Correction of femoral fracture in a cat by intramedullary pinning at UMK Teaching Hospital, Malaysia.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

Abbreviation	Elaboration
%	Percentage
µL	Microliter
µm	Micrometer
BID	Two times a day
gm/dl	Gram per liter
GRA	Granulocytes
HCT	Hematocrit
HGB	Hemoglobin
IM	Intramuscular
IMP	Intra medullary pinning
IV	Intravenous
LYM	Lymphocytes
MCH	Mean corpuscular hemoglobin
MCHC	Mean corpuscular hemoglobin concentration
MCV	Mean corpuscular volume
Mg	Milligram
MON	Monocytes
MPV	Mean platelet volume
PCT	Plateletcrit
PCV	Packed cell volume
PDW	Platelet distribution width
Pg	Picogram
PLT	Platelet
RBC	Red blood cell
RDW	Red cell distribution width
SC	Subcutaneous
SID	Once daily
WBC	White blood cell

ABSTRACT

The current case report's goal was to outline a surgical strategy for treating a cat's femur fracture. During an externship placement, the case was documented at the University Malaysia Kelantan Veterinary Medicine Teaching Hospital located in Bachok, Kelantan, Malaysia. A Domestic short-haired male cat, nine months old and weighing 3.7 kg, named Oreo was brought to the UMK hospital after experiencing leg-carrying lameness as a result of being struck by a car on the road. Physical examination revealed that the cat was alert and active. Right femur discomfort and crepitation were felt upon palpation, and a complete femoral fracture was confirmed by radiography. The doctor fixed the bone by pinning but it came out by rupture of skin Then they decided to do pinning for the second time. Using a conventional surgical technique, retrograde intramedullary pinning (pin type K WYRE, 1.6 mm) was used to treat the fracture. Throughout the procedure, general anesthesia (Isoflurane only, 5% for induction and 3% for maintenance) was administered and maintained. Amoxicillin and clavulanic acid combination (17 mg/kg, IM), Meloxicam (0.3mg/kg, SC), Tramadol (4 mg/kg, slow IV), vitamin K1 (2.5 mg/kg, SC) and vitamin B12 (100 mcg/kg, IM) were used as preoperative medications. Clindamycin (30 mg/kg, IM, SID, 6days), Meloxicam (0.3 mg/kg, SC, SID, 3days), Methylcobalamine (500 mcg, orally, BID, 6days), Beazyme tablet (1 tab/1,50000 IU Papain, orally, BID, 6days) and Sonoton therapy (15 mins, BID, for 6days) were given together with protective bandages as part of the post-operative treatment. On the seventh postoperative day, mild weight-bearing was noted, and on the tenth day following surgery, the sutures were removed. Three months following surgery, the cat was fully recovered and able to bear weight on the injured limb, with no difficulties related to bone repair. The current case study indicates that treating feline femur fractures with intramedullary pinning with wires is highly successful.

Keywords: Femur fracture, intramedullary pinning (IMP), radiography.

CHAPTER I
INTRODUCTION

Cats have long been cherished companions and members of countless households worldwide. Their role as pets has evolved from mere utility to that of valued family members. This elevated status places a significant responsibility on veterinarians and the field of veterinary medicine to ensure the health and well-being of these beloved feline friends. Orthopedic injuries, particularly fractures, are among the most common and challenging medical issues to treating cats (Aithal et al., 1999; Scott, 2005). A fracture is a loss of continuity and balance in the bones and cartilages caused by injury to the bone tissue. A frequent issue in the field of orthopedics in both dogs and cats is the occurrence of long bone fractures. Among the various bones susceptible to fracture, the femur, the longest and one of the strongest bones in the feline skeletal system. According to Scott (2005), these fractures make up 50% of all feline fractures, and the femur is a commonly broken bone in both dogs and cats, as noted by Johnson et al. in 1989. Furthermore, it was demonstrated that femoral fractures constitute 45 percent of all long bone fractures, with femoral diaphysis fractures making up 28 percent of these fractures (Harasen, 2003). Another study by Das et al. in 2010 found that the femur had the highest proportion of fractures at 42.86 percent, followed by the humerus at 25.40 percent, the radius and ulna at 20.63 percent, and the tibia and fibula at 11.11 percent.

Fracture patterns will vary based on the specific forces the bone experiences, such as compression, bending, tension, or torsion (Cullinane *et. al.*, 2001). Additionally, the rate at which force is applied, as pointed out by Johnson in 2002, can influence both the type of fracture and the extent of soft tissue damage. Various types of femur fractures, including those involving the capital physeal, femoral neck, trochanteric, subtrochanteric, diaphyseal, supracondylar, condylar, or distal physeal regions, can occur. In immature dogs and cats, femur fractures are most commonly found at the proximal or distal physis. For long bones, the metaphyseal, diaphyseal, and epiphyseal segments may also be affected (Tercanlioglu and Sarierler, 2009).

The evaluation of a femur fracture in a cat is crucial for effective treatment planning. Cats have a tiny body size and a tendency to wander into traffic, which makes them vulnerable to complex fractures. Both palpation and radiography are effective means of identifying fractures in cats. It's

essential to assess factors like the fracture's location, whether it's open or closed, the type of fracture, joint involvement, and the direction of distal fragment displacement. When treating femoral fractures, techniques such as biological osteosynthesis and anatomic reduction with stabilization can be employed. The choice of surgical approach will vary depending on the chosen method. However, in less severe cases, cats can often be restored to health through less invasive treatments rather than extensive reconstructive surgery. The fundamental idea is to realign two fracture fragments to their natural positions, either through closed or open fixation procedures. Repairing long bone fractures can be achieved using a range of devices, each with its advantages and disadvantages. These devices include the lag screw, intramedullary pin, bone plate, and screws, interlocking and cross pins, dynamic compression plate, and cerclage wire (Perren, 2002; Horstman *et al*., 2004).

Among all the surgical techniques that have been developed to address femur fractures in cats, intramedullary pinning emerging as a notable option (Scott, 2005). Intramedullary pinning involves the placement of a metal pin or rod within the medullary cavity of the femur to stabilize the fracture and promote healing (Stigen, 1999; Scott, 2005). The process of inserting pins is straightforward from a technical standpoint, and the required tools and implants are both affordable and readily accessible. The feline femur is characterized by being a straight, tubular bone with a large medullary canal. It's important for the pin to fill approximately 70% of the medullary canal's diameter, thanks to a significant additional blood supply outside the bone, which contributes to speedy healing. Most fractures typically affect the diaphysis and the distal shaft of the femur. Intramedullary pinning approach has gained popularity due to its potential benefits, such as reduced complications and improved postoperative function.

The aim of this case report is to explore the clinical and radiological evaluation of a femoral fracture in a cat and the successful stabilization of the fracture using intramedullary pinning guided by a C-arm X-ray.

CHAPTER II

MATERIALS AND METHODS

2.1 Case History

Oreo, a nine-month-old domestic short-hair cat, arrived at the UMK Veterinary Medicine Teaching Hospital weighing 3.7 kg and presenting with a history of injury to his right-hind limb. Oreo was struck by a car on the road, according to the owner's complaint. The cat was unable to support its weight on its right hind limb upon presentation. Upon palpating the afflicted limb, palpation revealed signs of discomfort and crepitation. To locate the fracture, a preoperative radiograph was obtained. Radiographs revealed a proximal segmental fracture of the right femur. Using the results of the radiographic evaluation as a guide, C-arm guided intramedullary pinning was done but the pin came out by rupture of skin. Then the doctor decided to do intramedullary pinning for second time. The owner's verbal consent was obtained to carry out the procedure. Before surgery, the patient's overall health was also recorded.

Table 1: CBC report of Oreo

Haemogram		Test Result	Reference value
WBC	10^3/µL	16.4	6.0-15.15
LYM		**7.3 H**	1.0-5.0
MON		**1.5 H**	0.1-1.0
GRA	10^3/µL	7.6	2.0-8.0
LYM%	%	44.3	20.0-55.0
MON%	%	9.3	2.0-12.0
GRA%	%	46.4	35.0-75.0
RBC	10^6/µL	**9.48 D**	6.5-10.00
HGB	g/dl	12.2	10.0-15.0
HCT	%	45.0	30.0-45.0
MCV	µ^3	47.5	39.0-55.0
MCH	pg	**12.9 L**	25.9-34.0
MCHC	g/dl	**2.1 L**	30.0-35.9
RDW	%	**17.3 H**	10.0-16.0
PLT	10^3/µl	102	300-800
MPV	µm^3	9.5	7.0-11.0
PCT	%	**0.097 L**	0.200-0.500
PDW	%	**42.4 H**	10.0-18.0

2.2 Radiographic Examination

A radiographical examination was performed on lateral and ventral views by using a digital X-ray machine which confirmed that the cat had suffered from a postoperative injury with a pin that came out by rupture of the skin (Figures 1 and 2).

Figure 1: Lateral view of X-ray of hind limb

Figure 2: Ventral view of X-ray of hind limb

2.3 Restraining and Anesthesia

The cat was restrained by a towel and an assistant held the cat and another assistant provided inhalation anesthesia (Isoflurane 5%). After 5-6 minutes the cat was relaxed and anesthetized. Then they inserted a 3.5 mm cuffed endotracheal tube through the trachea and reduced the Isoflurane percentage to 3%. The area was shaved with a trimmer and washed the skin with chlorhexidine, then alcohol, and then 5% povidone-iodine. Then shifted the cat to the OT table.

2.4 Preoperative Medication

The doctor injected a combination of Amoxicillin and Clavulanic acid @ 17mg/kg, IM; meloxicam @ 0.3 mg/kg, SC; Tramadol @ 4 mg/kg, slow IV; vitamin K1 @ 2.5 mg/kg, IM; and vitamin B12 @ 100 mcg/kg, IM as preoperative medication to reduce pain and infection during surgery.

Figure 3: Induction of anesthesia, endotracheal intubation, surgical site preparation and preoperative patient preparation.

2.5 Surgical Technique

After patient preparation and draping of the patient, the previous suture was removed, and the previous incision line was opened by blunt dissection. The incision was given on the subcuticular muscle layer to expose the underlying muscle bundles. Then by blunt dissection, the muscle bundles of vastus lateralis and biceps femoris were separated to expose the underlying bone. The point of fracture was identified by retracting the muscle bundle and exposing the fractured bone. The fractured parts were taken in apposition with each other and held by bone-holding forceps. Then two intramedullary pins (k-WYRE 1.6mm) were inserted obliquely through the lateral and medial condyle into the medullary cavity of the femur. Then holding the condyle using bone-holding forceps the intramedullary pins were curved according to the natural curvature of the condyle. The pins were cut at the appropriate size (8.9 mm for both pins) using a pin cutter. The

site was washed with metronidazole solution (5 mg/ml) and Normal saline solution. Then the muscle layer was closed using absorbable suture materials Ecosyn 3/0, Poly (Glycolide-co-Caprolactone) in a simple continuous pattern. The subcuticular layer was closed using the same suture material in a simple continuous pattern. The skin was closed by non-absorbable suture material Brilon 3/0 Synthetic, Monofilament, Polyamide in an interrupted horizontal mattress pattern.

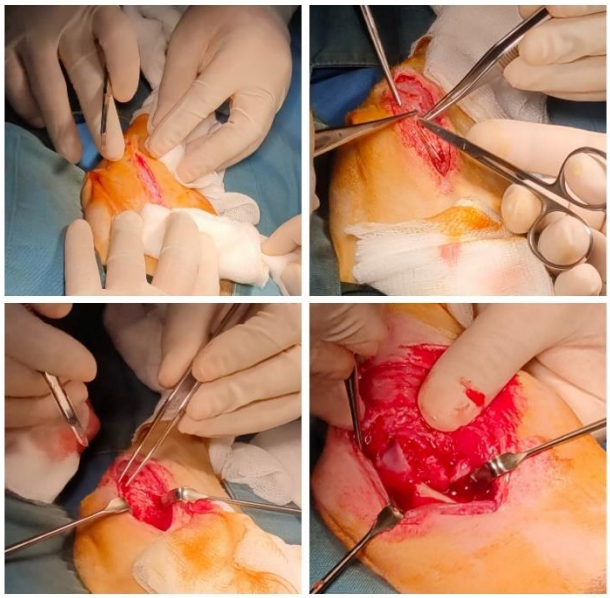

Figure 4: Incision of skin exposing underlying tissue

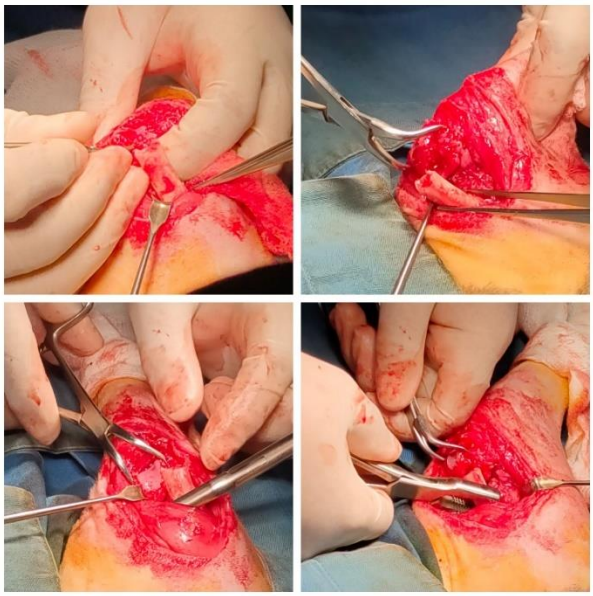

Figure 5: Exposing fractured bone

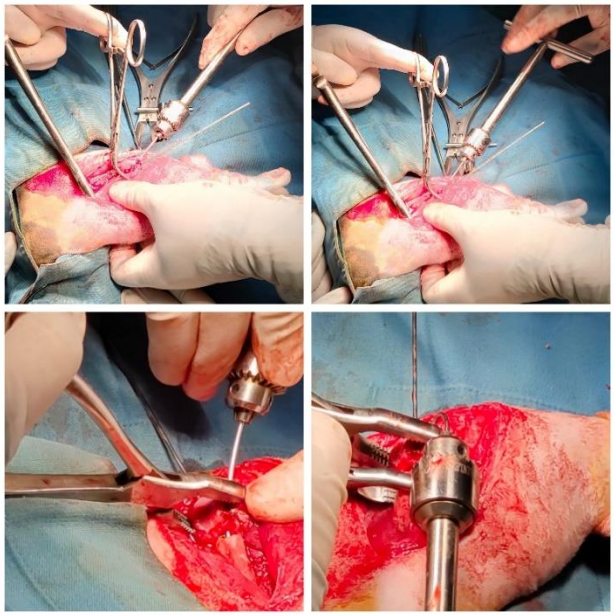

Figure 6: Insertion of intramedullary pin

Figure 7: Fixation of fractured bone

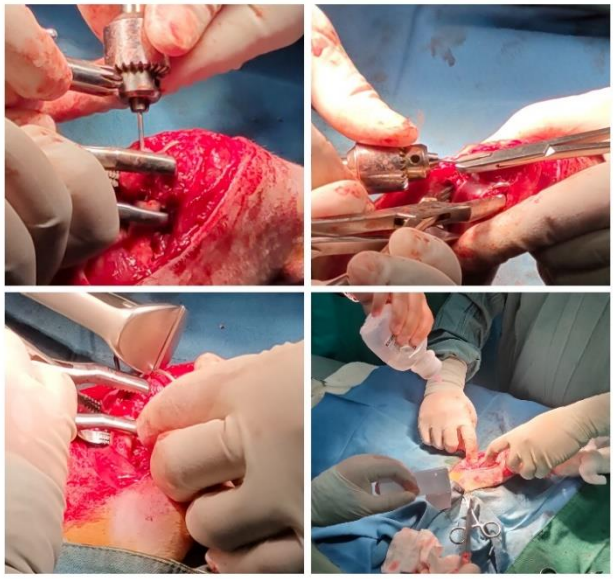

Figure 8: Fixation and cutting of pin

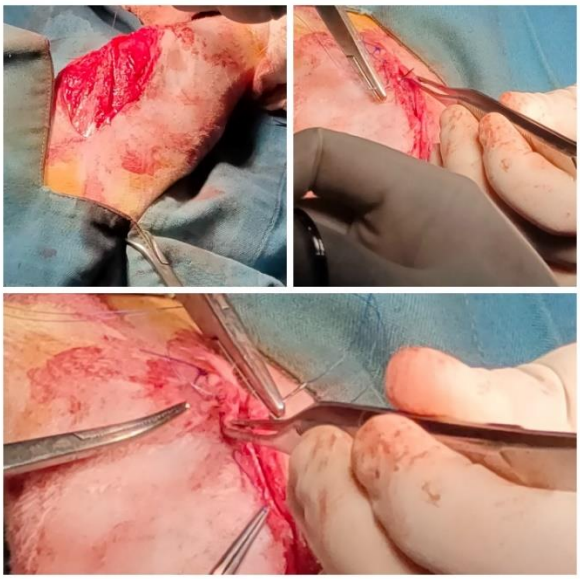

Figure 9: Suturing muscle, subcutaneous tissue and skin

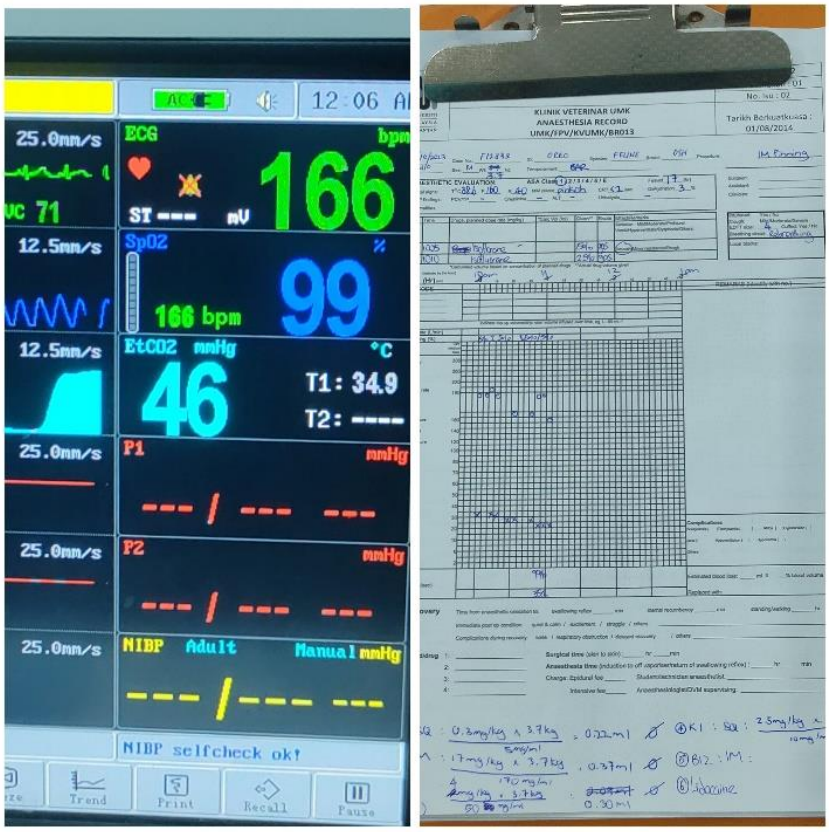

Figure 10: Vital signs monitoring and record keeping

2.6 Post-operative Care

After surgery Chloramphenicol 1% ointment and ‘Opsite spray’ was applied to surgical wound then modified Robert Johnes Bandage was applied on the affected leg. Postoperatively the cat was treated with systemic antibiotics, analgesics, and nerve tonic with a protective bandage and restricted movement for one week. Fentanyl @ 50 mcg/kg was given in a single dose to reduce post-surgical pain. Clindamycin @ 30 mg/kg, IM, SID, for 6 days; meloxicam @ 0.3 mg/kg, SC, SID, for 3 days; methylcobalamine @ 500 mcg, orally, BID, for 6 days; Beazyme tablet @ 1 tab (1,50000 IU Papain), orally, BID, for 6 days and ‘Sonoton’ applied on the affected area for 15 minutes, BID, for 6 days.

Again, the radiographical examination was performed after the the surgery on both lateral and ventral view by using a digital X-ray machine which confirmed that the pins were in good condition (Figures 12 and 13).

Figure 11: Applying modified Robert Jones bandage on the affected limb

Figure 12: Ventral view of postoperative X-ray of hind limb

Figure 13: Lateral view of postoperative X-ray of hind limb

CHAPTER III
RESULT AND DISCUSSION

The results of this study show that the cat was able to begin bearing some weight 7 days after the procedure and to be able to bear its entire weight 2 months and 15 days later. The femur's bone and shaft are the most often fractured locations in cats. Research into the past has revealed that falls from a considerable height and severe injuries are the two most common causes of fractures. (Denny and Butterworth, 2008). Anatomically reduced fractures were tightly anchored using pins, wires, screws, and plates in traditional internal fracture healing techniques. This was carried out to reduce the possibility of more fractures. (Sultana, 2019). There are techniques that need to have pins inserted into the intramedullary area in order to be used with the femur. There are intrinsic problems in several of the well-established procedures for treating distal femoral fractures, including muscle tie-down, inappropriate reduction or pin placement, irritation of soft tissues, and joint pain or arthritis due to damage from pin cuts. These are, however, a few of the various methods. Furthermore, some techniques require additional surgical intervention to remove the implants after they have been placed. (Dehghani *et al*., 2013). However, it was shown that treating distal end femoral fractures with an arrow pin in addition to external fixation was effective. This was done to get around the issues mentioned before. Generally speaking, an intramedullary pin should occupy between 70 and 80 percent of the medullary cavity's diameter. An intramedullary pin can be inserted more quickly and easily, and once the osteosynthesis material has been withdrawn, the healing process is simple. The intramedullary two-way stacked Kirschner wire application is a more economical and successful technique for treating supracondylar and diaphyseal femoral fractures in cats. (Altunatmaz *et al*., 2017). Making the right pin selections is crucial because of the potential for pin migration and loosening. The size of the IMP cavity in the bone that needs to be fixed, the shape of the fracture, and the use of any additional means of fixing should all be taken into account when selecting an appropriate pin. It is advisable to use pins with sizes between 1.6 and 4.8 mm for most cats. (Sultana, 2019). However, since the cat was overly active in our situation, we utilized 2.5mm pins for greater stiffness. In this study, the subjective assessment of a patient's mobility throughout the postoperative period was based on a limited number of characteristics. Nonetheless, if a suitable scaled-based assessment for pain and mobility is employed in a longer study for the basic findings that we found in the majority of cats, it may

be possible to argue that the arrow pin technique is a better way to fix femoral fractures in cats. This would only be the case if a longer study period was used to examine the outcomes found in the majority of cats. (Rathnadiwakara *et al*., 2020). The patient was given post-operative antibiotic medicine after surgery with the hope that it would help treat any secondary bacterial infections that could have arisen. In cats, the absence of discharges or post-operative edema at the surgery site indicated that the post-operative treatment was being successfully delivered there. (Erwin *et al*., 2018). Postoperative care must be managed carefully to prevent problems. Pin detachment and migration are the most frequent problems associated with intramedullary pinning procedures, which are considered to carry a significant risk. Conversely, another risk associated with open fractures is infection. The cat's immunity in this investigation also aided in his speedy recovery.

CHAPTER IV
CONCLUSION

The research indicates that intramedullary pinning is a reasonably priced, effective treatment option for femur fractures that provides satisfactory stability with few complications. Strong fixation and good alignment are given to the broken bone by the intramedullary pinning. Considerations for managing fractures include using the right surgical approach, providing sufficient reduction and stability, choosing the right fixing method, preserving soft tissue, and providing the right postoperative care. In the end, we determined that the use of intramedullary pins was a safe and economical fracture care technique for a cat with a complete femur fracture.

LIMITATIONS

No serum biochemical test of the patient was done. A cultural sensitivity test of the sample from the wound was not done to aid in appropriate antibiotic selection. No supplemental heat source was supplied to prevent hypothermia during surgery.

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