A Successful Surgical Correction of Long Bone Fracture in Cat by Retrograde Intramedullary Pinning: 2 Cases

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The Author

Abstract

One of the most frequent clinical manifestations seen in feline patients is fractures. They are most frequently brought on by severe trauma, such as that which results from car accidents, high-rise syndrome, and dog bites. This study's objective was to retrospectively assess the frequency of feline long bone fractures that were successfully treated by intramedullary pinning. Intravenous anaesthetic was used to successfully treat a total of 2 occurrences of long bone fractures in cats of various breeds. A 14-month and 13-month indigenous male cats' weight 4.2 kg and 3 kg were admitted to Teaching and Training Pet Hospital and Research Center, Purbachal, Dhaka with the history of injury in the long bone. The cat's owners complain that they were hurt when they fell from the building's fifth and seventh floors. According to a clinical evaluation, the cats were hardly able to bear its weight, and the injured limb also displayed symptoms of discomfort, including limping and crepitation. Oblique mid diaphyseal complete fracture of left humerous (Figure-2) and Complete transverse proximal diaphyseal fracture of right femur (Figure-3) were found in radiographic examination. Patients were prepared aseptically, and standard surgical techniques were used along with the appropriate anaesthetic protocol to accomplish the surgery. Preanesthesia was provided by xylazine, while maintenance was provided by ketamine and diazepam. The surgical treatment of the presented fracture patients involved intramedullary pinning procedures. The cats were given systemic antibiotics, NSAIDs, and protective bandages after surgery. All cases were assessed using radiographs and the clinical effectiveness of the operated limbs. Information was obtained by calling the owner. At the 14th post-operative day, light weight bearing was noted. At the 45th postoperative day, full weight bearing, a functional limb outcome, and bone healing were noted. According to the results of the current case study, managing long bone fractures in cats can be done successfully using the retrograde IMP.

Keywords: Intramedullary pinning; Fracture management; Long bone fracture; Retrograde technique

Chapter 1: Introduction

The number of cats kept as pets for entertainment is rising daily (Das et al., 2019). In Bangladesh, the high-rising syndrome, which is the main factor causing many fractures in cats, is also on the rise (Das et al., 2019). A fracture is an emergency situation that occurs when there are total or partial breaches in the continuity of bone or cartilage (Sharma et al., 2022). Fractures in small animals have become more common events recently, both in terms of frequency and incidence (Sharma et al., 2022). This high number of occurrences is happening because there are a number of automobile accidents, high-rise syndrome, rapidly growing pet animal population, human abuse, gunshot wounds and dog bite wounds etc. (Sharma et al., 2022; Zurita & Craig, 2022). Fracture usually harms several bodily systems, including broken bones and wounded limbs. (Zurita & Craig, 2022). Veterinary professionals and specialists are increasingly needed to treat a variety of fractures involving the humerus, radius and ulna, femur and tibia and fibula as the feline population rises (Zurita & Craig, 2022). Humeral fractures account for 5–13%, radial and ulnar fractures account for 2–14%, femoral fractures account for 20–26% (Libardoni et al., 2018; Zurita & Craig, 2022), and tibial fractures account for 10–20% of long bone fractures in cats (Zurita & Craig, 2022). Additionally, these accidents result in varying degrees of soft tissue damage to the surrounding tissues, including the muscles, tendons, ligaments, nerves, and blood supply, which eventually compromises the locomotor system (Sharma et al., 2022).

A fracture site might divide into 1 (proximal), 2 (diaphyseal), and 3 (distal) zones (Libardoni et al., 2018). Again, each fracture can be categorized as A (simple fracture), B (multiple fracture/reducible wedge), or C (comminuted fracture/non-reducible wedge), depending on its severity (Libardoni et al., 2018). Subsequently, the kind and degree of bone fragmentation are then taken into consideration when categorizing each evaluation into 1 (slight), 2 (moderate), or 3 (severe) categories (Libardoni et al., 2018). Early ambulation and complete limb function restoration are the ultimate objectives of a fracture repair (Zurita & Craig, 2022).

Fractures are diagnosed using history-taking, clinical, ultrasound, orthopaedic, and radiographic investigations (Libardoni et al., 2018). Reports include information on the species, age, gender, weight, and pathogen (Libardoni et al., 2018). In addition to swelling over the lateral aspect of the limbs and crepitation upon touch, the patient exhibits non-weight-bearing lameness of both the forelimb and the hindlimb (Ghosh et al., 2018). The clinical examination includes mental status,

respiratory rate and pattern, heart rate, mucous membrane color, capillary refill time and body temperature should be checked in order to detect signs of hemodynamic compromise (Zurita & Craig, 2022). Biomechanical evaluation, such as routine blood analysis, may be necessary to anaesthetize the patient and assess the cat's general health. (Zurita & Craig, 2022). Alkaline phosphatase, creatinine kinase, serum calcium, total erythrocyte and total leucocyte counts, haemoglobin, packed cell volume, lymphocyte, monocyte, and thrombocyte, mean platelet volume, mean corpuscular volume and mean corpuscular haemoglobin are the haemato-biochemical parameters examined (K et al., 2017). To rule out preclinical issues such as anaemia or renal illness, hematocrit, total solids, and blood urea nitrogen screenings should be performed (Zurita & Craig, 2022). Urine may be present in the abdominal cavity if the abdominal fluid's creatinine and potassium values are higher than those of peripheral samples (Zurita & Craig, 2022). Likewise, haemorrhage is present when the packed cell volume level in the abdomen fluid is higher than blood levels (Zurita & Craig, 2022).

The presence of abdominal discomfort, bruises, vomiting, and urinary tract symptoms notifies the doctor of a potential abdominal injury (Zurita & Craig, 2022). All traumatized cats should be screened for thoracic and abdominal imaging (e.g., utilizing ultrasonography, as well as radiography if the cat is stable) to find concomitant diseases of the abdomen and thorax (Zurita & Craig, 2022). In car accidents, 17% of cats with limb fracture have been reported to have thoracic trauma (Zurita & Craig, 2022). Determining fracture configuration requires radiographic imaging with orthogonal views (Zurita & Craig, 2022). CT may be useful when superimposed bones, such as those in the tarsi, carpi, and pelvis, make it difficult to determine the fracture shape on two-dimensional imaging. (Zurita & Craig, 2022).

Treatments are effective when applying basic repair concepts (Libardoni et al., 2018). Numerous external and internal techniques are used to manage different fractures in cat’s worldwide (Das et al., 2020.). There are several options for treating fractures, including internal fixation with open reduction, external skeletal fixation (E.S.F.) with open or closed reduction, and external coaptation to obtain direct bone healing (Sharma et al., 2022; Zurita & Craig, 2022). Bone plates and screws, intramedullary pins and cerclages, blocked intramedullary nails, and external skeletal fixators that use biological osteosynthesis or anatomical reduction and stiff fixation are all acceptable implants (Libardoni et al., 2018). The classification and severity of the instances allowed for an evaluation

of the fixing techniques (Libardoni et al., 2018). Depending on the kind and configuration of the fracture, fracture fixation procedures with substantial clinical results are used (Sharma et al., 2022). Each fracture fixation method has benefits and drawbacks (Sharma et al., 2022; Zurita & Craig, 2022). For example, external skeletal fixation may be beneficial for treating higher-grade open fractures because it makes it easier to manage wounds while stabilizing the fracture and has the benefit of being easily removable, which reduces the risk of implant-associated infection (Zurita & Craig, 2022). There have been reports of synostoses and radio humeral luxation as side effects of fractures stabilized by an E.S.F. (Zurita & Craig, 2022). A loose wire at the site of a fracture might impede healing because it affects the vascular buds trying to revascularize and heal the fracture (Zurita & Craig, 2022). This can prevent blood flow, recovery, or on-union (Zurita & Craig, 2022). Again, in order to maintain the axial alignment of the fracture and prevent the application of bending forces in all directions to the bone, retrograde intramedullary pinning, a simple and affordable internal fixation technique, typically functions as an internal splint of the medullary canal of a long bone that shares loading with other bones (Das, 2020.). The most frequent issue with using the simple I.M. pinning procedure was proximal pin migration and nonunion (Das et al., 2020. Sharma et al., 2022). If another fracture fixing method is employed concurrently, IM-pin migration can be decreased (Sharma et al., 2022). All invasive fracture fixation methods have postoperative challenges for the surgeon and the owner. (Sharma et al., 2022). The owner should always be informed by an orthopaedic surgeon about the results and potential complications of the fracture fixation technique (Sharma et al., 2022).

The purposes of this case report are to evaluate the outcome of the retrograde intramedullary technique of common fractures, e.g., humeral fracture and femoral fracture in cats and to know the success rates as well as complications if any of retrograde intramedullary pinning to the veterinarian of Bangladesh.

Chapter 2: Methods & materials

2.1 Case history:

Indigenous male cats aged 14 months and 13 months weighing 4.2 kg and 3 kg were admitted to Purbachal, Teaching and Training Pet Hospital and Research Center in Dhaka with a history of long bone injury. The cat's owner claimed that they were hurt when they fell from the fifth and seventh floors of the building. These patients were found to be unable to support their own body weight and unwilling to walk after completing a clinical evaluation.

Figure 1: Pre-operative patient condition case 1 (Left) and case 2 (Right)

2.2 Restraining and anesthesia:

The patients were restrained both physically and chemically. A sedated state was achieved in the cat by administering xylazine intramuscularly at a dosage rate of 2 mg/Kg. For general anaesthesia (GA), a combination of ketamine and diazepam was injected intravenously; the dosages of ketamine and diazepam were 10 mg/Kg and 0.5 mg/Kg, respectively.

2.3 Clinical Examination:

A. By physical examination

a) Close inspection:

The presenting signs were first carefully observed and noted during a close inspection. The patients were alert and active and also displayed lameness.

b) Direct palpation:

The damaged area was palpable with the tips of the fingers, and the humerus and femur bones felt broken in their original positions. The damaged area was intensely painful when palpated.

B. By imaging technique:

Radiography(X-Ray):

An X-ray was taken to determine the type and degree of the fracture. On the X-ray, it was noted that the right femur had a complete transverse proximal diaphyseal fracture (Figure 3) and the left humorous bone had an oblique mid diaphyseal complete fracture (Figure 2). It was decided to do X-ray guided intramedullary pinning utilizing simple Steinmann pinning after a radiographic assessment by the on-call clinician. Before beginning the surgery, the owner's consent was obtained, and a general examination of the patient was also done.

Figure 2: Oblique mid diaphyseal complete fracture of humerous (Case 1)

Figure 3: Complete transeverse proximal diaphyseal fracture of femur (Case 2)

2.4 Surgical Technique:

The patient was placed on the table in the operation theatre after the animal had been restrained and examined. The patient was then prepared for aseptic surgery by clipping, shaving, using povidone iodine, and finally wiping the damaged area's dermis with 70% alcohol. Over the area of the surgical site, a draper was placed and a skin incision was created, and the subcutaneous layer was separated. The muscular bundle was separated, taking care not to damage any blood vessels. A finger was used to guide a cut under the bone fracture by following the discretion of the muscle by blunt dissection after the muscle layer was incised. After that, bone curette and bone-cutting forceps were used to separate the broken bone. Hohman retractor, bone holding forceps were then used to place the broken bone down in its usual position. After that, the injured bone was drilled through using a bone drilling machine, and the drilling site was covered with a fixation splint. 2.5mm Steinmann pin was used to fix the fracture fragments. The muscle was then closed with a simple, continuous vicryl (no. 2-0) suture. Vicryl (no. 2-0) was also employed in a simple and continuous pattern to achieve the apposition of the subcutaneous tissue. Silk was used for the cross-mattress suture, which was used to affix the skin layers together. The region around the suture line was cleaned with povidone iodine. 200 ml of normal saline was given intravenously during the procedure. The damaged area was then immobilized with a bandage, and an X-ray was performed to establish that the intramedullary pinning procedure had been successful.

Figure 4: Patient preparation; case 1(Left) & case 2 (Right)

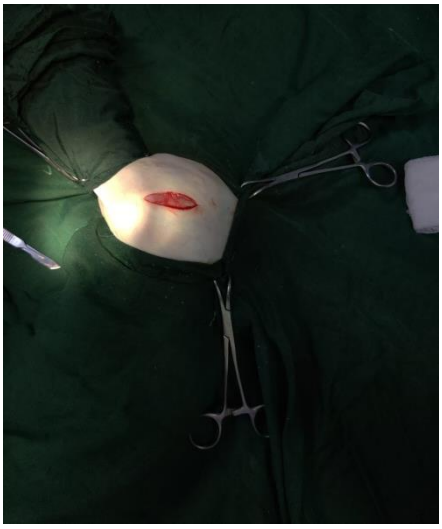

Figure 5: Skin incision in case 1 (Left) & case 2 (Right)

Figure 6: Exposed fracture fragments in case 1 (Left) & case 2 (Right)

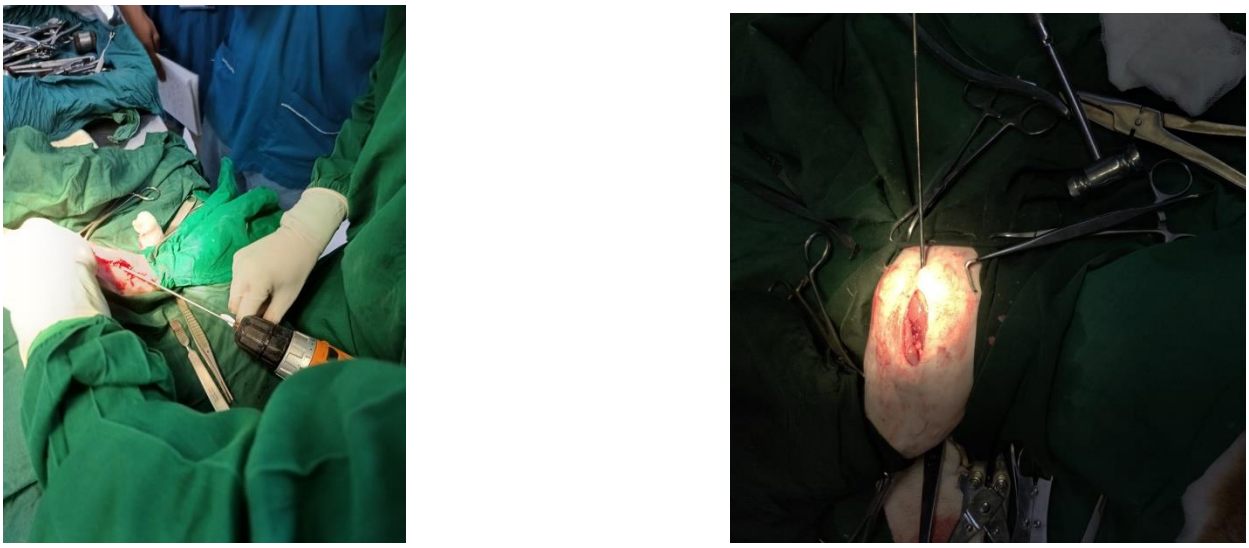

Figure 7: Intramedullary fixation in case 1 and case 2

Figure8: After successful internal fixation by 2.5mm Steinmann pin in case 1 (Left) & case 2 (Right)

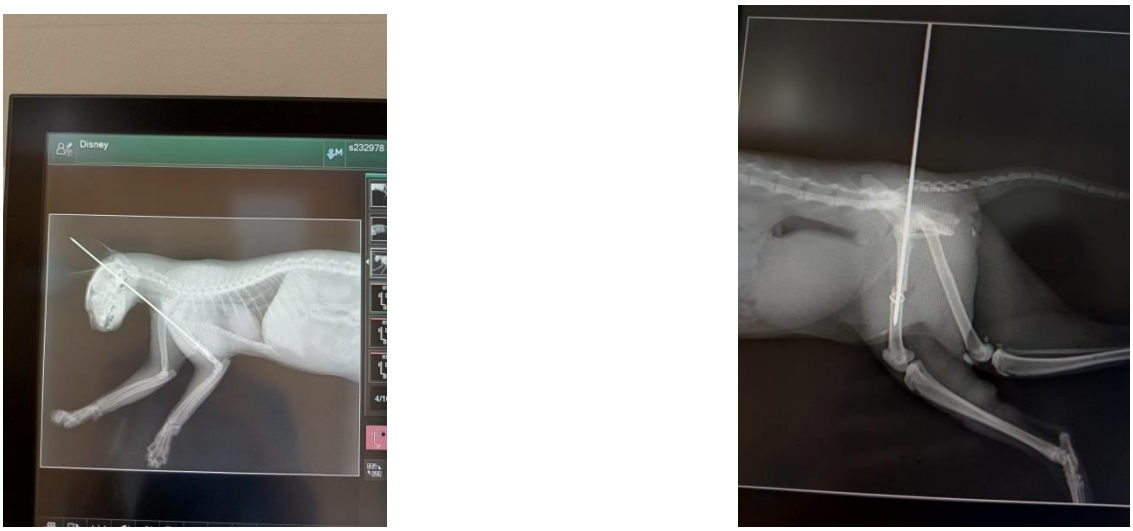

Figure 9: PO X-Ray case 1 and case 2

2.5 Post-Operative care:

Antibiotics and anti-inflammatory drugs were given to the patient to hasten the healing process. Ceftriaxone was administered intramuscularly for seven days at a dose rate of 50 mg per kilogramme (Inj. Trizon 250mg IM) to prevent secondary bacterial infection and Meloxicam was administered subcutaneously for three days to reduce swelling and pain. For a total of fourteen days, both therapies were given. Antihistaminic diphenhydramine hydrochloride (inj. Phenadryl), was administered intramuscularly as 0.2 ml over the course of seven days at a dosage of 2 mg/kg of body weight. For 15 days, a calcium supplement (Tab. Calbo-D) was advised for one month. The owner was advised to limit the cat's activity and keep the cat away from water until the pet had fully healed. After two weeks, the sutures were removed. Radiographic assessment persisted until the fracture had fully healed.

Chapter 3: Result

On a radiograph taken immediately following surgery, the displaced fragments had excellent apposition. The current study showed that the cats started to be able to bear partial weight 4–7 days after the operation. On Day 7 following surgery, the surgical incision had healed, and the stitches had been removed with no wound problems. After 2 months and 15 days, it was able to support its entire weight. The cats led a very happy life, and the owner was thrilled that information was obtained over the phone from the pet's owner. The current case study concluded that retrograde intramedullary pinning can be used successfully to treat long bone fractures in cats, and that it is not required to remove the pins because there are no complications.

Chapter 4: Discussion

In the current case study, indigenous male cats weighing 4.2 kg and 3 kg at the age of 4 months and 13 months, respectively, had humeral and femoral fractures. Persian cats only have a 3.17 percent fracture frequency compared to non-descriptive cats' (96.83%) metropolitan cities. Another study discovered that the age range with the highest fracture frequency was between six and twelve months (35.6%), followed by three years and older (20.1%), and one to two years (18.0%). This is likely because cats of this breed made up the majority of the cat population in metropolitan cities (Das et al., 2019.). This was most likely due to the fact that most of the cats were tightly supervised up to three months of age, and when they were permitted to travel freely after about three months of age, they were more prone to road traffic incidents (Das et al., 2019.).

Long bone fractures are the most prevalent in cats. The injury was commonly caused by trauma, a car accident, or jumping from high locations (Das et al., 2019). Cats falling from the fifth and seventh floors were the cause of humerous and femoral fractures in the current case study. This is due to the fact that young cats are very active and energetic, and they learn to cope with the risks of their surroundings via experience. Intramedullary implants, bone plating, and external skeletal fixing in small animals are among the treatments used to stabilize lengthy bone fractures. It is possible to utilize additional fixation methods, such as lag screws or cerclage wires, but only in conjunction with one or more of these fundamental ones (Kumar et al., 2022).

Contrary to prior observations that issues with delayed union or shortening of limbs or other abnormalities were common in cats, the fracture repair in the present case study was carried out via intramedullary pinning without any complications. For intramedullary pinning, K-wire or Steinmann pin selection is important. The size of the intramedullary cavity, the bone being repaired, the fracture configuration, and the use of supplementary methods of fixation all play a role in choosing the right pin. In the current case study, a 2.5mm Steinmann pin was used for fracture fixation. It was decided to use a pin that would occupy roughly two-thirds of the medullary cavity (Ghosh et al., 2018) or at its thinnest point, fills at least 60 to 70 percent of the medullary cavity (Das et al., 2020.). To support the immobilization and keep the broken bone in its proper alignment, a cerclage wiring of the fractured bones' edges was carried out using a 20-gauge stainless steel orthopaedic wire (Ghosh et al., 2018). Since pin migration was not observed in this instance, the fracture fragments were stabilized effectively using the right pins. Again, injuries that

frequently occur after intramedullary pinning include pin migration and nonunion. (Das et al., 2019.). Non-union incidence ranges between 5.2% and 16.66%. Another study found that the rate of non-union was quite low (0.85%) (Das et al., 2020.). However, there was no non-union consequence from intramedullary pinning in the current case study.

Chapter 5: Conclusion

The results of the current case study revealed that intramedullary pinning is a simple and efficient treatment for long bone fractures in felines. The success of postoperative care, which includes antibiotic administration, immobilization, and rest, is dependent on the correct pin being used. According to our findings, the Steinmann pin approach provided adequate stability as well as good resistance to rotational and axial forces in long bone fractures. Furthermore, our findings indicated that this procedure would result in a considerable reduction in the number of fractures in long bone fractures in cats.

Limitations

1. There were several laboratory tests that were not done, including haematological and biochemical examinations.
2. As a foreign body, the intramedullary pin delays healing.
3. Cause the inner blood circulation and bone marrow damage.
4. Osteomyelitis and pin loss could result, making the fixation less stable.
5. Secondary bone union and a gradual return to function.

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Biography

I am Mongchai Sing Marma. I am the student of 23th Batch and an intern veterinarian under faculty of veterinary medicine in Chattogram Veterinary and Animal Sciences University. I have passed Secondary School Certificate (SSC) in 2015 followed by Higher Secondary Certificate (HSC) in 2017. I come from Dolia Para, Rajasthali, Rangamati. In the future, I would like to work as a veterinary practitioner and do research on clinical animal diseases in Bangladesh.