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Original Article

Osteo-synthesis Use in Dogs' Femur Surgical Fractures Repair: An Experimental and Comparative Study

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ABSTRACT

Study carried out with the purpose of evaluating the outcomes of dogs' femur fracture unions by using intramedullary pinning and bone plating fixation. For the study, 8 adult animals, both males, weighing around 8 and 16 kg, were employed. The animals were divided into two similar groups and subjected to a simple complete transverse osteotomy on the left femur. In group 1 (G1), the site of osteotomy was fixed by the intramedullary pinning, in group 2 (G2), an osteosynthesis by plates and screws were placed. The groups were subdivided into 4 periods (P15, P21, P28 and P35) for evaluating x-ray aiming to check local bone union process. X-ray studies showed that G1 developed a faster repair process in all observation periods when compared to G2. This fact was confirmed by radiographic evaluation. We conclude that the intramedullary pinning may be routinely used in orthopedic surgery, providing an early bone healing.

Keywords: Osteosynthesis, Femur, Fixation, Radiology.

INTRODUCTION

The primary goal of fracture treatment is to achieve a healed fracture with normal bone alignment and promote immediate function of the affected limb (Johnson et al., 1998). The femur is a long bone mostly subjected to fractures in dogs. Many reported implant systems are suitable for fracture repair Intramedullary pins, bone plate and screws, external skeletal fixation, lag screws as well as interlocking pins are mostly used as implant devices (Beale, 2004). A fracture repair involves a sequence of cellular events that evolve, since the very aggression, to hematoma formation, the beginning of a plastic callus, as well as its organization and remodeling. Some fractures' union occur appropriately after the proper use of a given stabilization method, but others result in delayed repair or non-union. Many factors are important in order to be successful in repairing fractures; among those factors we can mention the biomechanical factors (excessive movements in the fracture core), anatomical factors (age, deficient vascularization, diastasis, infection, and others) and metabolic factors (nutrition). It is important to choose an implant system that is capable of adequately neutralizing all the disruptive forces at the fracture site and allowing bone healing to rapidly progress. These forces cause bending, compressive, tensile, shear, or torsional stresses to act on the fractured bone and fixation system at the same time (Perren, 2002).

The aim of this study is to focus a light on the healing process of femur fracture with two treatment protocols. Moreover, it tried to compare between them to get the best treatment protocol with least complications in dogs.

MATERIAL AND METHODS

Eight adult, male dogs weighting between 8and 16 kg were used and divided into 2 groups with 4 animals each being kept in separate cages and feed with balanced ration once a day and with water ad libitum. The animals were submitted to premedication with I/M injection of chloropromazine hydrochloride in a dose of 1mg /kg. Intravenous injection of atropine sulphate (0.04 mg/kg body weight); buprenorphine IM injection (0.02 mg/kg body weight), and then general anesthesia was conducted by I/V injection of tilitamine -zolazepam (5mg/kg body weight). After the trichotomy of the posterior left limb, the skin antisepsis by rubbing with degerming polypyrrolidone diluted in saline solution was performed. All animals were submitted to a total simple surgical fracture at the diaphysis of the left femur by using a low-speed drill attached to a cutting disc. In the first group (G1), intramedullary pinning by retrograde manner was placed and renforced by hemicerclage wire (Fig. 1) which according to the technique by Brinker. In the second group (G2), the procedure was done by placing plates and screws at the lateral face of femur (Fig. 2). Surgical wounds were sutured with needled Nylon 3-0 and protected with dry and sterilized bandages. The same analgesic agent was used in both groups at a dosage of 0.02 mg/kg, once a day, during three days. Just after the operation, injecting an antibiotic pénistreptomycine during 10 days, the wound is cleaned daily by antiseptic solution. Each group was divided into

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periods, aiming a better radiographic evaluation, as follows: P15= 15 days after surgery, P21= 21 days, P 28= 28 days, and P35= 35 days postoperatively. In each period, the animals were submitted to radiographic analysis, taking into consideration time and intensity of the periosteal reaction, presence of a bone bridge and of callus formation .X-rays were performed with a radiological technique of 70 k V p (kilovolts) and 32 m as (milliampere). Descriptive and comparative evaluations were performed using clinical and radiographic examinations at of each period for determining the best fixation method for fracture union.

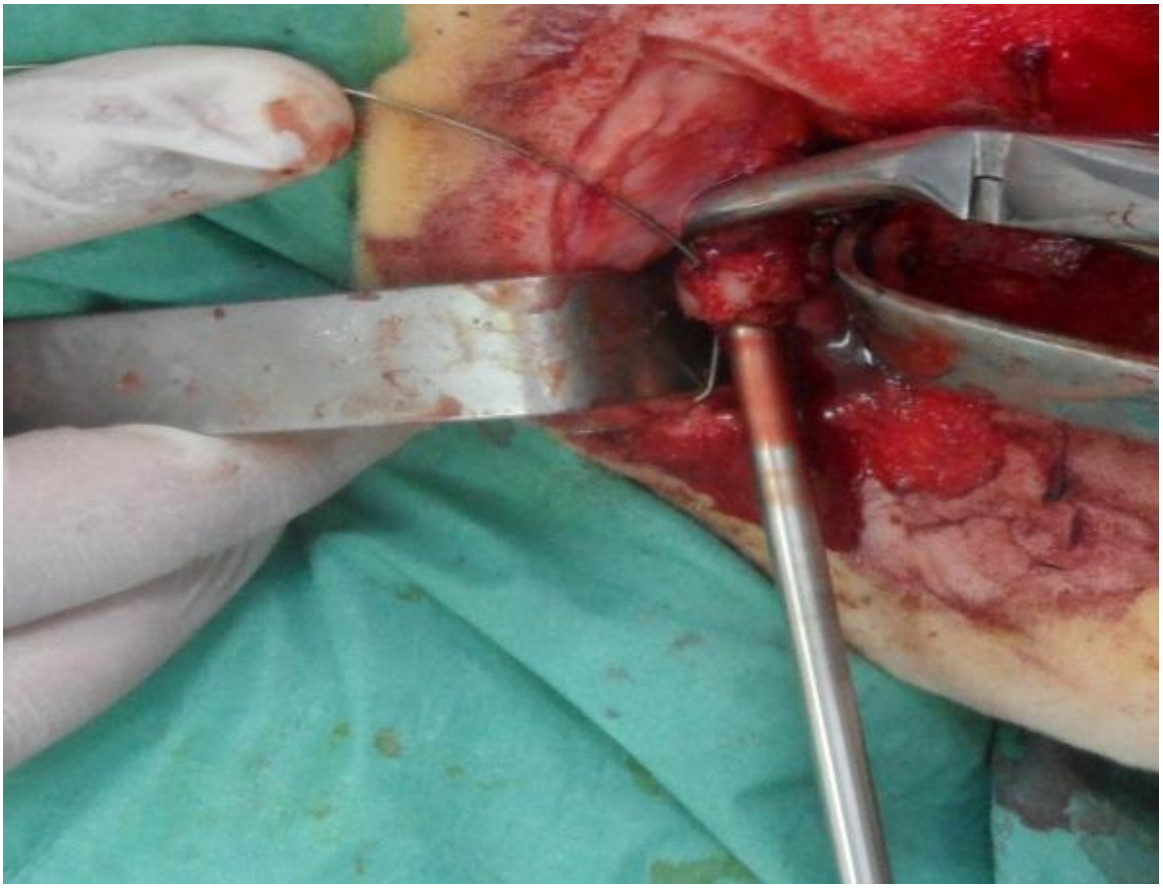

Figure 1. Intramedullary pinning and hemicerclage wire

Figure 2. Bone plate at the lateral face of femur

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RESULTS

Osteosynthesis performed under general anesthesia effect, a sufficient operating time for the installation of two types of fixation; muscle relaxation and analgesia showed no failure throughout the procedure. However, the application of a bone plate took longer operative time than an intramedullary pinning. The average time for setting up a bone plating and intramedullary pinning fixation respectively is 1h 30 min and 45 min.

One dog treated with the bone plating has presented two major intraoperative complications, which are muscle damage and embrittlement bone during screwing. For the remaining animals, the sequence of interventions revealed no complications, and the awakening took place peacefully. During the post-operative follow, we found the presence of oedema at the operative site in all animals, and more significantly in patients treated with bone plate group (Fig. 3), its disappearance was observed after one week.

Neurological examination after surgery confirmed the absence of injury to the sciatic and femoral nerve in all animals. From a functional point of view, recovery and return to function of dogs treated with intramedullary pinning took place gradually; in contrast, the group treated with bone plating was very early but did not last long because the failure of the osteosynthesis material used (Table 1).

A **B**

Figure 3. Postoperative edema of two groups (A: group 2; B: group 1).

Table 1. Evolution of clinical support animals during the follow-up perio

		1st week		2nd week		3th week		4th week		5th week		6th week	
	Support	Station	Walking	Station	Walking	Station	Walking	Station	Walking	Station	Walking	Station	walking
Groupe 1	Case N°1	±	-	±	-	+	+	++	++	++	++	++	++
	Case N°2	±	-	±	-	+	-	-	-	-	-	-	-
	Case N°3	±	±	+	±	+	±	±	±	++	++	++	++
	Case N°4	++	+	++	++	++	++	++	++	++	++	++	++
Groupe 2	Case N°1	+	±	-	-	/	/	/	/	/	/	/	/
	Case N°2	+	+	++	++	++	++	++	++	++	++	-	-
	Case N°3	++	++	++	++	++	++	/	/	/	/	/	/
	Case N°4	++	++	++	++	++	++	/	/	/	/	/	/

±: very light support. +: Lightweight Support. + +: Full Support

In the sequential x-ray evaluations, it was seen that both groups concluded the bone repairing process, with the group in which the intramedullary pinning was placed - G 1 (group 1) - presenting a faster recovery and a shorter evolution time.

In the analysis of the three parameters: periosteal reaction, bone bridge formation, and bone callus formation, G1 (group 2) showed a better evolution regarding union process. Periosteal reaction was graded as slight (+) to moderate (++); bone bridge was evaluated by the presence of bone fragment joining fractured ends. Table 2 represents the comparative radiological evaluation of the groups in percentages.

Table 2. Table showing radiographic occurrences at P1; P2; P3 and P4.

		Periosteal reaction	Bone bridge formation	Bone callus formation
P1	15 days G1	75% (+), 25% (++)	25%	-
	15 days G2	25% (++), 25% (+)	-	-
P2	21 days G1	75 (++)	75%	50%
	21 days G2	50% (++), 25% (+)	-	+/-
P3	28 days G1	25% (+++)	75%	75%
	28 days G2	50% (++)	-	+/-
P4	35 days G1	75% (+++)	75	75%
	35 days G2	25% (+++)	-	25%

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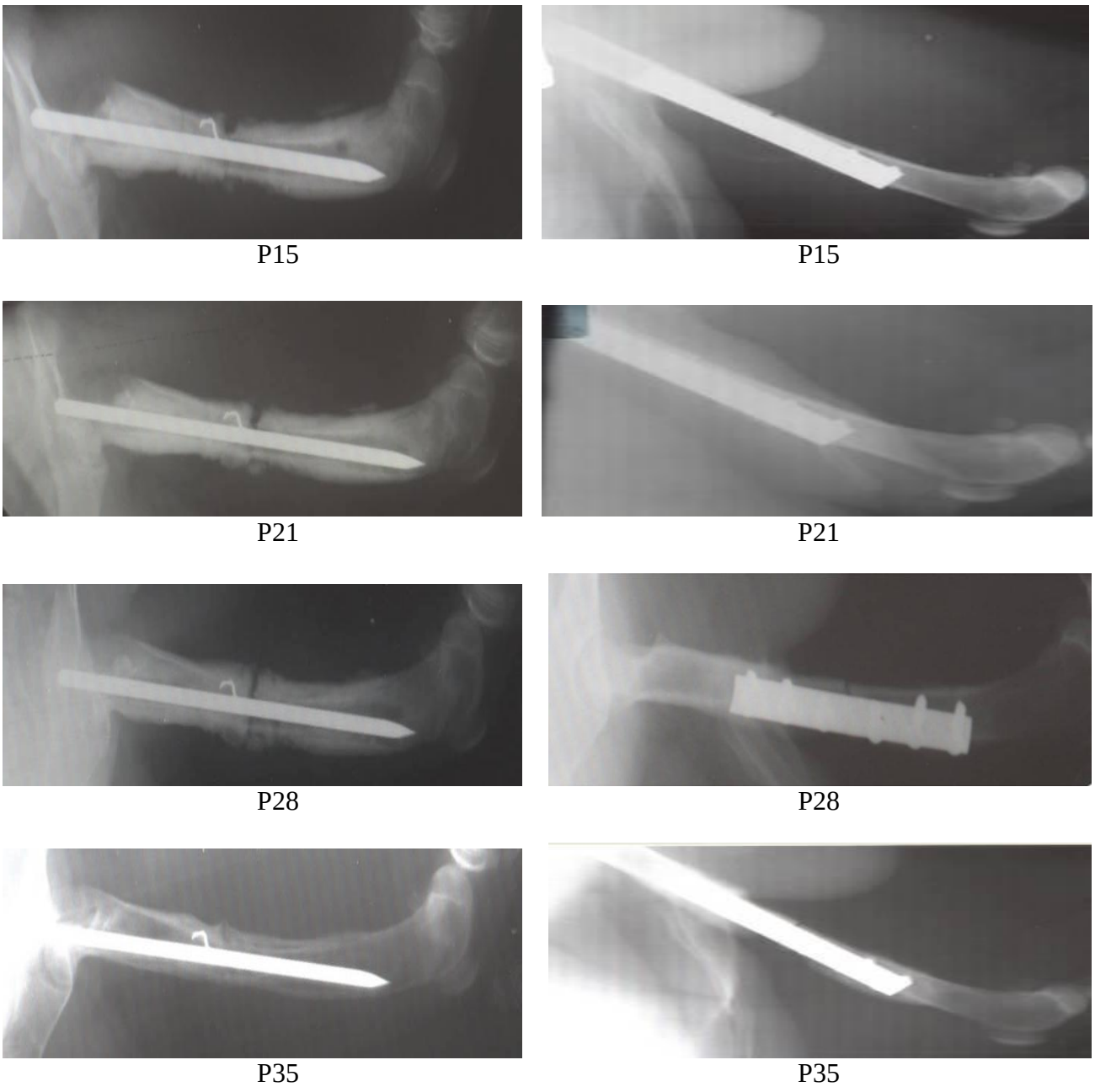

Figure 3. Radiographic evolution between the groups (Lateral x ray)

DISCUSSION

According to Daglar et al. (2007), intramedullary pinning operation take less operative time than plating operation this reflect less exposure to anesthesia and this is of benefit specially in risky patients as elderly and multiply injured patients. In one study showed that the advantages of retrograde pinning might include decreased operative time, decreased blood loss, and amenability to poly trauma situations.

Our study shows the effectiveness of the fixation intramedullary pinning compared to the bone plate, with functional improvement, increased consolidation ratio and mechanical solidarity in the use of intramedullary pinning. Same results are found by the study of Kesemenli et al. (2012). Intramedullary pinning favors charging member, and allows by law of Wolff accelerate callus strength and prevents muscle atrophy and joint ankylosis (Mills and Jackson, 2003).

The evolution of bone callus formation happens in the following periods: P28, P35 a, with a better performance at fracture cores in G1, when compared to G2.

The results of present study showed early support and functional recovery of the member in the group treated with bone plating; but the group 1 has a progressive support but with aire perm ant compared with the G2 with has not durable in the time. This finds are similar constant reported by Brinker et al. (1994).

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Intramedullary pinning is minimally traumatic as they interfere with endosteal and not periosteal callus formation (Stiffler, 2004). In this study, the radiographic follow-up showed that, after 15 days, bone repair process had already been started; this finding is in accordance to Piermattei et al. (2006), when referring to intramedullary pinning as a way to stimulate a fast beginning and formation of a bone bridge. However, we can see that a higher number of animals in G2 weren't presented a beginning of bone bridge formation; the radiographic events seen for G1 at subsequent periods showed a better development of callus formation, and also the presence of bone remodeling process; those findings have not been evidenced in G2

Harasen (2003) added that, the intramedullary pin fixation is effective in neutralizing bending forces as the bending support afforded by intramedullary pin depends on the load sharing between the bone and pin. intimate contact of the intramedullary pin with the endosteal surface improves the bone resistance to bending and horizontal shear forces, a fact which coincided with study of Bernarde et al (2001); who added that bone pinning currently represents the most effective treatment for most diaphyseal fractures in the femur. The intramedullary pinning showed a marked bone growth in the process of fracture repair presenting bone tissue loss. However, it is important to underline that osteoprogenitor cells and inductive factors are essentially responsible for a good bone repair process course.

CONCLUSION

By the present study, we can conclude that the intramedullary pinning stimulates the early beginning of bone repair process in dogs when compared to the bone plate fixation, the radiographic finding show a better evolution of the bone callus formation with the use of an intramedullary pinning.

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