Journal of Veterinary and Animal Sciences pISSN 2550-1283; eISSN:2622-0571
DOI: https://doi.org/10.24843/JVAS.2021.v04.i02.p05 August 2021 Vol. 4 No.2: 37 - 48

Case Report: Os Femoral and Os Tibial Diaphysis Fracture on Local Dog

Maria Clafita Witoko[1*], I Wayan Wirata[2], A.A. Jaya Wardhita[2].

[1]Veterinary Student, Faculty of Veterinary Medicine, Udayana University, Bali, Indonesia

Email: clafitawitoko@gmail.com

[2] Laboratory, Department of Veterinary Surgery, Faculty of Veterinary Medicine, Udayana University, Bali, Indonesia

Email: wirata@unud.ac.id

[2] Laboratory, Department of Veterinary Surgery, Faculty of Veterinary Medicine, Udayana University, Bali, Indonesia

Email: jayawardhita@unud.ac.id

*Corresponding Author Email: clafitawitoko@gmail.com

Abstract. The purpose of this study was to determine the open reduction internal fixation on femoral and tibial diaphysis oblique fractures on a local dog. A physical, hematological, and radiography examination had been conducted on a 7-months-old female dog, weighing 8 kg at the Animal Educational Hospital, Faculty of Veterinary Medicine, Udayana University. Based on the result of the examinations, the animal was diagnosed with sinister caudal extremity femoral and tibial diaphysis oblique fractures with a fausta prognosis. Open reduction surgery was conducted to return the fractured bones-back to their normal position. Post-operation, the animal was administrated intramuscularly with 0,8 ml of long-acting amoxicillin (Longamox), continued with amoxicillin and clavulanic acid (Claneksi Forte) with 2 x 2 ml as given dosage for 10 days after surgery and Meloxicam tab 7,5mg with 1 x 0,8 mgas given dosage for 5 days after surgery.

Key words: femoral fracture, tibial fracture, bone healing, dog fracture

I. INTRODUCTION

A fracture is a break in the continuity of the bone with or without displacement of the bone fragments. Fractures are generally accompanied by soft tissue damage with varying degrees of severity, such as tearing of blood vessels, bruised muscles,

lacerations of the periosteum, and injury to nerves. Sometimes there are injured organs and torn skin. (Mahajan, et al. 2016).

Caudal extremities fractures often occur in dogs, where fracture often happen in Os femur. As for fractures of the long bones, 45% occulted in the femur and 20% in the tibia-fibula (Harasen, 2003; Jain, *et al.* 2016). The causes of fractures in dogs are vehicle accidents, falls from a height, and other trauma. Accidents are the most common factor because animals are allowed to roam freely outside and increase the risk of getting hit (Singh, *et al.* 2015).

The primary principle of bone fracture treatment is 4R concept which is recognition, reduction, retention, and rehabilitation. Recognition is the step of knowing the fracture type and determining the best treatment that can be done. Recognition involves anamnesis, physical,and nerve examination that can be confirmed by radiology examination. Reduction is to restore the position of the fracture to its original position. There are two types of reduction, open reduction, and closed reduction. Retention is maintaining fracture fragments with fixation devices during the fracture healing period (immobilization). Rehabilitation is an effort to restore the ability of the limbs to function again as before (Erwin, et al. 2019).

Fracture of caudal extremities generally requires internal fixation, especially in the femur. Intramedullary pinning is used as an internal splint in the medullary canal of the long bone to support the axial line. Whereas, in the tibia and fibula, plate, screw, and/or wire were used for bone stabilization.

II. MATERIALS AND METHODS

Case Description: Female local dog, weighing 8 kg, was found in front of the rescuer's home in Denpasar after being hit by a car on 2 December 2019. The dog was aggressive and showing severe pain. Sinistra Caudal extremity showed inflammation and laceration. Physical examination and blood test results can be seen in Tables 1 and 2.

Table 1. Physical Examination Result

Examination	Result	Alert
Temperature	39°C	Normal
Heart Beat	120x/min	Normal
Pulses	120x/min	Normal
Respiration	32x/min	Normal
CRT	<2sec	Normal

Table 2. Complete Blood Check Result

Parameter	Result	Alert	Limit
RBC	3.50	L	5.00 – 8.50
Hb	5.9	L	12.0 – 18.0
MCV	64.9	N	60.0 – 77.0
MCH	16.9	N	14.0 – 25.0
MCHC	26.0	L	31.0 – 36.0
WBC	14.67	N	6.0 – 15.0
PLT	132	L	160 - 625

pISSN 2550-1283; eISSN:2622-0571
August 2021 Vol. 4 No.2: 37 - 48

Description: H (*High*), L (*Low*), N (*Normal*)

Left lateral recumbency and dorsal recumbency radiographic examination was done with the result in Figure 1.

Diagnosis made based on anamnesis and clinical signs supported by x-ray. Femoral diaphysis oblique and the proximal tibial fracture were concluded as the diagnose with fausta prognosis.

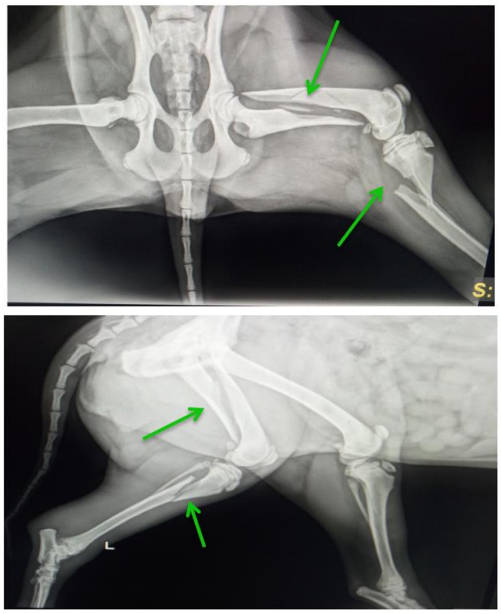


Figure 1. Left Lateral Recumbency and Dorsal Recumbency Radiographic Examination.

Open Reduction Technique:

The fractured dog, Jolene, was treated with open surgery reduction, namely surgery by making incisions in the skin and muscles so that the bone is visible, then returned to the normal anatomical position before experiencing fracture by attaching pins, wires, and screws, then tissue muscles and skins were closed again.

The dog has fasted for 12 hours before surgery to empty the gastric contents to prevent vomiting during surgery. After the tools and materials were prepared, the dog was inserted with a 24G intravenous catheter and was given Ringer's Lactate fluid and premedication, namely atropine sulfate 0.25% with a dose of 0.7 mL (0.02 – 0.04 mg/kg BW) and tranexamic acid with a dose of 0.8 mL (10-20 mg/kg BW) subcutaneously, followed by induction anesthesia in the form of ketamine at a dose of 0.8 mL (10-15 mg/kg BW) and xylazine with a dose of 0.4 mL (1-3 mg/kg BW) intravenously. Atropine sulfate premedication was used to exert a suppressive effect on the secretion of the salivary glands and bronchial mucus, pupillary dilation, accommodation disturbances, and vagus nerve obstruction to the heart to prevent bradycardia and slow movement of intestinal peristalsis and prevents the gag reflex (Brander et al., 1991; Robaj et al., 2014). Atropine sulfates act after 10-15 minutes after administration and are indicated by reduced saliva secretion in the dog's mouth. Ketamine induction acts as a narcotic sedative drug that provides

hypnotic, analgesic, and amnesic effects in animals (Gao et al., 2016). The administration of xylazine as a non-narcotic sedative drug causes sedation and visceral analgesia which acts to suppress the nervous system so that the sympathetic nervous effect is reduced, causing muscles relaxation (Robaj et al., 2014; Tenant, 2002).

Isoflurane inhalation anesthetic is used in this operation to maintain the anesthesia. Isoflurane is a halogenated liquid ether, colorless, non-explosive, and contains no preservatives. The induction process and the recovery tend to be faster compared to anesthetic inhalation drugs that are currently available, but still slower than sevoflurane (Mangku and Senaptahi, 2010). The rapid increase in isoflurane concentration causes a temporary increase in heart rate, arterial blood pressure, and norepinephrine rate (Morgan et al., 2006).

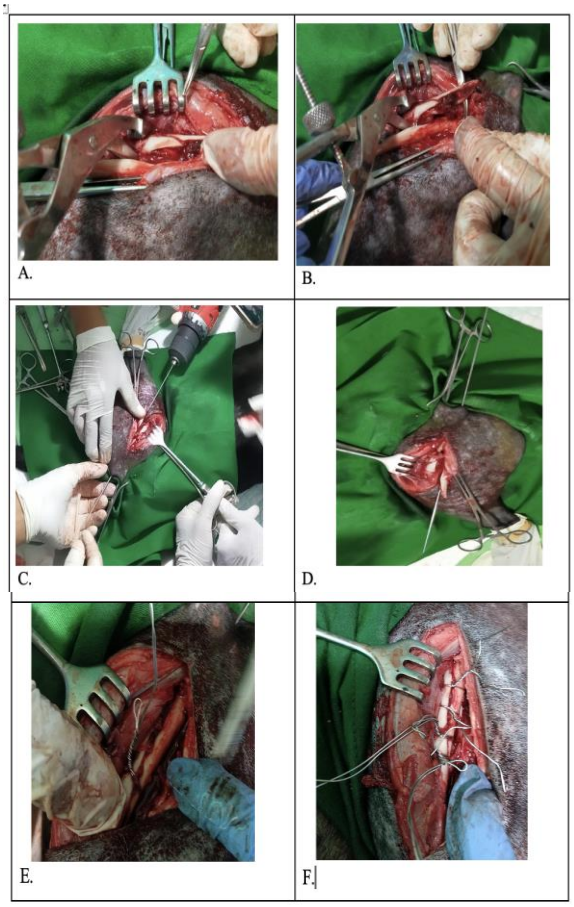
Operation

The operation begins by shaving the hair around the incision site until the skin is visible, then the skin is cleaned using alcohol and is applied betadine. A skin incision is made in the craniolateral femur using a scalpel and a blunt dissection was performed to expose the subcutaneous tissue and fascia superficially. The superficial fascia then retracted and the fascia lata muscles were identified. The Biceps femoris is then separated by incising the muscle along the cranial border of the bicep femoris. Bicep femoris were retracted towards the caudal femur, meanwhile, the vastus lateralis muscle and intermedius as well as the fascia lata was retracted towards the cranial femur so that the bone shaft femur was exposed (Fig. 2A). Forceps bone then attached to the proximal femur (Fig. 2B). Bone pin with a diameter of 2 mm attached to the drill. The pins that were already installed in the drill were then inserted into the medulla of the proximal femur fracture which was proximally towards the trochanter of the femur, penetrating the skin (retrograde method) (Fig. 2C;D). After the pin was firmly attached to the proximal fracture, the distal fracture was held using bone forceps to reattach to the proximal fracture to form a normal femur. After the normal shape of the femur has been achieved, put the end of the pin back in the drill to insert the pin into the distal fracture. Pin was placed in the medulla of the second fracture, holding the femur from the

pISSN 2550-1283; eISSN:2622-0571
August 2021 Vol. 4 No.2: 37 - 48

inside. The bone wire is cut sufficiently then made into 2 layers (2 layers of wire). The tie was made twice on the distal femur with a distance of ± 1 cm from the first bond (Fig. 2E). Above the second bond, entering the proximal femur, two bond wire is made with only 1 layer, each with a distance of ± 1 cm from one bond to another (Fig. 2F). The long strand of wire is then cut short and pressed close to the femur shaft (Fig. 2G; H). Pin that was left on the outside were cut as close possible to the skin. Fascia lata muscles and biscep femoris sutured using chromic catgut 2-0 with a simple continuous pattern (Fig. 2I). The skin was then closed with subcuticular sutures using chromic catgut thread 2-0 (Fig. 2H).

Dissection on the Os Tibia started with disinfecting the medial skin of the tibia with alcohol and betadine. An incision was made on the craniomedial tibia and then a blunt dissection was performed to open the fascia superficial (Fig. 3A; B). Musculus tibia cranialisthen retracted towards cranial tibia and musculus long digital flexor also retracted towards caudal tibia using allis forceps (Fig. 3C). An oblique fracture on the proximal could be seen (Fig. 3D). Proximal fracture were drilled to make a hole (Fig. 3E). A14 mm screw was inserted into the drilled hole (Fig. 3F). The screw serves as a pressure on the open fracture so that it re-attaches with other parts (Fig. 3G). Long digital flexor muscles and tibia cranialis were then reattached and sutured with chromic catgut 2-0 using a simple continuous pattern. The skin was closed with subcuticular sutures using a 2-0 catgut chromic thread (Fig. 3I). Chlorhexidine Gluconate and Betadine were applied to the incision site.



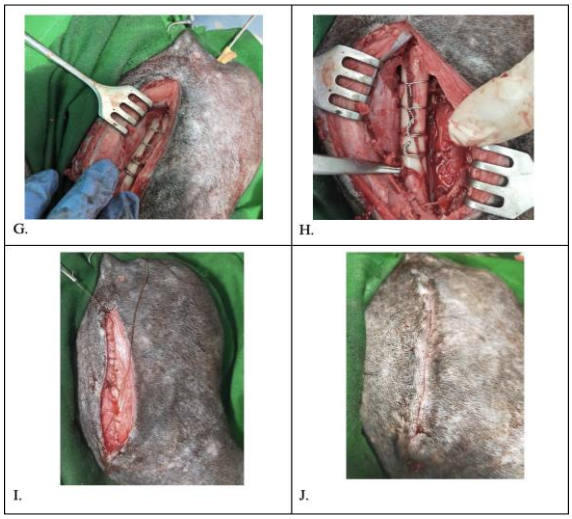
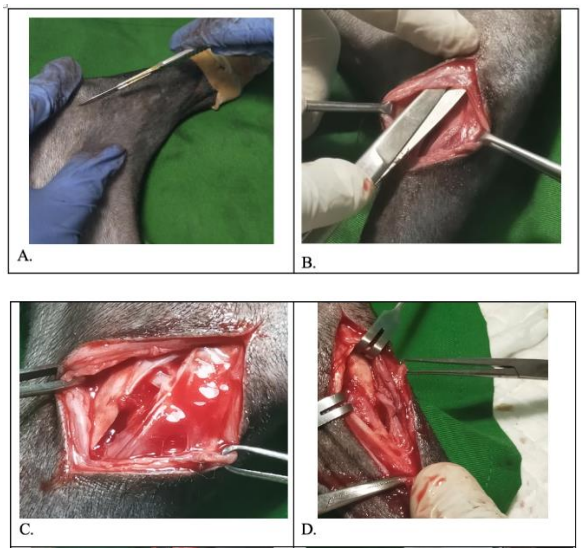


Figure 2. Os Femur Open Reduction Technique. A. Bicep femoris retracted towards cranial femur to expose bone shaft; B. Bone Forceps attached to proximal femur fragmented fracture; C;D. Pin installation using a drill with retrograde method; E. installation of cerclage wire; F. Cerclage wire fixed; G. wire strands cut short; H. Wire pushed towards femur shaft; I. closing bicep femoris and fascia latae with simple continuous suture; J. Subcuticular suture of the skin.



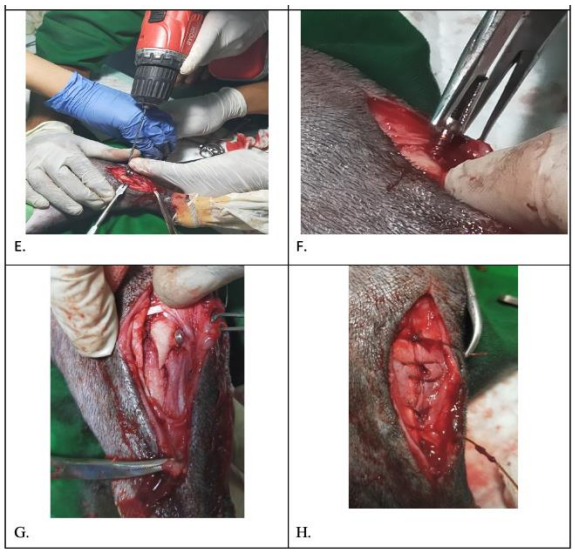


Figure 3. Os Tibia Open Reduction Technique. A. Incision on craniomedial tibia; B. Blunt dissection on fascia superficial tissue; C. Retraction of musculus tibia cranial dan musculus long digital flexor; D. Fracture exposed; E. fracture segment drilled; F. Screw installation; G. fracture Gape closed; H. closing of the muscle with simple continuous; I. skin closing with subcuticular.

Post-operation

The dog was put on an Elizabeth collar (E-collar) to prevent from licking the stitches. Tolfedin analgesic with a dose of 0.8 mL, given intramuscularly to reduce pain and followed Meloxicam tab 7.5 mg at a dose of 1 x 0.8 mg for 5 days. Amoxicillin Antibiotics, Clavulanic Acid (Claneksi Forte) given at a dose of 2 x 2 mL for 10 days to prevent infection. Case dog was also given supportive therapy (Hematodin) which contains taurine, ammonium, methionine, histidine, tryptophan, cobalt acetate, cyanocobalamin, and excipient qs at a dose of 1.6 mL for 3 days after the operation.

III. RESULTS AND DISCUSSION

After the operation, the dog was placed inside a clean cage and had an *Elizabethcollar* put on. It was observed for 2 hours post-operation and then IV catheter removed. After the case dog gained consciousness, the surgical wound was monitored and kept clean. The first-day result of the postoperative observation, surgical wound was still wet and inflammation can be seen however, the appetite was back to normal, urination and defecation were normal. Inflammation generally occurs post-operation and continues for 2-3 days and even lasts for 5 days (Fossum, 2000).

On the 7th day, the incision wound completely dried and the skin healed perfectly.

Discussion

Wound recovery is affected by postoperative care and treatment. Aside from that, other factors such as age, nutrition, condition, and time of occurrence also affect the recovery process. The recovery process based on Fossum (2000) involves an inflammatory phase that begins with bleeding that cleans and fills the skin that is wounded after the trauma. This phase occurs for 2-3 days and even lasts for 5 days until the debridement phase, which is indicated by the infiltration of neutrophils and monocytes into the wound area. This happens around 6-12 hours after the injury.

The repair phase happens 3-5 days after the injury. The processes that is involved in this phase are *fibrogen* and *collagen*, which is the process of fibroblast immigrating to the injured area after the inflammatory phase. Then fibroblasts invade the wound to synthesize and deposit collagen, elastin, proteoglycan, which then undergo maturation to form fibrous tissue.

After 5 days, fibroblast, fibrin, and the edge of the wound. The amount of collagen reaches 2-3 weeks. Afterward, granulation tissue will fill and protect the wound by forming a barrier towards infection and base layer that triggers the migration of epitel. Granulation tissue is the source of specific fibroblast cells that are called myofibroblast. Then epithelialization occurs within 24-48 hours of the injury. In the open wound, the process starts after the granulation tissue layer forms, usually after 4-5 days. Epitel cell initially forms only 1 layer (*one cell layer*) and is fragile. Then the layer thickens by forming new layers. Wound contraction then happens, which is the process by which the wound is reduced due to the contraction of myofibroblasts present in the granulation tissue. This process happens along with the formation of granulation and epithelialization tissue. Generally, the wound decreases in size by 0.6-0.7 mm per day. Wound fixation and inelasticity, or the presence of tugging on the wound, hinder the process. Other than that, consumption of antiinflammation steroid, antimicrotubular, and muscle relaxant drugs could also hinder the process of wound contraction. This process will be completed when the edges of the wound meet.

capillaries form a parallel position with

Figure 4. The incision wound dried and the skin healed perfectly

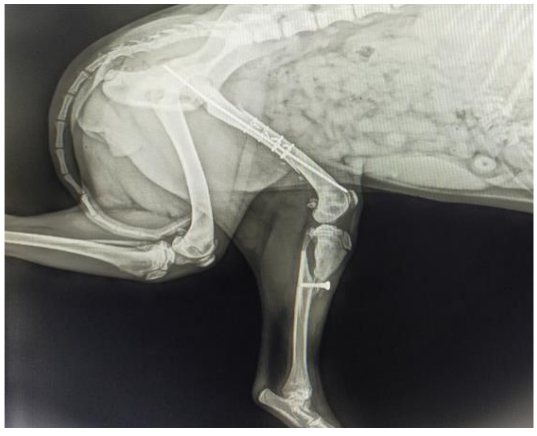


Figure 5. Bone condition on the 14th day

pISSN 2550-1283; eISSN:2622-0571
August 2021 Vol. 4 No.2: 37 - 48

The maturation phase is the final phase that happens after a sufficient amount of collagen has been deposited in the wound area. This process happens within 17-20 days after the wound is formed and could continue for a few years.

In this fracture case, open reduction is used with fixation technique of intramedullary bone pinning and cerclage wire on the Os femur, while the Os tibia uses fixation technique using the screw. According to Palmer (2019), before performing fixation using an intramedullary pin and cerclage wire it is important to observe whether the fracture can be reconstructed or not. It can be assumed that two-part or three-part fractures can be reconstructed. Fixation technique with intramedullary pin and wire can only be performed on long bone fractures and can be reconstructed. Installation of the pin on the femur can be done with the normograde method, either from the proximal or distal part of the femur, or can be done with the retrograde method which is the installation of the pin from the fracture zone to the main fracture segment in the proximal bone. In this operation, the installation of the pin is done using the retrograde method. Retrograde method has to be done when the proximal segment fracture is positioned at the reduced hips, extended, and neutral rotation-wise to prevent sciatic nerve. The use of the wire as supplemental fixation is aimed to provide extra stability. The wire is generally used on the spiral or oblique fracture and is not recommended for non-reconstructable fractures with multiple fragments. Installation of the screw at the fractured proximal tibia is aimed to give pressure at the fractured area so that it re-attaches to the unfractured tibia.

On the 14th day of the post-operation, a radiographic evaluation was carried out to determine the development of the callus formation and recovery process of the bone. According to Marsell and Einhron (2011), the recovery of fractures is divided into two which are indirect fracture healing, where the recovery of the bone occurs in fractures that were not treated through open reduction surgery whose process includes the acute inflammatory response phase, recruitment of mesenchymal stem cells, cartilage and periosteal callus generation, revascularization and neoangiogenesis in the fracture zone, mineralization and reabsorption of cartilage callus, ending with bone remodeling. And second, direct fracture healing, which is the process of bone recovery that occurs in fractures that were treated with open reduction surgery.

The main purpose of open reduction surgery is to restore the anatomical position of the fractured bones without leaving the gap formation in the slightest and obtain stable fixation so that inter fragment strain is reduced. Direct fracture healing has two main mechanisms in the process of fracture recovery. The two mechanisms are contact healing, which occurs in fractures with gaps smaller than 0.01 mm between the edge of two fractures as well as inter fragment strain no more than 2%, and gap healing, which occurs in fractures with gaps less than 0.01 mm, cutting cones consisting of osteoclast forming in between two edges of the nearest osteon in the fracture zone which then will generate longitudinal cavity at the speed of 50-100 nm per day. The cavity will then be filled with new bones that are made by osteoblast in cutting cones so that the unification of bones happens in unison and the Haversian system restores. The Haversian system will then supply blood. The osteons will mature by direct remodeling and turn into the lamellar bone that recovers bones without forming callus periosteal (Marsell and Einhorn, 2011).

In the gap healing process, the unification of bones and Harvesian remodeling does not happen at the same time. The fracture zone is filled by lamellar bones perpendicularly on the long axis and is mechanically weak. This process happens between 3-8 weeks followed by the second remodeling process that resembles the formation process of cutting cones in the process of contact healing (Marsell and Einhorn, 2011).

From the results of the radiographic evaluation that had been done, the formation of callus could be seen on the fracture line of the Os Femur, showing clear opacity. The return of opacity on the fracture line proves the unification of the bones. However, callus formation on the Os Tibia was not as good as callus formation on the Os Femur. This could be proven by the gap on the fracture line that is caused by movements from the installed screw, which makes the fixation occur imperfectly. On the 3rd and 4th day of post-operation, the dog leaped out of the cage causing imperfect mobilization. The use of feet before the proper time could cause movements of the bone, therefore, a refixation surgery needed to be done.

IV. CONCLUSION & SUGGESTIONS

The dog was diagnosed with an oblique fracture on the diaphysis of the Os Femur sinistra and the proximal of the Os Tibia sinistra. The treatment was done by open reduction surgery using a fixation

pISSN 2550-1283; eISSN:2622-0571
August 2021 Vol. 4 No.2: 37 - 48

technique with an intramedullary pin and cerclage wire on the Os Femur and fixation with a screw on the Os Tibia. On the 7th day, the surgery wound dried and the skin re attaches perfectly. The formation of callus could be seen on the 14th day after the surgery. Fracture treatment should be done as soon as possible to prevent unnecessary callus formation.

REFERENCES

[1] Brander, G.C., Pugh, D.M., Bywater, R.J., Jenkins W.L. 1991. Veterinary AplliedPharmacologyand Therapeutics. 5th Ed. ELBS. Bailliere Tindall.

[2] Erwin, Amiruddin, Rusli, Etriwati, Sabri, M., Adam, M., Ramadhana, C.E., Kusuma, A.Y. 2019. Fiksasi Internal Secara Terbuka Fraktur Bilateral Pelvis pada Anjing. Acta VeterinariaIndonesiana.

[3] Fossum, T.W. 2000. Small Animal Surgery 2nd Ed. Mosby, St. Lois London. Philandelphia Sydney. Toronto.

[4] Gao, M., Rejaei, D. Liu, H. 2016. *Ketamine Use in Current Clinical Practice*. Acta PharmacologicaSinica.

[5] Jain, R., Parihar, A.S., Kamble, S., Parihar, Y.S., Ganguly, S. 2016. Multiple Fractures in Tibia Bone of Dog: A Case Study. International Journal of Contemporary Microbiology. Vol 2.

[6] Mahajan, T., Para, P.A., Ganguly, S. 2015. Fracture Management in Animals: A Review. Journal of Chemical, Biological, and Physical Sciences. Vol. 5.

[7] Marsell, R. dan Einhorn, T.A. 2011. The Biology of Fracture Healing. Injury. Elsevier.

[8] Palmer, R.H. 2019. Fracture Fixation Techniques. NAVC Conference Small Animal. Vet Folio.

[9] Robaj, A., Hamidi, A., Sylejmani, D., Postoli, R., Gjino, P. 2014. Effects of Atropine Sulphate Prior to Usage of Pre Anesthetic and Anesthetics in Dogs. Journal of Internation Scientific Publications: Agriculture and Food.

[10] Singh, R. Chandrapuria, V.P., Shahi, A., Bhargava, M.K., Swamy, M., Shukla, P.C. 2015. Fracture Occurrence Pattern in Animals. Journal of Animal Research. Vol.5.

[11] Tenant, B. 2002. Small Animal Formulary 4th Ed. England: BSAVA.

[12] Udin, M.K., Hassan, M.Z., Islam, M.M.M., Islam, M.R. 2017. Internal Fixation of Fracture of Femur of Dog Using Intramedullary Pinning. Asian-

Australians Journal of Bioscience and Biotechnology.