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Evaluation of the mini T-plate for fixation of distal radial fractures in puppies and small breed dogs

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The present clinical study was conducted on six young dogs presented with distal radial fractures. The fractures were treated by internal fixation using 2.0 mm or 2.7 mm mini T-plates. Fractures stabilized with 2.0 mm or 2.7 mm mini T-plates produced rigid fixation in all the six dogs. Immediate postoperative radiographic examination showed good apposition and alignment of the fracture fragments in all the six dogs. Follow-up radiographs revealed primary bone healing with minimal callus formation. The serum alkaline phosphatase and calcium values increased significantly from day 0 to day 14, and thereafter returned to normal values by 45th postoperative day. From the present study it was concluded that the mini T-plates provided satisfactory stabilization of distal radial fractures in small dogs particularly when the distal fragment was small.

***Key words**: Biochemical evaluation, Bone healing, Distal radial fractures, Dogs, Internal fixation, Mini T-plates*

Simple distal radial fractures are common in small and toy-breed dogs after a jump or fall (Piermattei *et al*., 2016). Plate fixation is especially successful for treatment of distal radial and ulnar fractures in small and toy breeds of dogs, predisposed to delayed union or non-union. The design of the T-plate allows purchase of two screws in the short distal radial fragment (Balfour *et al*., 2000), thereby provide stable fixation of fracture.

For small breed and very small puppies of medium breed dogs, small plates with 2.7 mm screws or the mini plates with 2.0 mm screws are recommended (Hamilton and Hobbs, 2005). Hence, the present study was conducted with the main objective to treat the clinical cases of distal radial fractures in puppies and small breed dogs using mini T-plates and to assess the fracture healing by clinical, biochemical and radiological evaluation.

Materials and Methods

Following initial clinical assessment, the dogs reported with distal radial fracture were subjected to preoperative radiographic evaluation (orthogonal views). The details of the cases are presented in (Table 1).

All the dogs were premedicated with atropine sulphate (0.04 mg/kg body wt, s.c.), followed 15 min later by xylazine HCl (1 mg/kg body wt, i.m.). Ten minutes later, general anaesthesia was induced by intramuscular injection of ketamine HCl (10 mg/kg body wt). Anaesthesia was maintained by intravenous injection of propofol (4 mg/kg body wt), whenever necessary, during the surgical procedure.

In the present study, mini T-plates were used for stabilization of fractures in all the six dogs. The plates with 2.0 mm diameter holes with corresponding cortical screws were used in three dogs (weighing less than 10 kg) and in other three dogs (weighing more than 10 kg) plates with 2.7 mm screws were used.

A cranio-medial skin incision was made directly over the radial shaft from mid shaft to the carpus to expose the radial diaphysis. Following fracture reduction, the mini T-plate of appropriate size was contoured to match the cranial surface of the radius and then secured using self-tapping screws. In all the six cases, the distal screws were placed first to anchor the plate to the distal fragment and the proximal screws were placed afterwards (Lakshmi *et al*., 2007) (Fig. 1).

Postoperatively analgesic anti-inflammatory drugs (for 3 days) and broad spectrum antibiotic (for 5 days) were administered. The lameness and weight bearing were assessed periodically. The postoperative day on which the dog started bearing weight was

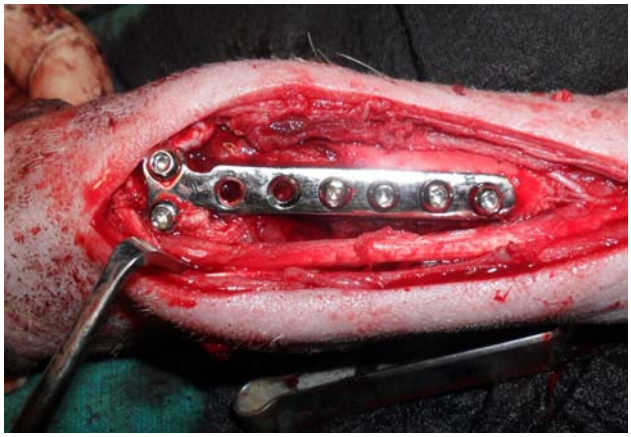

Fig. 1: Surgical site with the mini T-plate, at the time of surgery

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Table 1: Clinical History of the Dogs selected for the study.

Case No.	Breed	Age (months)	Sex	Body weight (Kg)	Cause	Dayssince fracture
1.	Non-descript	16	Male	6	Automobile accident	1
2.	Rottweiler	5	Male	14	Fall from height	3
3.	German shepherd	3	Female	12	Automobile accident	2
4.	Spitz	8	Male	5	Fall from height	4
5.	Spitz	10	Male	8	Fall from height	5
6.	Non-descript	6	Male	11	Fall from height	3
	Mean	8.0±1.87		9.33±1.45		3.0±0.57

noted and graded (Vasseur *et al.,* 1995) as: Grade I- normal weight bearing on all limbs at rest, and while walking; Grade II- normal weight bearing at rest, favours 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; and Grade V- does not bear weight on limb at rest or while walking. The details of lameness grading are presented in table 2.

Plain craniocaudal and mediolateral radiographs of the operated radius were obtained immediately after surgery and on 7th, 15th, 30th and 45th postoperative days and whenever needed, on later dates to assess the progress of bone healing.

Serum alkaline phosphatase, calcium and phosphorus were estimated on 0th, 14th and 45th day after surgery (Table 3). The values were subjected to standard statistical analysis using one way ANOVA and student's 't' test.

Results and Discussion

In the present study two orthogonal preoperative radiographs of affected limb including the proximal and distal joints revealed transverse fractures of distal radius in two dogs, oblique fractures in three dogs and spiral fracture in one dog.

A cranio-medial approach to the radius-ulna, as also suggested by Denny and Butterworth (2000) and Johnson (2013), provided good exposure of the fracture site. In the present study, following reduction of the fracture, the mini T-plate was applied on the cranial surface of the radius and secured using self-tapping screws. Johnson (2013) and Piermattei *et al.* (2016) suggested that mini T-plate must be applied to the cranial surface (tension side) of the radius in distal radial fractures. Mini T-plates allowed placement of two or three screws in the short distal fragment without penetrating the physis for fractures that are so far distal. None of the dogs showed any postoperative complications like premature closure of the growth plate or other deformities. The surgical wounds healed well in all the dogs without any complications. Similar findings were reported by Hamilton and Hobbs (2005).

Lameness grading in all the dogs preoperatively showed grade V lameness before surgical stabilization of the fracture, which gradually improved to normal weight bearing (Grade I lameness) by the 30th postoperative day (Fig. 2).

Fig. 2: Postoperative radiograph, immediately after the surgery

In the present study, in all the animals, the fractures healed by primary bone healing with minimal callus formation. Immediate postoperative radiographic evaluation confirmed proper placement of the T-plate and screws, good apposition and alignment of the distal fragments of the radius in all the six dogs. Radiographs obtained during the successive postoperative days revealed good callus formation, bridging of the fracture site with lesser and opaque callus with faintly visible fracture line in all the six dogs. By the end of 45thday, the radiographs showed disappearance of the fracture line and restitution of cortico-medullary continuity. Radiographs showing progressive fracture healing in different postoperative days were shown in fig. 3.

The serum alkaline phosphatase and serum calcium significantly increased from preoperative day to 14th postoperative day and thereafter the levels decreased reaching normal by 45th day. The serum phosphorus mean values showed no significant variation postoperatively and the values were within the normal range. Increase in serum alkaline

Fig. 3: Postoperative radiograph, 70 days after the surgery

phosphatase level might be due to increased chondroblastic proliferation to facilitate bone formation during the fracture repair. These findings were in concurrence with those of Nagaraja *et al*. (2003) and Uma Rani and Ganesh (2003).

From the results of this study, it was concluded that mini T-plates provided excellent stabilization of distal radial fractures in small dogs, particularly when the distal fragment of radius was small. The implant used in this technique was economical, making it amenable to use in veterinary practice. As there is increasing demand for fracture treatment in toy breed dogs, these mini T-plates can be used with excellent clinical outcome for the treatment of distal radial fractures in small breed dogs.

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