

Complications Encountered in Management of Femur Fractures in Dogs using String of Pearls (SOP) Locking Plate System with or without Intramedullary Pinning

Anita Kumari, P.Bishnoi*, A.K.Bishnoi, Sakar Palecha, Raj Kumar

ABSTRACT

The present study was performed in 16 clinical cases of femur fractures in dogs. The cases were divided into two groups A and B. In Group-A (n=9) femur fracture was stabilized with SOP locking plate system alone, while in Group-B (n=7) femur fracture was stabilized with plate-rod construct using SOP locking plate and intramedullary (IM) pin. Complications during post-operative period were observed in 8 out of 16 animals, out of which the single complication was seen in 5 cases, while multiple complications were encountered in 3 cases. The commonest complications recorded were plate breakage (3 cases), screw loosening and bone splitting (3 cases), deformity of bone (1 case), demineralization of bone (1 case) and IM pin migration (1 case). The complications were less in Group B, where the fractures were stabilized with SOP and IM pin construct.

Keywords: Complications, Femur fracture, IM pin, Screws, String of Pearls (SOP) locking plate.

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INTRODUCTION

SOP (String of pearls) locking plate system, a veterinary-specific locking plate, is composed of larger pearls (nodes) for screw insertion separated by internodes, such that the plate vaguely resembles the appearance of pearls on a string. The SOP plates are made of 316 L stainless steel and SOP system utilizes standard cortical bone screws, either self-tapping or non-self-tapping. Plates are available in 2.0, 2.7, or 3.5mm sizes. The inside of the pearl portion of the plate is contoured in the shape of a ridge, which allows press-fit of the screw head into the plate, this helps to prevent screw loosening during cyclic loading of the plate (Field *et al.*, 2018). The SOP plates can be contoured in six degrees of freedom: medial to lateral bending, cranial to caudal bending, and torsion, for this purpose special plate bending irons are available that interface with the rounded nodes and allow bending at the internode site, which helps to preserve the locking function of the pearl portion of the plate. In SOP, there is a secure double-locking mechanism. First, the conventional "thread-in-thread" feature and a second interference fit between screw head and pearl. The screw holes are not weak points because of that the empty screw holes can be left over a fracture line or elsewhere, according to the clinical need. SOP has a relatively consistent stiffness profile, which optimizes the biomechanical environment at the fracture site and which mitigates damaging stress concentration under bending loads. The SOP plates can be cut to any length without compromising locking function (Field *et al.*, 2018). Mechanical testing using ASTM (American Society for Testing and Materials) standards demonstrated that the 3.5 mm SOP was approximately 50% stiffer, and had a bending

Department of Veterinary Surgery and Radiology, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal sciences, Bikaner-India

Corresponding Author: P. Bishnoi, Department of Veterinary Surgery and Radiology, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal sciences, Bikaner-India, email: drpbishnoi@gmail.com

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strength (load at which the plate bends) 16-30% greater than that of the 3.5 mm LCP, DCP, or LC-DCP (De Tora and Kraus 2008; Ness, 2009). In the present study, the complications encountered during the management of femur fractures in dogs using String of Pearls (SOP) locking plate system with or without IM pinning were evaluated.

MATERIALS AND METHODS

The study was carried out at Department of Veterinary Surgery and Radiology, College of Veterinary and Animal Science, RAJUVAS, Bikaner (India) during the year 2020-21. In all 16 clinical cases of dogs with femur fracture were divided into groups A and B for surgical repair by SOP locking plate without IM pin (group A, n=9) and with IM pin (group B, n=7). The dogs were pre-medicated with Atropine sulfate @

0.02 mg/kg body weight i/m and Xylazine @ 1 mg/kg body weight intramuscularly (i/m). The anaesthesia was induced with Ketamine hydrochloride @ 5 mg/kg body weight i/m and maintained with Isoflurane (1-2.5%) in oxygen.

The surgical site for femur fracture stabilization was prepared from lumbo-sacral region to mid tibia. The dogs were positioned in lateral recumbency keeping the affected limb on upper side for a cranio-lateral approach. Open reduction was done in all the cases and SOP plate was applied following standard procedure as described by Association of the Study of Internal Fixation (AO/AISF). A 3.5 mm SOP plate was used for dogs >10 kg body weight and 2.7 mm SOP in dogs <10 kg body weight. The cortical bone screws used with these plates were 3.5 mm and 2.7 mm, respectively. The drill bit of 2 mm was used for 2.7 mm cortical screws and 2.7 mm bit for 3.5 mm cortical bone screws. SOP plate bender was used for bending of SOP plate as per contour of the femur. The IM pin with a diameter of 30-40% of medullary cavity diameter of femur was used with SOP plate in Group B (n=7). Ancillary fixation with full cerclage wire (FCW) was performed in 12 cases.

Post-operatively a modified Robert Jones bandaging (RJB) was applied for 2-3 post-operative weeks and antibiotics for 5-7 days, NSAID (Meloxicam 5 mg/ml) for 3 days and calcium-phosphorus oral supplement for 30 days were prescribed. Skin sutures were removed after 10-15 days of surgery.

Clinical evaluation of the dogs was done immediately after surgical fixation and on 14th, 30th and 60th day post-operatively for lameness grading. Based on the periodical clinical examination, the lameness grading was assessed and categorized as per the classification devised by Carr and Dycus (2016). The radiograph in two orthogonal views was obtained of affected femur bone with surgical fixation, immediately after fixation and on 14th, 30th and 60th post-operative days. The radiographic union was estimated as per scale given by Hammer *et al.* (1985).

RESULTS AND DISCUSSION

Suture dehiscence was seen in one case in each group, in case A3 distal end of SOP plate got exposed due to dehiscence of skin sutures, while dehiscence of skin sutures was seen in case B1 but plate was not exposed. Das *et al.* (2012) also reported that, in a case distal three screws were found to be exposed through the skin at 60th post-operative day. In case A7 post-operative knuckling was observed on day 25 and stifle and hock stiffness and internal deviation of limb was noticed at 35th post-operative day, whereas bone deformity and angulation of bone was seen radiographically at 90th postoperative day. These complications might have developed due to concurrent fracture of proximal tibia of same side managed by external fixation and Modified Robert Jones Bandaging for long time and uneven weight bearing on affected limb led to uneven growth of bone as this was a younger pup and this condition might have occurred due to Quadriceps contraction (QC). Ulusion *et al.* (2015) also reported Quadriceps contraction (QC), as a result of improper bandage application or operations due to femoral fractures in 11 cases. In case A4 pus discharge from suture line with suture dehiscence (Fig.1) was seen at 7th post-operative day because the dog bite wound was communicated with fracture site and on radiography the screws were found dislodged and bone plate was completely detached from bone. There was abundant callus formation over whole length of bone and bone was almost got necrosed and was converted into sequestrum and splitting of bone (Fig. 2 & 3) as observed during surgical removal of plate. Vaughan (1975) reported similar condition in twenty-five dogs, and stated that the infection arising in connection with the surgical repair of a fracture is the commonest cause of osteomyelitis in dogs. Loosening of the implant, with consequent loss of fracture immobilization, is a common feature, screws become less securely embedded and the plate may lift off the bone and bone lysis is sometimes evident immediately adjacent to the implant.



Fig. 1: Infection at surgical site and suture dehiscence



Fig. 2: Sequestrum/Splitting of bone and Plate dislodgement



Fig. 3: Screw dislodgement & splitting of bone



Fig. 4: Mediolateral radiograph showing broken SOP plate



Fig. 5: Broken SOP plate



Fig. 6: Screw dislodgement & splitting of bone & Pin migration

In present study, the plate breakage (Fig. 4 & 5) was seen in two cases (A5 & A6) of Group I, on 7th and 10th post-operative day, and in one case of Group II after 45 days post-operatively, but the fracture line was completely healed in this case. The plate breakage from internode site of SOP was also reported in six cases by Field *et al.* (2018). In two cases (A3, A6) bone splitting and screw dislodgement was seen at 20th day post-operative radiography. Although, Field *et al.* (2018) reported screw breakage, but in present study screw breakage was not found, however, in case B4 bone splitting and screw loosening from bone and screw dislodgement and IM pin migration (Fig. 6) was seen due to ignorance of owner at 14th day post-operative radiography.

CONCLUSION

In the present study, most of the cases of femur fracture in dogs could be managed with SOP plate system or Sop plate-IM pin construct with minimum complications and these complications were manageable.

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