

Stabilization of Vertebral Fracture and Luxation with Stainless Steel Wire in a Persian Cat: A Case Report



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Stabilization of Vertebral Fracture and Luxation with Stainless Steel Wire in a Persian Cat: A Case Report



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Abstract

This study was planned to stabilize vertebral fracture and luxation with stainless steel wire in a Persian cat. This case was observed at Shahedul Alam Quadary Teaching Veterinary Hospital (SAQTVH) during an internship placement. A female Persian cat was brought with a history of falling from 9th floor of a building. After conducting physical and radiological examinations, the cat was diagnosed with fracture at T₁₃ vertebra and dislocation between T₁₂-T₁₃ vertebrae. The patient showed partial paraplegia with moderate nociception in the hind quarter. Despite initial medical therapy, spinal surgery was deemed necessary to correct the condition. The surgery was performed under gaseous anesthesia following standard surgical procedures. Using stainless steel wire during surgery proved essential in addressing spinal stabilization procedures for a cat. Post-operative care included administering systemic antibiotics, painkillers, vasodilators, anticonvulsants and vitamin supplements. Applying povidone-iodine to the wound was also recommended until it fully healed. Notably, the cat's post-operative recovery remained smooth, and no significant complications were observed. After surgery, the owner was advised to keep the cat indoors with restricted movement. Neurological response and clinical improvements were observed as soon as two weeks after the surgery. The cat remained free of any unusual clinical signs during the one-month follow-up examination.

Key Words: Spinal stabilization, Thoracic vertebrae, Gaseous anesthesia, Bone wiring, Stainless steel.

Chapter 1

Introduction

Spinal trauma can lead to injury of the vertebral column and spinal cord, which can cause neurological malfunction in dogs and cats. This type of trauma frequently results in vertebral fractures, luxation, or subluxation. The animal's orientation determines the precise form of injury at the moment of impact, the amount of force involved, the site of impact, and the vertebral column's intrinsic strengths and weaknesses (Bagley,2000).

If spinal fracture or dislocation (luxation) occurs, the resulting vertebral displacement frequently injures the spinal cord. Concussion and compression of the spinal nerves disrupt the function of the nerves, with symptoms ranging from mild weakness to paralysis (inability to operate the limbs deliberately). 6% of all neurological disorders in cats are caused by vertebral fractures or luxation (Marioni *et al.*,2004). Patients, who are severely affected may become incontinent. They can also lose their ability to detect sensations in their extremities. The cats can be graded from 0 to 5 on the basis of neurological signs.

In summary, the scoring criteria are as follows: 0–normal cats, 1–pain only, no motor weakness, 2–persistent pain, proprioceptive deficit, ambulatory paraparesis, 3–non-ambulatory paraparesis, 4–paraplegia with deep pain perception, and 5–paraplegia without deep pain perception (Fossum *et al.*,2007). The majority of fracture cases are the result of accidents or falls, but bite wounds, gunshot wounds, and other causes are also included (Grasmueck *et al.*, 2004). In Bangladesh, the majority of fracture cases, including spinal fractures, are caused by high-rise syndrome.

The frequency of spinal fracture is higher in the thoracolumbar region, which is statistically proven. In case of cats, about 49% lesions are located in this area. (Jeffery *et al.*,2010). Conservative or surgical treatment options are available to correct the condition. External immobilization with splints and bandages, exercise restriction, cage confinement, analgesia, and anti-inflammatory medications are all part of conservative treatment (Bruce *et al.*,2008). There are several surgical ways to correct the condition. Surgical treatments include stabilizing the spine using screws or pins, polymethylmethacrylate (PMMA), plating, stapling of the vertebral column, bone wiring, external skeletal fixation etc. (Bruecker *et al.*, 1992). Minor spinal fractures can be

treated conservatively, with rest and medication, but surgery might be required to realign the bones in complicated cases. Stabilization in spinal trauma is the preservation of the function of unharmed neural tissue.

To protect the injured spinal cord and eliminate the existing compression, surgically performed decompression and stabilization are required (Ozak *et al.*, 2016). If left untreated, the spinal fractures can lead to permanent injury of the spinal cord. The consequences could be more severe like nerve damage and paralysis. If the condition doesn't improve after surgery and the prognosis remains poor, euthanasia can be performed (Penha *et al.*,2011).

The main objective of the study is to evaluate the clinical use and outcome of stainless steel wire in spinal stabilization. There have been few studies conducted on the surgical stabilization of feline spinal fractures and dislocation in our country.

Chapter 2

Materials and Method

2.1 Case description

This case concerns a 6-month-old female Persian cat weighing 3.00 kilograms with a history of falling from the 8th floor of a building in Chattogram. Then, it was brought to a local private veterinary clinic for initial treatment. The clinical signs presented were- Temperature: 100.8°F, M/m-pale, slow respiration rate and injury to the eyes. The cat was in shock. They recommended x-ray with a possible suspect of spinal injury and referred to Shahedul Alam Quadary Teaching Veterinary Hospital (SAQTVH). They prescribed steroidal drug, amino acid-vitamin supplement and normal saline.

On the next day, the patient was brought to SAQTVH . The patient was examined and the significant clinical findings were paraplegia, urinary retention and injury to the eyes. A diagnostic radiography scan revealed a fracture at T₁₃ and a dislocation between T₁₂ and T₁₃ (Fig. 1.a). Injury to the spinal cord was also detected. The prescribed treatment was- Vitamin B complex(Inj. Neuro B), Dexamethasone sodium phosphate (Inj. Dexavet), Gabapentin (Tab. Gabapen 100), Prazosin (Tab. Alphalock 2 mg), Moxifloxacin (Eye drop Mosquinin D) and scheduled for spinal surgery after five days.

2.2 Pre operative care

Before surgery, all the preparations should be arranged. The cat was unable to urinate on its own. So, Urine was evacuated from the urinary bladder by applying pressure manually (Fig. 2.b). Also, the patient was kept deprived of food for 6 hours to avoid intraoperative or postoperative emesis. For infusion of intravenous fluid, cannulation on the left fore limb was done (Fig. 2.a). The desired area of the limb was shaved and properly sterilized adequately before injecting the cannula.

2.2.1 Preparation of surgical instruments

All the equipment needed for surgery should be adequately sterilized. A Variety of instruments are needed for the orthopedic surgery. In this surgery, the surgical pack was composed of-Mayo scissors, Artery forceps, Plain tissue forceps, Rat tooth tissue forceps, Allis tissue forceps, Self-

Retaining Retractors, Rat tooth forceps, Towel clamp, needle holder, Scalpel handle, Bone reduction forceps, Bone curette, Orthopedic wire, Wire passer, Wire twister with cutter etc. The surgical pack was autoclaved at-temperature:121°C, pressure:15psi, Time-30 minutes. Wrapping materials allow penetration of the sterilization agent and maintenance of sterility after sterilization. Electro cauterizer with monopolar probe was also used in the surgical procedure. Two hot water bag was prepared to maintain the temperature during surgery.

2.2.2 Preparation of surgical site

The patient should be prepared according to the surgical need. After sedation shaving of the surgical area was done(Fig. 2.c). After shaving, at first ,70% alcohol was used. Then, an iodine solution was used and again, 70% alcohol was used for disinfection. Surgical site infection is a significant concern before surgery.it includes infection that directly results from surgical procedures. Eliminating exposure to this flora is extremely important during surgery. Pre-operative preparation reduces the number of bacteria and the likelihood of infection.

2.3 Anesthesia and restraining

The patient was controlled by using both physical and chemical methods. Numerous choices are available for the premedication of the veterinary patient. As pre-anesthetic, Diazepam (Sedil, Square Pharmaceuticals Ltd, Bangladesh, 0.2 mg/ kg body weight) was used to calm and sedate the patient. The patient was given 5% DNS intravenously as fluid therapy. For induction, ketamine (Ketalar, Popular Pharmaceuticals Ltd, Bangladesh, 5.5 mg/kg body weight) was given intravenously. After that, endotracheal tube intubation was done by using a laryngoscope(Fig. 2.d). The whole surgery was maintained by using gaseous anesthesia (Fig. 3.f). Isoflurane was used in this respect.

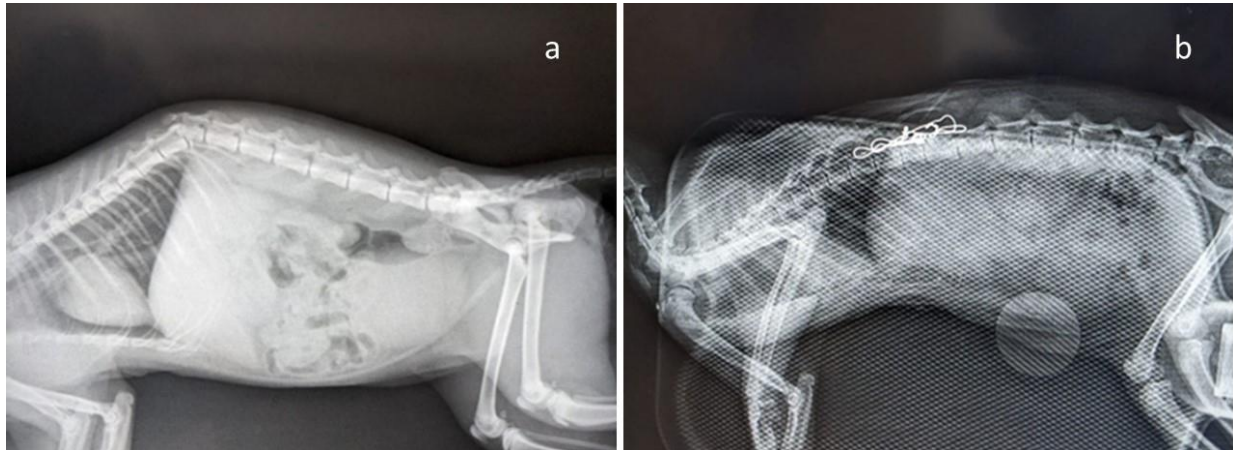


Fig. 1: Radiological examination. a) X-ray before surgery. b) X-ray after surgery.



Fig 2:Pre operative preparation. a)cannulation. b)Evacuation of urinary bladder manually. c)Surgical site preparation. d)Intubation of ET tube.

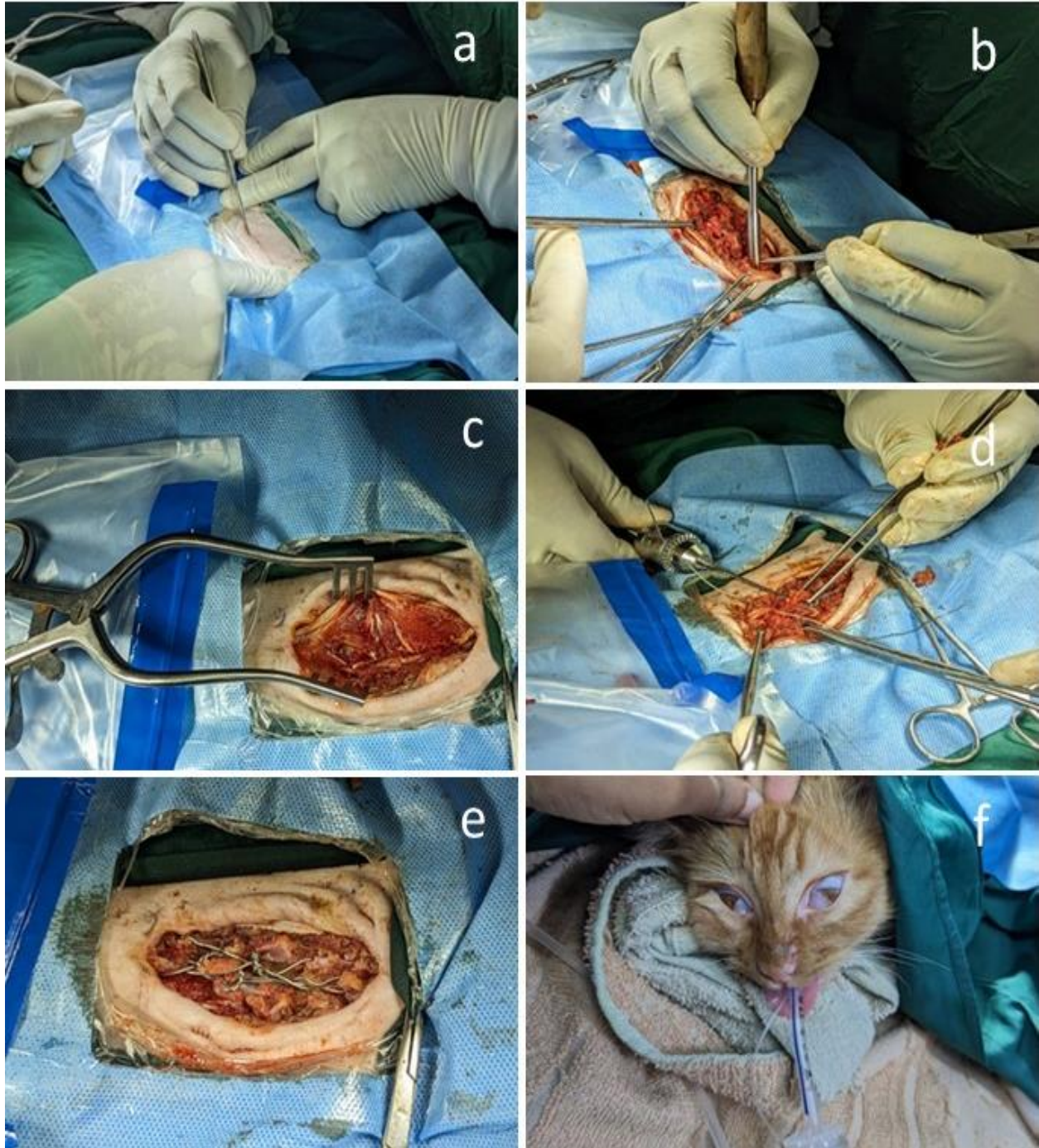


Fig 3: Operation procedure. a) Surgical Incision b) Detection of injured vertebrae c) Exposing injured vertebrae d) Drilling on the vertebrae e) Wiring by stainless steel f) Deep anesthesia.

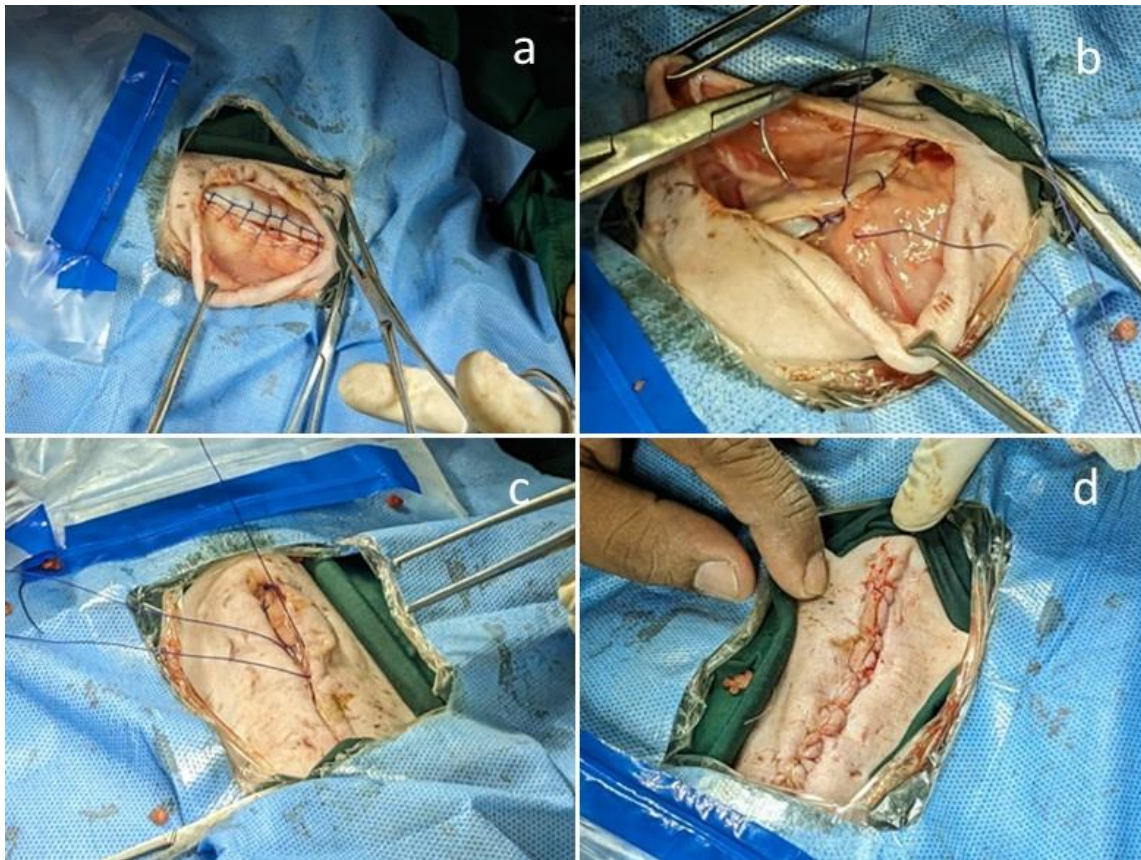


Fig 4: Different suture pattern to close the wound a)Ford interlocking suture on muscle b)Simple continuous suture c)Subcuticular suture on skin d)Vertical mattress on skin.



Fig 5: Cutting of suture.

2.4. Operation procedure

This surgery was planned to correct the condition of the cat. Proper hygiene and pain management were ensured during surgery to ensure the patient's safety. A sterilized general surgical pack was used. Anesthesia was given correctly and maintained. The patient was positioned in the sternal recumbency on the operation table. The animal was supported with a bag filled with hot water on each side of the abdomen. It effectively maintained a desirable temperature and maintained perfect position and alignment. The patient was covered with a sterilized draper, keeping the operative site open. Clamping was done to expose the surgical site properly. A skin incision was done adjacent to the dorsal midline, which was sufficient length to reach 3-4 thoracic vertebrae (Fig 3.a).

Subcutaneous tissue and muscle were incised sequentially. Electro cauterizer was used throughout the surgery to avoid hemorrhage. The muscles associated with spinous process, articular facet and lamina was separated (Fig. 3.b). Then, the dislocated and fractured region was identified. The spinous process and transverse process of T₁₃ thoracic vertebrae was fractured and dislocation between T₁₂ and T₁₃ vertebrae were spotted. The main focus was to correct the dislocation. Then, the dislocated vertebrae was reduced to its normal position. The articular facets and spinous processes of T₁₂, T₁₃ and L₁ vertebrae were drilled (Fig. 3.d). These vertebrae were held together by threading stainless steel wire through the drilled holes. The wiring between two vertebrae was done like 8 shape to have more strengthened stabilization (Fig. 3.e).

The muscle layer was sutured with ford interlocking pattern (simple continuous pattern) (Fig. 4.a). The fat layer was sutured with also ford interlocking pattern (simple continuous pattern) (Fig. 4.b). The skin incision was closed using suturing two times. First, subcuticular suture, also known as cosmetic suture was used to close the wound (Fig. 4.c). For all these, braided and coated polyglactin 910 violet (U-synth) was used, which is a synthetic absorbable surgical suture. Secondly, skin was sutured by vertical mattress suture with non-absorbable nylon suture material (Fig. 4.d). Finally, bandage was applied on the incision area.

Table 1. Observation of different parameters during surgery:

Time	Fluid infusion rate(ml/h)	Isoflurane (vol%)	etCO ₂ (mmHg)	Respiration rate/minute	O ₂ (vol%)
At the beginning of surgery	28	1.5	63.0	16	30.0
At 10 th minute	20	1.5	71.2	13	30.0
At 20 th minute	20	1.5	67.3	16	30.1
At 30 th minute	20	1.5	58.5	16	30.2
At 1 st hour	20	1.5	60.4	17	30.2
At 1 hour 10 th minute	20	2	57.4	23	30.0
At 1 hour 20 th minute	20	2	55.1	24	30.0
At 1 hour 40 th minute	5	2	72.7	18	30.0
At 2 nd hour	5	1.5	66.6	17	29.9
At the end of surgery	5	1	59.7	17	29.7

2.5. Post operative care

After surgery, an antibiotic, ceftriaxone (Inj. Triject-Vet) @20mg/kg body weight was administered intramuscularly for 7 days at 12 hours interval. Morphine (Inj. Morphine) was administered intramuscularly @0.2mg/kg for 3 days at 5 hours interval. Vasodilator prazosin (Tab. Alphalok) was administered @0.5mg/kg orally for 7 days. Gabapentin (Tab. Gabapen) was used @5mg/kg as an anticonvulsant medication. The cat was also provided vitamin b complex (Tab. Neuro-B). The owner was suggested to provide antiseptic povidone Iodine ointment on the incision site for 10 days. The animal was suggested to put a wrap on abdominal region to avoid violent movement because it may worsen the condition and suggested to observe. The stitches were cut after 9 days of surgery (Fig. 5).

Chapter 3

Result and Discussion

The spinal fracture was successfully reconstructed surgically. In this stabilization process, stainless steel proved highly effective. The pain management and anesthesia were flawless. The anesthetic effect was lasted for a day, after which the cat returned to normal condition. The owner was advised to keep a close eye on the cat during the follow-up period. The patient showed improved neurological condition. There were no signs of complications. The urine retention issue was resolved, and the cat began to urinate on its own. Both limbs responded well to pain. The patient was followed up for one month, and all health parameters were satisfactory.

This study demonstrated that spinal fractures and dislocations can be repaired surgically. Many factors influence surgical success. The operating area is also a major concern. Because of the constant risk of contamination to surgical patients, the operating area should be strictly aseptic. During surgery, doors between clean and contaminated areas were kept closed all the times, reducing the possibility of cross- contamination between areas. This also reduces the movement of airborne contaminants. Airborne contaminants may lead to infection (Camus *et al.*,2016). The majority of particles and bacteria found in operating room air are shed by operating room personnel from their skin and hair. To avoid this situation, every individual in the operating room had gowns on during this surgery.

The surgical area also had a small number of people. According to some studies, the incidence of surgical site infection increases as the number of personnel in the operating room increases. (Allo *et al.*,2005). Members of the surgical team remained in the sterile area. The amount of talking was kept to a minimum because talking causes the release of bacteria-laden moisture droplets. In spite of having other choices, Diazepam was used as a preoperative anesthetic. Diazepam is a benzodiazepine that is highly lipid-soluble and has a long duration of action. Anxiolysis, anticonvulsant activity, sedation, spinal cord mediated muscle relaxation and amnesia are the five principal pharmacologic effects of benzodiazepines.

It has anxiety-reducing and sedative properties that make it ideal for use as a premedication. (Chiu *et al.*,2016). Diazepam, like other benzodiazepines, has little effect on the cardiovascular system. Because of the pain of the injection and the variable absorption, intramuscular (IM) injection is a poor route of administration. Diazepam should be administered intravenously (IV) and administered slowly, preferably diluted with crystalloid carrier solution to reduce the risk of irritation and pain with injection (Can *et al.*,2016). Ketamine was used as an induction drug. Ketamine is a dissociative anesthetic which has been utilized in veterinary medicine for many years. It is a central nervous system depressant that causes dissociation by inhibiting thalamocortical connections and stimulating the limbic system. When administered intravenously, it has an onset of one minute and a fast bridging of the blood-brain barrier (Pascoe et al, 2007). Perioperative ketamine infusions may aid individuals undergoing massive procedures with considerable surgical trauma or those with pre-existing central sensitization (Lemke and Creighton, 2010). Ketamine causes sympathetic nervous system activation in the cardiovascular system, with increased heart rate and blood pressure, cardiac output and cardiac oxygen demand. In mechanical ventilation, it can be maintained by isoflurane and oxygen. (Zoetis *et al.*, 2012).

The cat was monitored intraoperatively using continuous respiratory rate, pulse oximetry, capnography, and other techniques. In the above instance, stainless steel wire was used to stabilize the spine. The benefits include:

- Less invasiveness.
- Resistance to ventral bending.
- Ease of surgery.
- Less soft tissue dissection.

Because the implant is placed on the tension side of the spinal column, it resists ventral bending forces, restricting flexion or extension (Voss *et al.*,2004). The use of screws or pins to stabilize a somewhat big vertebral body has been described. However, because the patient was so little in this case, plates or screws could not be used. As a result, the use of wires is the greatest alternative for spine stabilization in little animals (Shores *et al.*, 2017).

Antimicrobial prophylaxis is typically thought to be enough to reduce the rate of surgical site infection in spine procedures. Our patient who underwent surgery got a post-operative

antimicrobial course of a broad-spectrum antibiotic (Välkki *et al.*,2020). To avoid subsequent bacterial infection, ceftriaxone (Trizon vet, 500mg, ACME Pharmaceuticals Ltd, Bangladesh, 30 mg/kg body weight) was given intramuscularly for 7 days as postoperative treatment. Ceftriaxone is a third-generation antibiotic in the cephalosporin group that suppresses bacterial cell wall formation by attaching to trans peptidases. It is a bactericidal antibiotic that is used to prevent a wide range of bacterial diseases and secondary bacterial infections. Pain sensation in affected limbs has been found to be an important prognostic factor following spinal injuries (Negrin *et al.*,2009). Animals with a fracture/dislocation in the caudal thoracic to cranial lumbar area may exhibit Schiff-Sherrington phenomenon though it was absent in our study (Schrader *et al.*,1998). Medical intervention, as well as physical therapy and rehabilitation, are said to be helpful in individuals with spinal cord injury (Can *et al.*,2016). The adverse impacts of neurological disorders on the urinary bladder include retention of urine and incontinence (Vallefuoco *et al.*,2014). In our study, the cat also had urinary retention but later the condition was improved.

Limitation

There was no scope of imaging techniques like CT and MRI which might be helpful to detect details about the injury. The condition of spinal cord could also be examined.

Conclusion

This study demonstrates successful clinical management of spinal fracture and dislocation in a Persian cat by stainless steel wiring. The pet was completely healed without any complications. In conclusion, spinal wiring can effectively regain the animal's normal neurological status after spinal injury.

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Biography of Author

The author, Arfanul Alam Simon, was born in Chattogram. He got admitted to Chattogram Veterinary and Animal Sciences University for the degree of Doctor of Veterinary Medicine in 2017-2018 sessions. He is currently an intern student at the Faculty of Veterinary Medicine. Before that, he completed his HSC from Chattogram College, Chattogram and S.S.C. from B.G.C. Academy, Chattogram. He has an immense interest to work in improving the health status of people through proper guidance and suggestions and to create awareness among people about food safety and nutrition as well as animal welfare. With his best knowledge and expertise, he hopes to deliver competent veterinary medical treatment and sustains the norms of professionalism in the future. He is very enthusiastic to become a skilled veterinarian in the future.