aproach for tibia and bone fragments were exposed.**B**.Drilling of hole using locking drill sleeve and 3.00mm drill bit with bateray operated power drill. **C**. Application of locking head screws using hexagonal screw driver. **D**. Bone after plate application. **E**. muscle suture **F.** skin suture

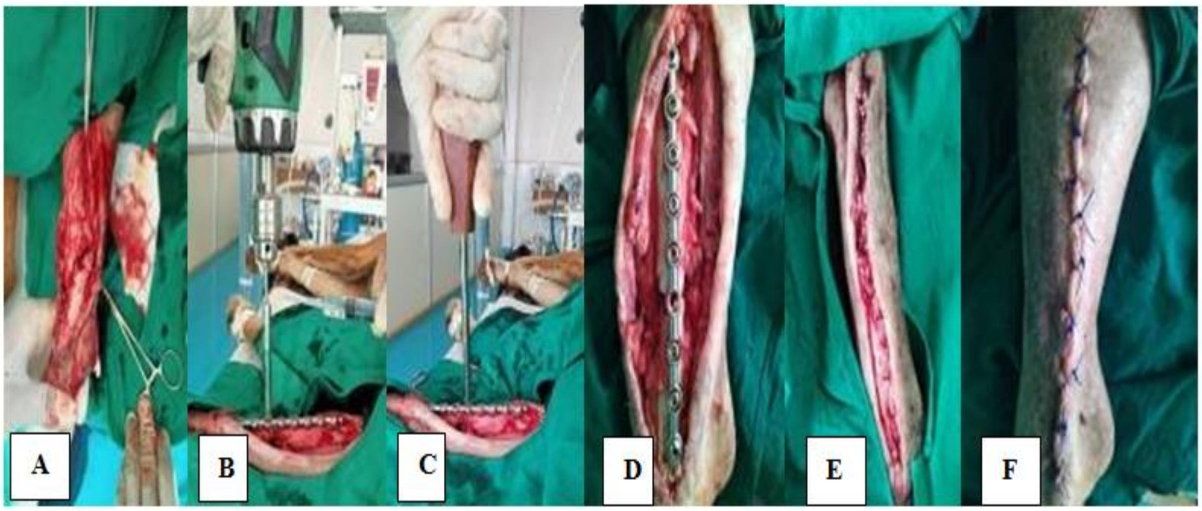
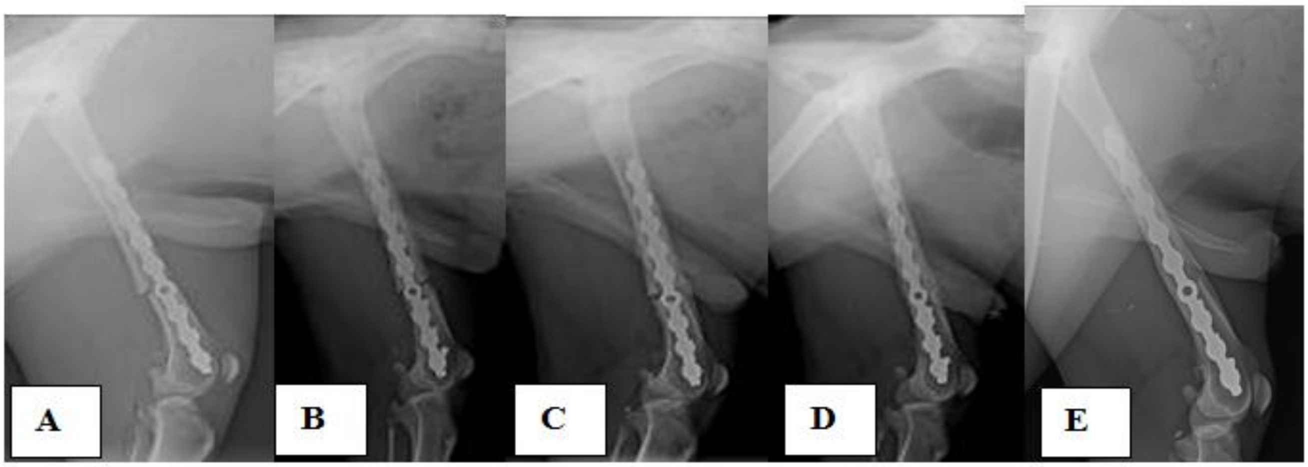


Fig.5A. Day 15 dog stands normally with obvious lameness while walking. **B**. Day 30 dog stands normally and slight lameness while walking. **C**. Day 60 dog stands and walks normally

Fig.6A. Day 0 distinct fracture line. **B.** Day 15 proper position and good alignment of the fracture fragments and good callus formation, bridging the fracture site. **C**. Day 30 formation of bridging callus. **D**. Day 60 obliteration of the bridging callus at the fracture area. **E**. Radiograph after 1 year complete bone union.

Radiographic healing pattern of femur

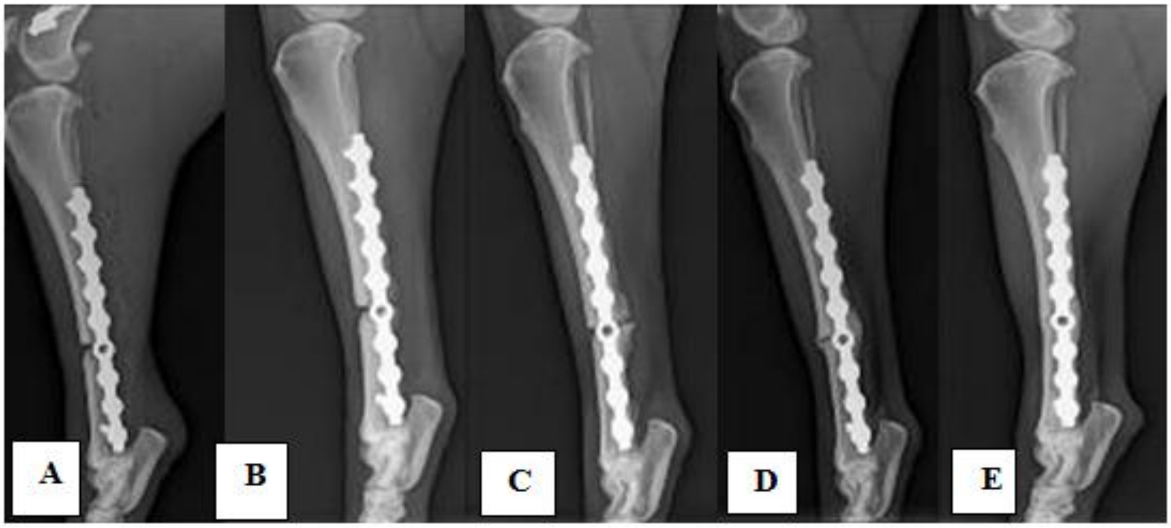


Medio-lateral view

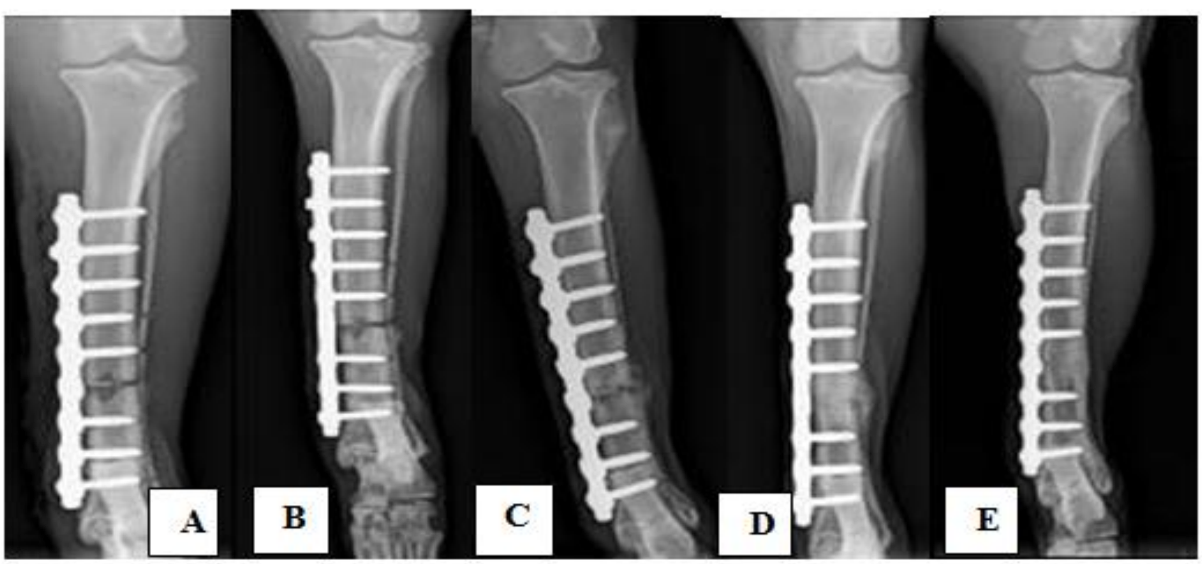
Cranio-caudal view

Fig.7A. Day 0 distinct fracture line. **B.** Day 15 proper position and good alignment of the fracture fragments and good callus formation, bridging the fracture site. **C**. Day 30 formation of bridging callus. **D**. Day 60 obliteration of the bridging callus at the fracture area. **E**. Radiograph after 1 year complete bone union.

Radiographic healing pattern of tibia



Medio-lateral view



Cranio-caudal view

Surgical procedure

Complications

No intra-operative complications were observed. The plates and screws were in position and no plate bending, plate breakage, screw loosening, screw breakage or screw jamming was noticed noticed in both the bones during the period of study. Complications related SOP plate as plate breakage (Kumar *et al.*, 2018; Reddy *et al.*, 2020; Fitzpatrick *et al.*, 2012). Kim and Lewis (2014) reported that, the main disadvantage of using string of pearls bone plate was that the prominent profile of implants created soft tissue irritation.

Locking string of pearls plate offered rigid fixation in multiple bone fracture (femur and tibia) on the same limb and appeared to be a strong plate to resist fracture forces of different bones in the same limb. The SOP plate when applied as internal fixator acted as buttress plate. Minimal callus formation was noticed in both the bones under study. However, the SOP plate (locking) should be used for further studies and evaluation in multiple fracture cases.

Acknowledgments

The author is thankful to the Department of Veterinary Surgery and Radiology, Veterinary College, Nandinagar, Bidar, KVAFSU Bidar, Karnataka, India.

References

Anderson, D. E., Jean, G., Vestweber, J. G. and Desrocher, A. 1995. Use of Thomas splint cast combination for stabilization of tibial fractures in cattle: 21cases (1973-1993). Agri. Pract. 15(8): 16- 23.

Aron, D. N. 1995. Stages of bone healing and practical techniques for fractures. In current techniques in small animal surgery. 4th ed. Teton New Media., pp. 872-873.

Benamou, J., Demianuik, R. M., Rutherford, S., Beckett, C., Ness, M. G., Haut, R. C. and Dejardin, L. M. 2015. Effect of bending direction on the mechanical behaviour of 3.5 mm String of Pearls (SOP) and Limited Contact Dynamic Compression Plate (LC-DCP) constructs. Vet. Comp. Orthop. Traumatol. 28(6):433-440.

Denny, H. R. and Butterworth, S. J. 2000. Guide to Canine and Feline Orthopaedic Surgery. 4th ed. Blackwell Science Ltd, Oxford, U K., pp. 512-533.

Fitzpatrick, N., Nikolaou, C., Yeadon, R. and Hamilton, M. 2012. String-of-pearls locking plate and cerclage wire stabilization of periprosthetic femoral fractures after total hip replacement in six dogs. Vet. Surg. 41(1):180-188.

Grand, J. G. 2016. Use of string-of-pearls locking implants for the stabilisation of acetabular and supra-acatebular fractures in three dogs. Rev. Vet. Clin. 51(1): 35-41.

Johnson, A. L. 2013. Management of specific fractures. In Textbook of *Small Animal Surgery*, 4th ed. Elsevier Health Sciences, Missouri., pp. 1142-1189.

Kim, S. E. and Lewis, D. D. 2014. Corrective osteotomy for procurvatum deformity caused by distal femoral physeal fracture malunion stabilised with S tring-of-P earls locking plates: results in two dogs and a review of the literature. Australian. Vet. J. 92(3):75-80.

Kraus, K. H., and Ness, M. G., 2014. The SOP Locking Plate System. *In Current Techniques in Small Animal Surgery*, Bojrab M J, V Ed., Williams and Wilkins, Baltimore. *pp* 792-796.

Kumar, K. M., Prasad, V. D., Lakshmi, N. D. and Raju, N. K. B. 2018. Management of distal femoral diaphyseal fractures with string of pearls locking plate in dogs. Indian. J. Anim. Res. 52(12):1757-1761.

Langley-Hobbs, S. 2003. Biology and radiological assessment of fracture healing. In. Pract. 25(1):26-35.

Malenfant, R. C. and Sod, G. A. 2014. In vitro biomechanical comparison of 3.5 string of pearl plate fixation to 3.5 locking compression plate fixation in a canine fracture gap model. Vet. Surg. 43(4):465-470.

Maritato, K. C. 2018. A brief history of veterinary locking plates applications. Locking plates in veterinary orthopedics. 1-5.

Mills, J. 2009. Transilial interlocking plate stabilisation of a sacral fracture and an ilial fracture in a dog. Vet. Comp. Orthop. Traumatol. 22(01):70-73.

Morgan, J. I., 1972. Radiology in Veterinary orthopaedics. Lea and Febiger, Philadelphia, pp. 44.

Ness, M. G. 2009. The effect of bending and twisting on the stiffness and strength of the 3.5 SOP implant. Vet. Comp. Orthop. Traumatol. 22(02):132-136.

Rani, R. U. and Ganesh, T. N. 2002. Kuntscher nails for immobilisation of Femur fractures in goats-Clinical and Radiological study. Indian. Vet. J. 79(10):1089-1091.

Reddy, G., Kumar, V., Raghavendera, K. and Pramod, D. 2020. Use of String of Pearls Locking Plate System for Stabilization of Femoral Fractures in Canines. Int. J. Livest. Res. 10(10):92-98.

Reems, M. R., Beale, B. S. and Hulse, D. A. 2003. Use of a plate-rod construct and principles of biological osteosynthesis for repair of diaphyseal fractures in dogs and cats: 47 cases (1994–2001). J. Am. Vet. Med. Assoc. 223(3): 330-335.

Scrimgeour, A. B. and Worth, A. J. 2011. The Use of the String of Pearls Locking Plate System in the Stabilisation of a Comminuted Calcaneal Fracture in a Giant Breed Dog. Case Reports in Veterinary Medicine.1-4.

Singh, A. P., Singh, G. and Singh, P. 2006. Fractures. In: Tyagi, R. P. S. and Singh, J. (ed.), Ruminant Surgery. 1st Edn. CBS Publishers and Distributers, New Delhi., pp. 344-345.

Singh, H., Sahay, P. N. and Dass, L. L. 2008. Gross and functional alterations following transfixation osteosynthesis in goats. J. Res. Birsa. Agri. Univ. 20(1):135-138.

How to cite this article:

Kartik Bidari, Doddamani Jahangirbasha, B. Bhagavantappa and Dilipkumar, D. 2022. Repair of Unilateral Femur and Tibia Fracture in a Dog Using Locking SOP Plate. *Int.J.Curr.Microbiol.App.Sci.* 11(07): 99-107. doi: https://doi.org/10.20546/ijcmas.2022.1107.011