IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 12, Issue 8 Ser. II (August 2019), PP 19-24
www.iosrjournals.org

Evaluation of bone fractures brought to Bingol University Veterinary Faculty Surgery Clinic

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Abstract: *In this retrospective study, the material of the study was consisted of 94 various animals brought to the Surgery Clinic of Bingol University with the complaint of bone fractures. Various bandage materials, intramedullary pins of various diameters, stainless steel wires of various diameters and cattle and winged animal bone muffs of various diameters, PMMA (Polymethyl methacrylate) were used in the retrospective study.*

According to localization of fractures; it was observed respectively femoral fractures (28 cases), humerus (20 cases), radius-ulna (20 cases), tibia-fibula (13 cases), metacarpus (5 cases), metatarsus (4 cases), mandibular (3 cases), articulation cubiti (1 case) and costa fractures (1 case).

The best results can be obtained with the orthopedic technique chosen according to the location, shape and type of the fracture. In addition, postoperative care of animals, especially rehabilitation of wild animals, will yield positive results.

It was concluded that bone muff applications especially in the treatment of double bones fractures (radius-ulna, tibia-fibula etc.) prevent synostosis formation. Bone muff can be used in wild birds and other small animals as it does not require bandage.

Keywords: *Bone, muff, fracture, evaluation, techniques.*

Date of Submission: 15-08-2019 Date of acceptance: 30-08-2019

I. Introduction

Fracture should be evaluated carefully in clinical and radiological aspects and the most appropriate osteosynthesis material and technique should be selected according to the condition of the case[1,2,3].

Methods of fixation used in bone fracture treatment with outlines can be classified as; Limb splintage (coaptation splints, casts, modified Thomas splint), Bone splintage (intramedullary pin, external skeletal fixator, bone plate), Compression (lag screw, cerclage/interfragmentary wire, tension band wire, tension band/compression plate)[1]. Also, bone muffs are used to fixation in bone fracture treatment[4].

In this retrospective study, It was evaluated of bone fractures brought to Bingol University Veterinary Faculty Surgery Clinic.

II. Material And Methods

The material of the study was consisted of 94 various animals (16 cats, 15 dogs, 11 calves, 3 lamb-goat, 3 hawk, 3 stork, 1 crow, 1 seagull, 3 owl, 3 swift bird, 1 chick, 19 budgerigar, 2 cock, 3 partridge, 4 Eagle, 3 pigeon, 3 Bonelli) brought to the Surgery Clinic of Bingol University with the complaint of bone fractures. It was applied only bandage (70), bone muff (7), bone muff + pin (3), pin (9), pin + stainless steel wire (4),Pin + PMMA (1) in treatment of bone fractures. In one stork, bone muff + pin was used for fixation of metacarpal fracture and pin + stainless steel wire was used for fixation of humerus fracture.

Various bandage materials, intramedullary pins of various diameters, stainless steel wires of various diameters and cattle and winged animal bone muffs of various diameters, PMMA (Polymethyl methacrylate) were used in the retrospective study.

Bone muffs prepared from cattle or winged animals in appropriate sizes were boiled in distilled water for 30-45 min to remove proteins and the salts (Figure 1).

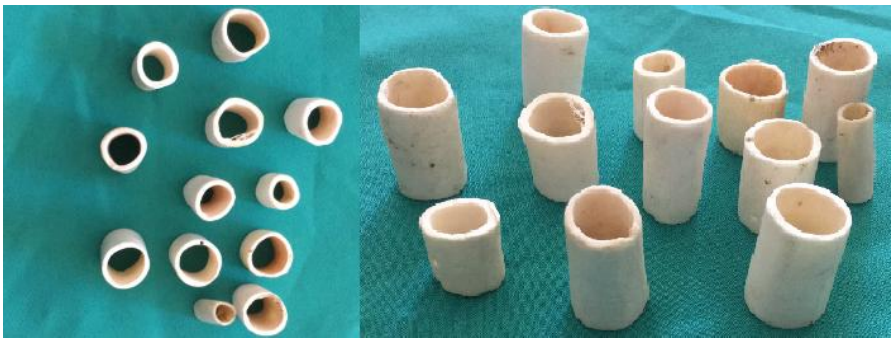

Figure 1. Appearance of bone muffs different diameters and lengths.

Sedation was applied in dog, cat, lamb-goat and calves before physical and radiographic examinations and postoperative bandage changes . For this purpose; α2- adrenergic-agonist agent (Xylazine) was used. Ketamine was used as general anesthetic for operative intervention in poultry. Dissociative anesthesia (Xylazine + Ketamine) was performed in other animals. Postoperative; analgesics (Carprofen, Meloxicam) were used to reduce anxiety, decrease stress and its associated hormonal and metabolic derangements, and to allow the patient to rest comfortably.

III. Results And Discussion

The data of 94 case (16 cats, 15 dogs, 11 calves, 3 lamb-goat, 3 hawk, 3 stork, 1 crow, 1 seagull, 3 owl, 3 swift bird, 1 chick, 19 budgerigar, 2 cock, 3 partridge, 4 Eagle, 3 pigeon, 3 Bonelli) with bone fractures are presented in Tables 1, 2, and 3.

Table 1: Distribution of bone fractures according to animal species.

Animals	Mandible	Costa	Humerus	Radius - ulna	Articulatio cubiti	Metacarpus	Femur	Tibia -fibula	Metatarsus	Total
Cat	1	-	1	7	-	1	2	3	1	16
Dog	-	-	3	5	-	1	3	2	1	15
Calf	2	-	3	1	-	2	2	1	-	11
Lamb-Goat	-	-	-	1	-	-	1	1	-	3
Sparrow hawk	-	-	2	1	-	-	-	-	-	3
Stork	-	-	2	-	-	1*	-	1	-	3+1*
Crow	-	-	-	1	-	-	-	--	-	1
Seagull	-	-	-	-	-	-	1	-	-	1
Owl	-	-	-	2	-	-	1	-	-	3
Swift	-	-	1	-	-	-	-	2	-	3
Chick	-	-	-	-	-	-	-	-	1	1
Budgerigar	-	-	1	1	-	-	16	1	-	19
Cock	-	-	-	-	-	-	1	1	-	2
Partridge	-	-	1	-	-	-	1	1	-	3
Eagle	-	-	4	-	-	-	-	-	--	4
Pigeon	-	1	-	-	1	-	-	-	1	3
Bonelli's Eagle	-	-	2	1	-	-	-	-	-	3
Total	3	1	20	20	1	4+1*	28	13	4	**94**

***:** Metacarpus fracture with humeral fracture. **PMMA:** Polymethylmethacrylate.

Table 2: Distribution of bone fractures according to orthopedic techniques.

Bone	Only Bandage	Bone muff	Bone muff + Pin	Pin	Pin + Stainless steel wire	Pin + PMMA	Total
Mandible	-	-	-	-	2	1	3
Costa	1	-	-	-	-	-	1
Humerus	12	1	-	5	2	-	20
Radius Ulna	16	1	2	1	-	-	20
Articulatio cubuti	1	-	-	-	-	-	1
Metacarpus	4	-	1*	-	-	-	4+1*
Femur	22	3	1	2	-	-	28
Tibia-Fibula	10	2	-	1	-	-	13
Metatarsus	4	-	-	-	-	-	4
Total	70	7	3+1*	9	4	1	**94**

***:** Metacarpus fracture with humeral fracture. **PMMA:** Polymethylmethacrylate.

Table 3: Distribution of orthopedic techniques according to animal species.

	Only Bandage	muff	Muff + pin	pin	Pin + stainless steel wire	Pin +PMMA	Total
Cat	10	3	1	1	1	-	16
Dog	9	2	-	4	-	-	15
Calf	7	-	-	1	2	1	11
Lamb-Goat	3	-	-	-	-	-	3
Sparrow hawk	3	-	-	-	-	-	3
Stork	1	1	1*	-	1	-	3+1*
Crow	1	-	-	-	-	-	1
Seagull	1	-	-	-	-	-	1
Owl	1	-	1	1	-	-	3
Swift	3	-	-	-	-	-	3
Chick	1	-	-	-	-	-	1
Budgerigar	19	-	-	-	-	-	19
Cock	2	-	-	-	-	-	2
Partridge	3	-	-	-	-	-	3
Eagle	2	-	-	2	-	-	4
Pigeon	3	-	-		-	-	3
Bonelli's Eagle	1	1	1		-	-	3
Total	70	7	3+1*	9	4	1	**94**

***:** Metacarpus fracture with humeral fracture. **PMMA:** Polymethylmethacrylate.

According to localization of fractures; it was observed respectively femoral fractures (28 cases), humerus (20 cases), radius-ulna (20 cases), tibia-fibula (13 cases), metacarpus (5 cases), metatarsus (4 cases), mandibular (3 cases) (Figure 3), articulation cubiti (1 case) and costa fractures (1 case).
Distribution of orthopedic techniques; it was detected only bandage (70 cases), bone muff (7 cases), bone muff + pin (4), pin (9), pin + stainless steel wire (4 cases) and pin + PMMA (1 case).

Only bandage applications; Positive results from bandage applications were obtained in the majority of patients. Various complications (Delayed union, nonunions etc.) were encountered in animals that could not be brought to our clinic for control.

Muff applications; It was used bone muff for fixation in 3 dogs, 2 cats, 1 stork and 1 bonelli's eagle. Bone muff was not preferred for fractures close to the joint (Figure 2 A,B). Intramedullary pin was used on the same bone with a bone muff in one stork (Figure 2 C,D).
In some cases, bone bandage was not applied (Figure 3 A,B,C,D). It was observed that the animals without bandage were calmer.
It was determined that the wild winged bone muff was absorbed longer than cattle muff.

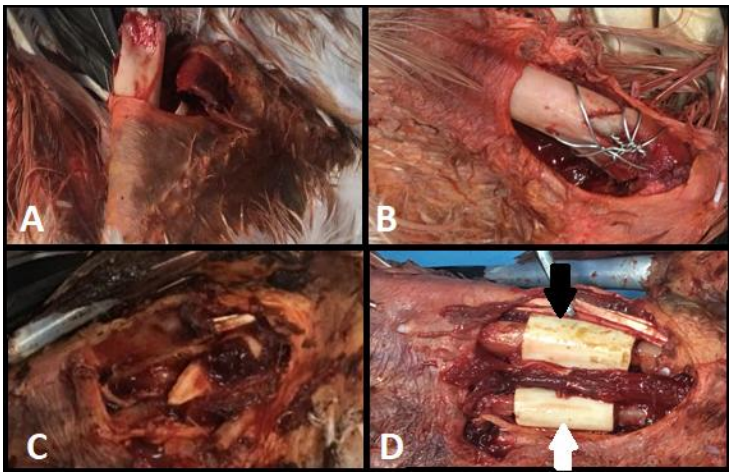

Figure 2. A: Appearance of humeus fracture in a stork. **B:** Pin + stainless steel wire was used for fixation of humerus fracture. **C:** Appearance of metacarpal fractures. **D:** Metacarpal fractures were stabilized with bone muff + pin (black arrow) and only muff (white arrow).

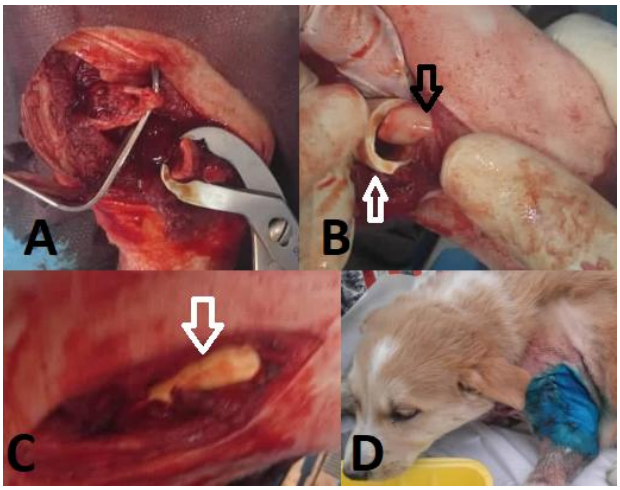

Figure 3: A: View of the oblique humerus fracture in a dog. **B:** Placing the distal fragment into the bone muff after the bone muff was inserted into the proximal fragment. **C:** The appearance of the bone muff after insertion into the proximal and distal fragments of the humerus. **D:** View of dog after operation.

Muff + pin applications; In the case of double bone fractures such as radius-ulna, the bone muff was used for radius and the pin was used for the ulna (in a cat), since intramedullary pin application to the radius was not appropriate (Figure 4 A). In radiographic examination , both radius and ulna fracture healing were excellent and synostose was not formed. The endosteal callus was formed before the periosteal callus (Figure 4 B,C).

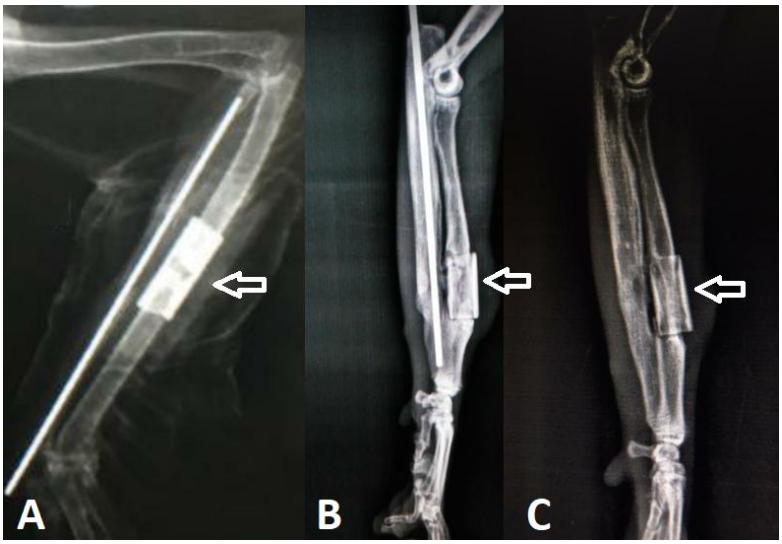

Figure 4: A: Postoperative radiographic view of the treatment of radius-ulna fracture with pin and wild winged bone muff (white arrow) in a cat. **B:** Radiographic view after 3 months **C:** Radiographic view 6 months.

Pin applications; In this retrospective study, a total of 9 bone fractures were treated with an intramedullary pin (humerus (5) femur (2) radius-ulna (1) tibia-fibula (1)). K-wires or Steinmann pins were used in the study.
Pin + stainless steel wire (cerclage) applications; total 4 bone fractures were treated with intramedullary pin + stainless steel wire (humerus (2), mandible (2)). Bilateral total mandible fracture in premolar region of a calf was treated with Steinmann pin + stainless steel wire. (Figure 5). One week after the application, the calf broke his jaw again. The second application, fractured jaw was treated with external fixation.

Figure 5: The appearance of bilateral total mandible fracture in premolar region of a calf(A). A view of mandible after treatment with pin and stainless steel wire (B).

Pin + PMMA applications; Mandibular fracture in one calf was treated with Steinmann pin + PMMA.

In order to ensure immobility of fractured bone, it is reported that bandage applications are appropriate in fractures whose fragments are not displaced, without angulation deformity, In cases where there is no interposition by entering any soft tissue between the fragments[3]. In this study only 70 cases were applied bandage.

It was reported that pins and wires can be successfully used in a high percentage of routine fractures, with minimal complications. Pin and wire fixation is much less expensive than bone plate fixation when the cost of implants, the large inventory of equipment needed, maintenance, and repair costs for bone plating equipment are compared to pinning costs[1]. IM (intramedullary) pins are most often used for diaphyseal fractures of the humerus, femur, tibia, ulna, and metacarpal and metatarsal bones. IM pins are contraindicated for the radius because the insertion point of the pin generally interferes with the carpus[2]. After fracture treatment, synostose may occur in fractures of adjacent bones such as radius-ulna, tibia-fibula etc.[3]. In this retrospective study; It was used pin in 9 cases, pin and stainless steel wire in 4 cases, pin and PMMA in 1 case. In the treatment of radius-ulna fracture in a cat; The radius was stabilized with bone muff. The ulna was stabilized with a steinman pin. In the controls, both radius and ulna fracture healing were excellent and synostose was not formed. It was reported that cattle, sheep and goat bone muffs are fully resorbed in 6 months, but wild winged bone muffs are resorbed in 10-11 months[4,5]. In this retrospective study, the resorption of cattle and wild winged muffs was performed within the specified periods.

In nature, wild birds remain hungry and dehydrated for a long time, infection of open wounds (especially in fractures of the wings), excessive muscle tears and necrosis formation decreases the chance of healing and survival[5,6,7]. Prognosis is good in simple fractures of wild birds, poor in multi fragment fractures, very poor prognosis in infected and over 24-hour fractures. Winged bones are light and cortex is thin. Therefore they can easily break. In addition, the distal part of the humerus was covered by a thin soft tissue, fractures in this region occur as multi fragments and open fractures[8,9,10]. The bone cortex is thin in wild birds, it is emphasized that the use of screws and plates is not appropriate[10,11]. The bone muff serves as an external support for the bone fragments; it does not require bandage, resorbs by the body, is not taken up by a second procedure, is very light and most importantly does not create damage to the joint. The muff is also an excellent material for flying birds as it provides a good fixation by wrapping the cracks and crevices of the broken bone[5,12,13]. Similar findings were found in this retrospective study.

IV. Conclusion

The best results can be obtained with the orthopedic technique chosen according to the location, shape and type of the fracture. In addition, postoperative care of animals, especially rehabilitation of wild animals, will yield positive results.

It was concluded that bone muff applications especially in the treatment of double bones fractures (radius-ulna, tibia-fibula etc.) prevent synostosis formation. Bone muff can be used in wild birds and other small animals as it does not require bandage.

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S. Unsaldi" Evaluation of bone fractures brought to Bingol University Veterinary Faculty Surgery Clinic" IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) 12.8 (2019): PP- 19-24.