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Management of radius-ulna and tibial diaphyseal fractures with type IIa external skeletal fixation in dogs

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Abstract
In this study Type IIa external skeletal fixation was applied to stabilize 5 radius-ulna fractures and 1 tibial fracture in dogs. Immediate postoperative radiographs revealed good alignment and apposition of the fracture fragments in all the dogs. The mean time of sufficient callus formation was 54.33 ± 6.60 days. Postoperative radiographs showed restitution of cortico-medullary continuity by 40^{th} to 55^{th} postoperative day in all the dogs. The complete weight bearing was ranging from 32^{nd} - 90^{th} postoperative day. The fixator was found rigid and stable till the completion of bone healing in all the dogs. The mean time of the fixator removal was 54.33 ± 6.60 days. Minor pin tract infection was noticed in one dog which was managed by treatment. Type IIa external skeletal fixation was well suited for the repair of radius-ulna and tibial diaphyseal fractures in dogs with a few negligible minor complications.

Keywords: type IIa external skeletal fixation, radius-ulna and tibial fractures, dogs.

Introduction
Radius-ulna and tibial fractures constitute 19% and 21.5% respectively of total long bone fractures that occur in dogs [8]. Fractures radius-ulna and tibia cannot be stabilized by internal fixation like IM pinning, as this technique may damage the joints associated with them [32, 33].There are difficulties in the management of fractures of radius-ulna and tibia with bone plating as this technique requires lot of instrumentation, time consuming and are costly procedures. That is why external skeletal fixation (ESF) is gaining importance in the treatment of long bone fractures in dogs as it is easy to apply, cause minimal damage to the structures associated with the fractured bone fragments, requires minimal equipment and leads to less complications. External skeletal fixators further provide versatile rigid fixation, avoids metal implants at the fracture site, allow easy access to the injured area for wound management and is easily removed after healing is complete. ESF can be applied to stabilize closed, compound, comminuted and infected fractures [4, 17] with minimal tissue disruption and can be used to supplement other forms of internal fixation [11, 19, 26, 35]. ESF allows anatomical reconstruction to the extent possible in severely comminuted and displaced diaphyseal fractures by preserving the vascularity of the bone and facilitates biological osteosynthesis [3, 21, 29]. Most of the components of ESF are reusable [3]. The aim of stabilization fractures is to accomplish fast healing, early weight bearing and ambulation [2, 34].

Hence ESF can be used clinically to manage diaphyseal fractures of radius-ulna and tibia. The objective of the present study was to evaluate the efficacy of Type IIa ESF in the repair of radius-ulna and tibial diaphyseal fractures of dogs.

Materials and Methods
Six dogs of different breed, age, sex and body weights were presented to the Veterinary Clinical Complex, with fractures of radius-ulna and tibia, were first examined as a clinically and if any soft tissue injuries were present also recorded. The dogs were also observed for loss of function, abnormal mobility, deformity or change in angulation of the affected limb, signs of local swelling, pain and crepitation at the fracture site. Neurological status of the dog was assessed and the dogs with neurological signs were excluded from the study.

The dogs were prepared aseptically for the surgery and general anaesthesia was induced with Ketemine and Xylazine at the rate of 10 mg/ Kg and 1.0 mg/Kg body weight, respectively, intramuscularly and the anaesthesia was maintained by giving incremental doses of Propofol at the rate of 4 mg/Kg body weight intravenously.

In the present study, out of 6 dogs, Type IIa ESF was used in 5 cases of radius-ulna and 1 case of tibial fractures. Limited open approach was used in 4 cases (radius-ulna 3 and tibia 1) and closed approach used in two cases (radius-ulna fractures).
The dogs with radial and tibial fractures were positioned in dorsal recumbency and the fractured limb was secured at the paw with bandage cloth and was suspended from an intravenous infusion stand. The limb was pulled up sufficiently tight to allow the limb to be suspended by the animal's own weight to achieve indirect reduction of fracture [12, 18]. After reduction of the fracture fragments either by limited open approach [20] or by closed approach [22], the proximal and the distal most centrally threaded (Thread length was 25 mm) positive profile full pins of 2-3 mm in diameter were drilled first through both the cortices of bone and soft tissues on both sides in craniomedial to caudolateral direction of the limb in all the dogs [18, 31]. The connecting bars with required number of clamps attached were fixed to the full pins of on either side of the limb. Then the intermediate full pins were drilled through the pre placed clamps in order to bring the pins in alignment. The clamps were then tightened to fix the full pins to the connecting bars. Clamps and connecting bars were positioned close to the skin however far enough away to allow for tissue swelling i.e., 10 mm. The subcutaneous tissue was closed in a row of continuous sub-cuticular sutures using 2-0 chromic catgut and the skin incision was closed with a row of horizontal mattress sutures of 1-0 synthetic poly amide. The excess size of pins and connecting bars was cut with pin cutter (Fig.1). The same technique applied in stabilization of a tibial fracture.
In the present study, cleaning with normal saline and dressing of the pin and skin interface with 5% povidone iodine pads was found effective in rendering the sites clean and sterile in all the groups of dogs and Inj. cefotoxime Sodium[1] was administered at the rate of 20mg/kg body weight as intramuscular injection twice daily for one week post operatively. Antibiotic therapy was prolonged for 3 to 5 more days whenever needed. Inj. meloxicam[2] was administered at the rate of 0.2 mg/ kg body weight as intramuscular injection once daily pre operatively and post operatively for four days and was prolonged for 3 to 5 more days whenever needed. Owners were advised to monitor the position of construct and to restrict the movement of the animal for 2 weeks after surgery and then to allow leash walking.
Clinical evaluation was routinely carried out at periodical intervals for the signs of swelling, exudation, weight bearing and stability of the fixator in all the dogs. Radiographs were obtained immediately after the Type IIa ESF of radius-ulna and tibial diaphyseal fractures and on 15th, 30th, 45th and 60th postoperative day and whenever possible on later dates, to evaluate bone healing. The Type IIa ESF was removed as one time removal after sufficient callus formation.

Results and Discussion

In this study Type IIa ESF was used in reduction of fracture fragments in radius-ulna and tibial diaphyseal fractures in dogs. Preoperative radiographs of the 6 dogs revealed transverse fractures of radius- ulna in two dogs, comminuted fractures of radius-ulna in three dogs and long oblique fracture of tibia in one dog. All the dogs had closed fractures. Craniomedial approach for radius-ulna and tibia, found appropriate for the easy application of Type IIa ESF. Good anatomical reduction was achieved through limited open approach and hanging limb technique in 4 dogs, by applying hanging limb alone in two dogs with comminuted fractures of radius-ulna and by applying cerclage wire in 1 dog with long oblique fracture [12]. Discharge from pins, decreased after few days postoperatively. Tolerance and stability of the fixator was good in all the dogs [9, 16, 36].
Taxim injection – Alkem laboratories Ltd. Mumbai. 2. Melonex injection - Intas Pharmaceuticals Ltd. Ahmedabad.
Evaluation of immediate postoperative radiographs revealed proper placement of the fixator, good alignment and apposition of the fracture fragments (Fig.2, 3 and 4) in all the dogs [14, 25, 31].
The dogs showed partial weight bearing from 3rd - 7th postoperative day. Moderate limb usage was observed from 7th- 15th post-operative day. Complete weight bearing was noticed from 32nd day onwards (Fig. 5). One dog with comminuted radius-ulna fracture showed only partial weight bearing till fixator removal. It showed complete limb usage 10 days after the removal of ESF. The mean time for complete limb usage was 51.0±8.71day [15]. Table 1.
Fixator stability was good in all the dogs [5, 6, 19, 28, 36]. The proximal most pin had become loose nonetheless this did not affect the fixator's rigidity.
Postoperative radiographs showed evidence of callus formation from 15th post-operative day onwards. Gradual decreasing of Fracture gap and the appearance of progressive bridging callus with adequate radio-density and the margins of fracture fragments becoming smooth were observed radiographically on 30th and 45th post-operative day respectively [3, 21, 22, 23, 25]. Fracture line disappeared and the callus became radio-dense with distinct cortical margins was evident by 60th post-operative day [1]. The fixator was removed when enough bone callus was seen with sufficient radio-density (Fig.6 and 7). The mean time of callus formation was 54.33 ± 6.60. Slight osteolysis around proximal pins was seen in one dog of group II and in one dog [7].
The fixator was removed between 37 days to 80 days with mean time of 54.33 ± 6.60 days table. 2. [13, 16, 19, 21, 24]. Ayyappan *et al.* [6], recorded the mean time for complete removal of external fixator was 72 days in radius and 68 days in tibia.
In present study, slight pin tract drainage was observed in all the dogs for 2-5 days. Minor pin tract infection was noticed in one dog which was managed by treatment [10, 16, 21, 24].

Conclusions

The Type IIa ESF was well tolerated by all the dogs and showed remarkable improvement in limb function with good fixator stability till the completion of bone healing. Use of cerclage wiring improved the stability of the fracture fragments in long oblique fracture of tibia in the study. The Type IIa ESF can be considered for fracture stabilization of radius-ulna and tibial diaphyseal fractures in dogs. This is a biomechanically versatile technique and easy to apply, well tolerated by the patient, easy to disassembly.

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Radius-ulna Tibia

Fig 1: Immediate post-operative appearance of radius-ulna and tibia

Fig 2: Pre and post-operative radiographs of transverse fracture of radius-ulna showing proper alignment

Fig 3: Pre and post-operative radiographs of transverse fracture of radius-ulna showing proper alignment

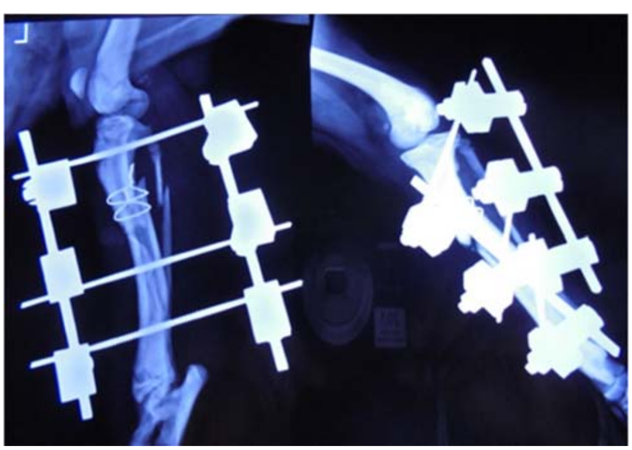
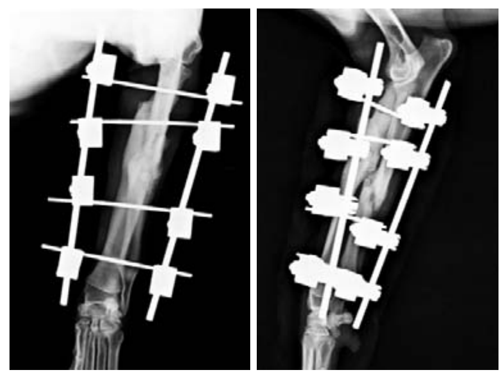


Fig.4: Post-operative radiographs of oblique tibial fracture showing proper alignment

10th postoperative day

30th postoperative day

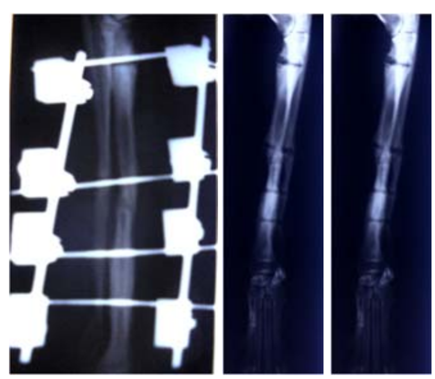
Fig 5: Postoperative weight bearing in radius-ulna and tibial fractures



30 Post-operative day in group II

Note. Fracture gap, gradually decreasing and the appearance of progressive bridging callus with adequate radio-density and the margins of fracture fragments becoming smooth.

Fig 6: Progressive Bone Healing of Comminuted Radius-ulna Fracture



Note. Fracture line disappeared and the callus became radio dense with distinct cortical margins and distinct pin insertion sites.

Fig.7: Before and after removal of fixator on 60th postoperative day in a radius-ulna fracture

Table 1: Table showing postoperative details of lameness score

Case No.	Pre-operative	Post-operative Weight Bearing at the end of				
		1 Week	2 Week	4 Week	6 Week	Full weight bearing observed
1.	1	2	2	3	4	45th day
2	1	2	2	2	2	90th day
3	1	2	2	2	4	60th day
4	1	2	3	3	4	37th day
5	1	2	3	3	4	32nd day
6	1	1	2	2	4	42nd day
Mean	1.0 ± 0.0	1.83±0.16	2.33±0.21	2.50±0.22	3.66±0.33	51.0±8.71day

1- No functional limb usage; limb carried most of the time, 2- Slight functional limb usage; limb carried during running but set down when walking, 3- Moderate functional limb usage and partial weight bearing; lameness evident, 4- Complete, normal functional limb usage.

Table 2: Table showing time of removal of fixator

Case No.	Days of ESF Removal
1	62
2	80
3	60
4	47
5	40
6	37
Mean	54.33±6.60

References

1. Allah SG, Farghalli H, Magdi A. Combined different fixation systems for reconstruction of comminuted diaphyseal fracture in dogs. Veterinary Medical Journal Giza, 2009; 57(4):525-541.
2. Aron DN. Practical techniques for fractures. In: current techniques in small animal surgery Bojrab M J. IV ed. William and Wilkins Baltimore, 1998; 872-873.
3. Aron DN. Stages of bone healing and practical techniques for fractures. In current techniques in small animal surgery Bojrab M J. IV ed. William and Wilkins Baltimore, 1995; 872-873.
4. Aron DN, Palmer RH, Johnson AL. Biologic strategies and balanced concept for repair of highly comminuted long bone fractures. Compend. Cont. Edu. Pract, 1995; 17:35-50.
5. Ayyappan S, Ganesh TN, Jayaprakash R, Shafiuzama M, Ganesh R, Ajith M, Kumar RS *et al*. C-arm guided external fixation for management of radial fracture in a dog. Indian Journal of Veterinary Surgery, 2010; 31(1):76.
6. Ayyappan S, Shafiuzama Md, Ganesh TN, Das BC, Kumar R Suresh. A Clinical Study on External Fixators for Long Bone Fracture Management in dogs. Indian Journal of Veterinary Surgery, 2009; 30(2):90-92.
7. Beck AL, Pead MJ. The Use of Ellis pins (negative profile tip-threaded pins) in External Skeletal Fixation in Dogs and Cats. Veterinary Comparative Orthopaedics and Traumatology, 2003; 16:223-31.
8. Ben Ali. Incidence, occurrence, classification andoutcome of small animal fractures: A retrospective study. World Academy of Science,Engineering and Technology, 2013-2005- 2010; 7:3-27.
9. Butterworth S. Use of External Fixators for Fracture Treatment in Small animals. In Practice, 1993; 15:183-192.
10. Corr S. Practical Guide to Linear External Skeletal Fixation in Small Animals. In Practice, 2005; 27:76-85.
11. Egger EL. External skeletal fixation. In: Current Techniques in Small Animal Surgery, Bojrab M J. IV ed. Saunders Philadelphi, 1998, 941– 950.
12. Fossum TW. Small Animal Surgery. III ed. Mosby Elsevier, Missouri USA, 2013, 1067-1078.
13. Gemmill TJ, Cave TA, Clements DN, Clarke SP, Bennett D, Carmichael S. Treatment of Canine and Feline Diaphyseal Radial and Tibial Fractures with Low-stiffness External Skeletal Fixation. Journal of Small Animal Practice, 2004; 45:85-91.
14. Gorse MJ. Using External Skeletal Fixation for Fractures of Radius and Ulna and Tibia. Veterinary Medicine, 1998; 93:463-472.
15. Harari J, Bebchuk *T*, Seguin B, Lincoln J. Closed Repair of Tibial and Radial Fractures with External Skeletal Fixation. The Compendium Small Animal Continuing Education, 1996; 18:23-29.
16. Harari J, Seguin B, Padgett SL. Principles of External Skeletal Fixation in Small Animal Surgery. Veterinary Medicine, 1998; 93:445-453.
17. Harari J. Complications of external skeletal fixation. Veterinary Clinical North America Small Animal Practice, 1992; 22:99-107.
18. Johnson AL. Tibial and fibular diaphyseal fractures. In Text book of small animal surgery Slatter D. III ed. Cheryl S Hedlund, 2007, 1126-1142.
19. Johnson AL, DeCamp CE. External skeletal fixation - Linear fixators. Veterinary Clinical North America. Small Animal Practice, 1999; 29:1135-1143.
20. Johnson AL, Dunning D. Atlas of Orthopedic Surgical Approaches of the Dog and Cat. Elsevier Saunders Missouri USA, 2005, 168.
21. Johnson AL, Kneller SK, Weigel RM. Radial and Tibial Fracture Repair with External Skeletal Fixation: Effects of Fracture Type Reduction and Complications on Healing. Veterinary Surgery, 1989; 18:367-372.
22. Johnson AL, Seitz SE, Smith CW, Johnson JM, Schaeffer DJ. Closed reduction and Type II external fixation for comminuted fractures of the radius and tibia in dogs: 23 cases. Journal of American Veterinary Medical Association, 1996-90-1994; 209:1445-1448.
23. Johnson KA, Simon C. Use of an aiming device for application of a type II (bilateral) external fixator to a fractured tibia of a dog. Journal of American Veterinary Medical Association, 1988; 192:1573-1576.
24. Kraus KH, Toombs JP, Ness MG. External Fixation in Small Animal Practice. I ed. Blackwell Science Ltd Oxford UK, 2003, 21- 26.
25. Langley-Hobbs S. Biology and Radiological Assessment of Fracture Healing. In Practice, 2003; 25:26-35.
26. Lewis DD, Cross AR, Carmichael S, Anderson MA. Recent Advances in External Skeletal Fixation. Journal of Small Animal Practice, 2001; 42:103-112.
27. McLaughlin RM, Roush JK. Principles of External Skeletal Fixation. Veterinary Medicine, 1999; 94:53-62.
28. Ozsoy S, Altunatmaz K. Treatment of Extremity

Fractures in Dogs Using External Fixators with Closed Reduction and Limited Open Approach. Veterinary Medicine – Czech, 2003; 48:133-140.
29. Palmer RH. Biological osteosynthesis. Vet. Clin. North. Am. Pract, 1999; 29:1171-1185.
30. Piermattei DL, Flo GL, Brinker Piermattei and Flo`s. Handbook of Small Animal Orthopedics and Fracture Repair. Saunders W B Company Philadelphia, 1997, 586-594.
31. Piermattei D, Flo G, De Camp C. Handbook of Small Animal Orthopedics and Fracture Repair. IV ed. Elsevier Inc Missouri USA, 2006, 49-94.
32. Pope ER. Fixation of Tibial Fractures. *In* Current Techniques in Small Animal Surgery. (Ed. Bojrab M J). IV ed. Williams and Wilkins Baltimore USA, 1998, 1050-1055.
33. Probst. Stabilization of Fractures of the Radius and Ulna. In: Current Techniques in Small Animal Surgery. (Ed. Bojrab M J). IV ed. Williams and Wilkins Baltimore USA, 1998, 1021-1031.
34. Shahar R. Relative Stiffness and Stress of Type I and Type II External Fixators: Acrylic versus Stainless-Steel Connecting Bars-A Theoretical Approach. Veterinary Surgery, 2000; 29: 59- 69.
35. Toombs JP. Eternal Skeletal Fixation. In: Current Techniques in Small Animal Surgery, 5th edn. Teton New Media, USA, 2014, 800-810.
36. Van Ee RT, Geasling JW. The Principles of External Skeletal Fixation. Veterinary Medicine, 1992; 87:334-343.