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EXPERIMENTAL STUDIES ON DIFFERENT TECHNIQUES ADOPTED FOR TREATMENT OF LONG-BONE FRACTURES WITH SPECIAL REFERENCE TO INTERNAL FIXATION.

BY

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SUMMARY

The aim of this study is to evaluate the different tehniques adopted for long bone fracture fixation including single intramedullary pinning, multiple intramedullary pinning and plate and screw.

Thirty mongrel dogs over the age of one year were used in this study. In the dogs femoral fractures were achieved. These were divided into three groups according to the method of fracture stabilization (single intramedullary pinning, multiple intramedullary pinning, or plate and screw fixation). The results were evaluated clinically and radiologically for all groups,

INTRODUCTION

Bone fractures Constitutes a main problem in small animals specially in dogs. The most commonly affected bones are the long bone (Tercav, 1978). The femur is considered to be the most common site of fracture among long bones (leonard, 1971 and De Angelis, 1975) and it represented 40 % of fractures encounterd in dog extremities. in Egypt (Ahmed, 1982). The surgical dealing of these differes fracture dependesg on the location and the type of the fractue. (Nunamaker, 1985).

Intramedallary Fixation was the most Commonly used technique (Rudy. 1975 and Brinker 1984). Single pins was applied for treatment of diaphyseal fracture. (Stephens, 1981; Leighton, 1982; Brinker, 1965 and. Nunamaker, (1985). Mutiple

pinning technique called stack pinning was a relatively easy procedure that usually result in few complications (Gilmore, 1990). Intramedullary pinning can be accomplished with a modest investment in implants and equipment compared to bone plating techniques. However rotalional instability was found to be the most difficult problem in the intramedllary pinning (Rudy 1975 and Vasseur et al 1984).

The aim of this study is to evaluate different direct techniques adopted for long bone fractures fixation including single and multiple bone pinning as well as plate and screws.

MATERIAL AND METHODS

Thirty mongeral dogs aged over 1 year were used as experimental animal, All dogs were housed in separat kennels. The dogs were bathed with diazinone 1: 1000 and injected subsutaneously with Ivermection 0.1 mg / kg.

These dogs were classified into 3 groups, ten animals each. Group 1 was treated by single intramedulary pinning, group 2 by multiple intramedulary pinning and the third group by plating and screw fixation.

These animals were prepared for aseptic surgical operation at the hip joint and sacral region including the whole limb till the hock joint.

The anaesthetic regime was after Short (1987) and included mixture of Atropine sulphate 0.05 mg / kg b. w., diazpam 0.5 mg / kg b.w. as preanaesthetic. Induction was via mixture of xylazine Hcl 1.1 mg / kg b.w and ketamine Hcl 5 mg / kg b.W. Anaesthesia was maintained by thiopentone sodium .

The used plates were with7 holes 3.5 mm dynamic compresion plates and seven 3-5 mm cortical screws.

Surgical Technique:

Lateral approach to the femoral shaft (Denny 1985) was performed. Mid shaft fractur was induced using Gigli saw. In group 1 and 2, Intramedullary pinning of the femur was performed retrogradely according to Olmstead and Newton, (1989) using a pneumatic drill. The pin was cut to appropriate length. In group2, the used pins were almost equal to the narrowest diameter of the bone being pinned. The diameter of the used pins ranged from 2-5 mm. In group 3, the plates were moulded to the anatomic contours of the bone. The cortex was drilled using 2.7 mm holes drill then measured using depth gauge and tapped using 3.5 mm cortical tap diammeter then the screws were driven. Reduction of the fracture site and fixation using bone holding forceps was performed in all animals. The holes were made eccentricily to achieve an axial compression on the line of fracture. (Nunamaker, 1985 and Newton, 1989). Muscle, fascia and skin were closed. All animals were to be confined to complete rest and recieved cephalosporin of 0.5 gm injection every 6h, I M for 7 days.

Mediolateral and cranio caudal radiographes were taken for each dog at 2 week interval post operatively and final radiograph just before euthanesia.

RESULTS

Group 1:

Clinically, slight oedema at the operation site was found post operatively in the first 2 days. then disappered gradually. The surgical wounds were clean and healed without complications. The gait was evaluated in all dogs one day post operatively. The affected leg was just touching the ground then bearing weight with development of outward deviation, this lasted till euthanasia. Radiographically, it showed calus formation 2 weeks postoperatively, and after extraction of the pin . It showed different stags of healing till complete remodelling (four months postoperatively). (Figures A , 1, 2, 3).

Group II:

Clinically oedema of the affected limb occured postoperatively and lasted for one week. The surgical wound heald within one week without complications. One day post operatively, the gait was evaluated and the dogs were allowed to walk . In the first day, just touching the ground, the improvement in weight bearing was active within 3 weeks without any outward deviation. 2 weeks postoperative radiographes showed optimum callus formation. At the end, excellent healing with remodelling of the bone shaft was clearly restored (Figure. A 4).

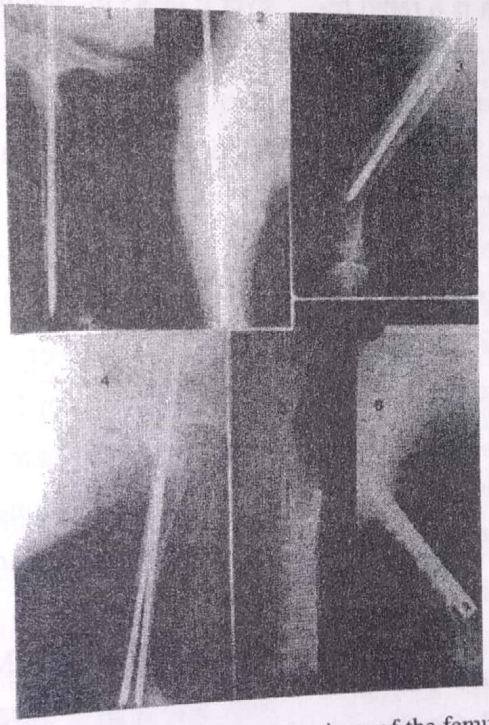

Figure A: 1 &2: Ventro dorsal and Medio lateral radio graphic views of the femur after single intramedallary bone pinning operation
3- Mediolateral radiographic view of the above dog after 12 weeks postoperatively sowing complete disappearnce of callus excellent remodelling and healing.
4- Medio lateral radiographic view of the femur. Showing perfect reduction and fixation post operatively with the use of three intramedullay bone pinning.
5 &6: Ventrodorsal and Mediolateral radiographic views of the femur 8 weeks post operatively showing complete fracture healing.

Group III:

Clinically there was slight odema from the first day postoperatively and regresed within 7-9 days. The surgical wounds were clean and healed within 7 days. The gait was evaluated one day post operatively and showed excellent weight bearing capacity in all cases and continued without alteration till euthanasia. Radiographs showed excellent reduction and proper fixation in all dogs. No callus formation could be detected after 4 months, excellent union and healing of the fracture ends. The plates (FigureA5 &6)) were removed after 4 months before euthanasia .

DISCUSSION

The primary aim of fracture fixation is a rapid return to normal function of the involved skeletal structures (Brinker, Hohen and Prieur, 1983). The principles used to achieve this goal include accurate anatomic reduction, atraumatic surgery and stable internal fixation (Harrari et al., 1986). However, inadequate stabilisation leading to delayed union or non union occurs frequently and may account for up to 52 % of the complications in fracture fixation (Lindahl, 1962; Cechner et al., 1977 ; Hunt et al., 1980). Meanwhile a variety of techniques are available in veterinary practice to provide fracture fixation.

In the present study different intramedullary pinning techniques were accomplished (single and multiple intramedullary retrograd) and compared with bone plating techniques to find out if these techniques provide adequate rotational stability for healing to occur . In the present study 50 % of the treated cases using single pinning showed different complications as delayd union, non-union and false joint formation. The repaired femoral fractures in the rest of the cases took longer time than in other techniques. The radiographic follow up in this study showed definitely that this delayed healing was because of the inadequate rotational stability. An exaplanation which met with that of Church and Schrader, (1990) . This would explain the variation in the duration of fracture healing in each group. Evaluation of healing depended mainly on radiographs, however, physical examination of the fractured limb was performed each time.

The single intramedullary pin was found to be effective only in neutralising bending forces. however it lacks the ability to resist axial and rotational forces (Schwartz, 1991). The intramedullary pinning has an advantage over other methods of fixation in that the implants are positioned within the medullary cavity near the neutral axis of the bone, making plastic deformities unlikely. Moreover, the diameter of the used pin seemed to play a role in this respect, as all the failed cases were pinned with 3 mm Steinmann pins. On the other hand, bigger diameters (4, 4, 5 & 5 mm) seemed to reduce the rotational forces. Meanwhile, angular stability was found to be achieved by anchoring the pin (s) in the proximal and distal cortical and trabecular bone. Moreover, bending and horizontal shear were best neutralised when there is an intimate contact of the implant with the inner cortical surface. Intimate contact of the implant to the bone allows effective load trasfer across the fracture site due to the development of adequate shear stress between the implant and the bone

(Perren, 1979). In this respect radiographic measurement of the diameter of the medullary canal was helpful in predicting the suitable diameter of the pin needed for fixation, also to avoid longitudinal cortical fissures (Vsseur et al., 1984). The ability of an intramedullary pin to resist bending forces is directly proportional to the diameter of the pin as well as to the ratio of the pin diameter to the medullary diameter (Hulse, 1980; and Smith, 1985).

In the present work fractures fixed with two or more pins gave better results. Dallman et al., (1990) concluded that multiple pinning technique was 1.8-3 times as effective in reducing rotational forces as single or double pinning techniques. They added that pins when driven as far distally as possible provided good embedement in the condylar cancellous bone. Moreover, multiple pins would fill the medullary cavity and provide pin cortex fixation within the femur (Nunamaker, 1985). Such improved rotational stability (four times as single pin) was partially due to obtaining multiple point fixation in both the proximal and distal fragments as well as the generation of greater implant to bone shear stress. Meanwhile, Rudy, (1975) and Chaffee, (1977) stated that the use of double pinning technique improved rotational stability because of the increased friction in the medullary cavity and from embedement of the pins in cancellous bone in different locations within this bone, in one or both ends of the long bone.

The obtained results showed that properly applied bone plates provided the most stable form of fracture fixation. Prieur and Smith, (1984) and DeYoung and Probst (1993) stated that bone plates were effective in neutralising all forces that commonly act on fractures including compression, tension, shear, torsion and rotation. Regrading the length and width of the used plates and the diameter of screws it was concluded that increasing the length was more important than increasing the width or using larger diameter screws, as longer plate distributes the stresses over a greter length of the loaded bone (Hulse, 1980; Smith, 1985; and Schwartz, 1991). However, in the present study radiographic studies revealed the presence of minimal loss of bone density beneath the plate and the fracture healed without deformtaus with minimal callus due to rigid immobilisation provided by the plate (Burk & Acherman, 1986, Wilson, 1988 and Uhthoff et al 1994) .

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