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Nanaboina Ramesh
M.V.Sc, Department of Veterinay Surgery and Radiology, College of Veterinary Science, Rajendranagar, Hyderabad, Telangana, India

M Anil
M.V.Sc, Department of Veterinary Gynecology and Obstetrics, College of Veterinary Science, Rajendranagar, Hyderabad, Telangana, India

KBP Raghavender
Professor and University Head, Department of Surgery and Radiology, College of Veterinary Science, Rajendranagar, PVNR Telangana Veterinary University, Hyderabad, Telangana, India

V Gireesh Kumar
Professor, Department of Surgery and Radiology College of Veterinary Science, Rajendranagar, PVNR Telangana Veterinary University, Hyderabad, Telangana, India

EL Chandra Sekhar
Professor, Department of Surgery and Radiology, College of Veterinary Science, Korutla, PVNR Telangana Veterinary University, Telangana, India

C Latha
Associate Professor, Department of Surgery and Radiology, TVCC, PVNR Telangana Veterinary University, Hyderabad, Telangana, India

Correspondence
Nanaboina Ramesh
M.V.Sc, Department of Veterinay Surgery and Radiology, College of Veterinary Science, Rajendranagar, Hyderabad, Telangana, India

A clinical study on the use of single 'Arrow-pin' technique for management of supracondylar femoral fractures in young dogs

Nanaboina Ramesh, M Anil, KBP Raghavender, V Gireesh Kumar, EL Chandra Sekhar and C Latha

Abstract
Six young dogs (5-12 months old, body weight ranging from 6-14 kg) were presented to Dr. Dog Pet Hospital, Banjarahills, Hyderabad, was diagnosed to have supracondylar distal femoral fracture over a period of one year (from December 2016 to December 2017). Physical examination and radiography aided in diagnosis. In all the six cases, the fracture was stabilized with self-designed single 'Arrow-pin' under sedation with the combination of Xylazine Hydrochloride and Ketamine Hydrochloride and Intravenous general anaesthesia with Propofol. Postoperative radiograph showed good pin placement and bone reduction. For all six the six dogs, cage rest and restricted activity was accomplished for 8 weeks. Fracture healing was assessed periodically by taking radiographs on the day 1, 15, 30 and 45. The mean lameness scores in the animals was found to be 3 ± 0.25, 2.16 ± 0.30, 1.33 ± 0.21, 1 ± 0 and 1 ± 0 respectively by the end of 1st day, 7th day, 15th day, 30th day and 45th day of surgery. Postoperatively, all the six dogs showed complete weight bearing in an average of 45-50 days.

Keywords: arrow-pin, radiographs, supracondylar femoral fracture, young dogs

1. Introduction
A quarter of all femoral fractures in small animals involve fracture of distal femoral physis [10]. Epiphyseal fractures are generally seen in young animals and supracondylar or intracondylar fractures may be seen in mature dogs. Supracondylar fractures are usually transverse, but oblique fractures are also recorded in some cases [3]. Arthrotomy of the stifle joint is necessary to expose the entire distal segment which is usually caudally displaced and mostly accompanied by hematoma [10]. A number of methods have been described in the literature for repair of supracondylar fractures in dogs. The fixation techniques include crossed K-wires [4], intramedullary pins [11], rush pins, lag screws, fixation with plates including tibial head compression plate, dynamic compression plate, horn plate and reconstruction plate, plate and rod combination, interlocking nail, modified type I external skeletal fixator etc. [2, 10]. The present study was discussed on the use of self designed Single "Arrow pin'' technique for the management of supracondylar femoral fracture in young dogs.

2. Materials and Methods
The present study was carried out in 6 young dogs of different breeds (Pomeranian, Labrador Lhasa Apso, Shih Tzu and Non-descript) and age with supracondylar femoral fractures over a period of one year i.e. from December 2016 to December 2017. The type of fracture and its severity was assessed by physical examination of the animal and radiography of the affected limb. The anamnesis of the animals under the study is mentioned in Table. 1.

Table 1: Anamnesis of the six dogs in the present study.

S. No	sex	Age/Months	Breed	Weight/Kg	Location of femur fracture	Type of fracture
1	Male	12	Non-descript	8	Supracondylar distal femoral	Transverse overriding
2	Male	10	Shih Tzu	6	Supracondylar distal femoral	Transverse overriding
3	Male	10	Lhasa Apso	8	Supracondylar distal femoral	Short oblique overriding
4	Male	6	Labrador	14	Supracondylar distal femoral	Transverse overriding
5	Female	6	Labrador	12	Supracondylar distal femoral	Transverse overriding
6	Male	8	Pomeranian	10	Supracondylar distal femoral	Transverse overriding

The arrow-pin used for intramedullary pinning in the present study was prepared by selecting a K-wire of suitable size. One end of the pin was heated in the blue flame of Bunsen burner until the end becomes red hot. The hot end of the pin is further flattened by hammering to obtain a thickness of around half of the total pin thickness. The flattened end is further subjected to filing to obtain prongs (Fig. 1). Finished pin resembled an arrow (Fig. 2); hence the technique was named 'Arrow-pin' technique.

All the six dogs were given a first aid for the fracture on the day of their presentation and advised 12 hours fasting prior to surgery. Temporary stabilization of the fracture site was done by application of Robert jones bandage, till the date of surgery. The affected limb was aseptically prepared by clipping the hair and operative site was shaved and scrubbed using povidone iodine surgical scrub. All the animals were prepared for aseptic surgery and were sedated with intramuscular injections of Xylazine hydrochloride @ 1 mg/Kg body weight. Following induction with ketamine hydrochloride @ 10 mg/kg body weight, anaesthesia was maintained with intravenous infusion of propofol at the rate of 4 mg/kg body weight.

All the six dogs with supracondylar femoral fractures were positioned in lateral recumbence with the fractured limb up (Fig. 3). The distal extremity of the limb was covered with sterile gauze bandage. The prepared site was painted with 5 % povidone iodine solution followed by application of surgical spirit. A skin incision was made along the cranio-lateral aspect of the stifle joint extending from distal femur to proximal tibia (Fig. 4). Following separation of subcutaneous tissue, the fascia lata muscle and joint capsule was incised to expose the distal femur. After reduction of the fracture fragments to their normal anatomical position (Fig. 5), a suitable size of single 'Arrow-pin' was selected for intramedullary pinning. The Arrow pin was passed in an antegrade fashion from trochlear groove directing it towards the medullary canal of the proximal fracture fragment using needle holder (Fig. 6) and prongs part of the pin was inserted in to trochlea by gentle tapping without causing unnecessary damage to the articular surface. Great care was taken that not to expose the distal pin edge from the articular surface of the trochlea (Fig. 7). Prongs of the Arrow-pin were lodged inside the cancellous bony part of distal femur, such that stifle movement was not compromised.

Following fracture repair, the incision on the joint capsule and fascialata was closed in a simple interrupted pattern using 2-0 chromic catgut. The skin incision was closed in a row of cruciate mattress suture using 2-0 polypropylene and the suture line was covered with a thin layer of sterile gauze bandage dipped in 5% povidone iodine solution, over this a modified Robert johns bandage was applied. The dressing was changed every alternate day until the sutures were removed on the 10th post-operative day. Ceftriaxone sodium was administered at the rate of 20 mg/kg body weight as intramuscular injection once a day for 7 days post-operatively. Meloxicam was administered once a day at the rate of 0.3 mg/kg by intramuscular injection for 3 days. Plain anterio-posterior and lateral radiographs of the operated femur were obtained immediately after surgery and on the 15th, 30th and 45th post-operative days and whenever needed on later dates to assess the progress of bone healing (Fig. 8).

Fig 1: Filing of flattened end of the pin to obtain prongs

Fig 2: Finished ''Arrow pin''

Fig 3: Fractured limb was draped and positioned for surgery

Fig 4: Skin incision was made from distal femur to proximal tibia

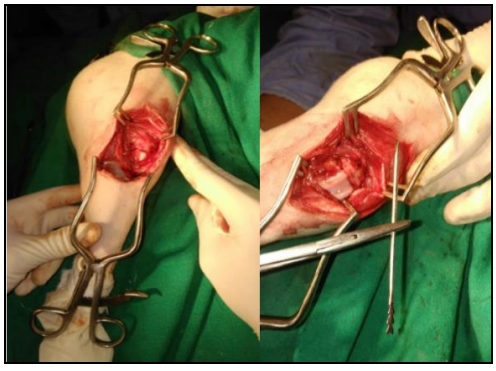

Fig 5: Fracture site was exposed and Redused

Fig 6: Passing the Arrow pin using needle holder

Fig 7: Prongs of the Arrow pin lodged inside the distal femur

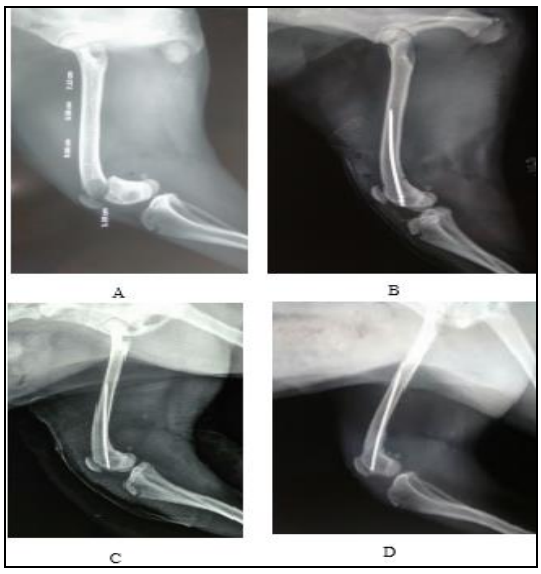

Fig 8: Progressive radiographic changes on the day before surgery (A), 1st (B), 15th (C) and 45th (D) post-operative days

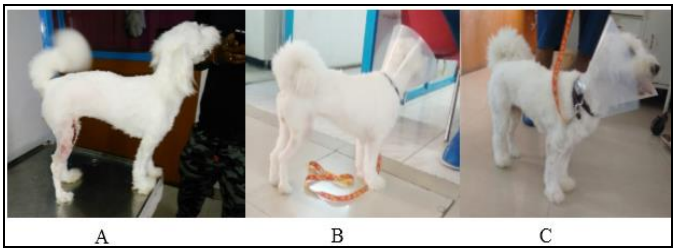

Fig 9: Progressive weight bearing on the 15th (A), 30th (B) and 45th (C) post-operative days

3. Results and Discussion

Self-designed Arrow pin used for stabilization of Supracondylar femoral fractures in present study resulted in good fracture fixation and immobilization. In the present study, the supracondylar fracture was stabilized with 2.0 mm Arrow pin in 5 dogs and 2.5 mm Arrow pin in one dog. Application of Robert-Jones bandage was found to be satisfactory for immobilization of the limb. The use of Ceftriaxone sodium effectively prevented post-operative infection. None of the dogs developed post-operative swelling.

All the six dogs in the present study showed partial weight bearing from the 1st post-operative day. One dog achieved complete weight bearing by the 7th post-operative day, three dogs by 15th post-operative day and two dogs by 30th post-operative day. The mean lameness scores in the animals was found to be 3 ± 0.25, 2.16 ± 0.30, 1.33 ± 0.21, 1 ± 0 and 1 ± 0 respectively by the end of 1st day, 7th day, 15th day, 30th day and 45th day of surgery.

Based on the observations of the present study it was revealed that the main cause of fractures was found to be trauma by road accidents in 4 dogs (66.66%) followed by fall from height in 2 dogs (33.33%). These findings are in accordance with Maala and Celo [7], Phillips [9], Aithal *et al.* [2] and Johnson *et al.* [5] the authors stated that automobile accidents and jumping from height were major exciting causes of fractures in dogs.

The patient preparation and anaesthetic protocol followed for the surgery was found satisfactory in all the six animals for management of fracture in the present study. Pardeshi and Ranganath [8] also adapted similar anaesthetic protocol.

The lameness grade was carried out in accordance with the protocol developed by Vasseur *et al.* [14]. In preset study, all the six cases showed grade-I lameness an average of 30-45 days post-operatively (Fig. 9).

Use of rush pins, crossed pins and IM pin as a single technique is a routinely practiced in management of simple distal femoral fractures in dogs. Intramedullary pins resist bending forces but are very poor in countering the rotational [13] and axial forces. Sukhiani and Holmberg [12] found crossed pins to be significantly stronger than single IM pins. Crossed pins are indicated in cats and small dogs, and for simple transverse or short-oblique fractures in adult animals [12, 6]. Aithal *et al.* [1] observed that the treatment of supra-condylar fractures of femur by cross pin fixation through stifle provides more than one point fixation, increasing the stabilization of fracture fragments leading to early fracture union in comparison to single pin fixation. However, in the present study, a single Arrow-pinprovided good stability and resisted rotational and axial forces, which was not provided upon use of a single IM pin. This lead to successful fracture repair and also avoided unnecessary trauma to the condyle.

All the six dogs recovered without any post-operative complications like pin migration, bending, etc. during the follow-up period of 6 months. In none of the cases, pin removal was taken up since the owners were reluctant for the second surgery.

4. Conclusion

Based on the present study, it was concluded that singe Arrow pin was found suitable for the treatment of supracondylar fractures in young dogs. Use of single 'Arrow-pin' resisted rotational and axial forces which traditional IM pinning fails to do as well as avoided unnecessary condylar trauma as seen in cross pinning and rush pinning. The implant used in this technique was economical, making it amenable to use in veterinary practice.

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