Healing Evaluation After Treatment of Vulnus Morsum on Domestic Cat Hind Leg: A Case Report

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ABSTRACT

A *Vulnus morsum* is a term used to describe a wound resulting from an animal bite. Specifically, wounds inflicted by cat bites are referred to as *Vulnus morsum felis*. A domestic cat named Sinto, approximately one-year-old with a body weight of 2.4 kg was examined with complaints of a torn wound on the right leg after fighting with another cat. The clinical examination results showed that case cat generally had a body condition score of 4/9 with an alert temperament and an attitude that always lowered its tail to protect the wound. Clinical examination also showed a *Vulnus morsum* on the hind right leg. A complete blood count showed that the cat had leukocytosis, granulocytosis, and thrombocytopenia. From the results of anamnesis, clinical examination, and supporting examinations, the case cat was diagnosed with *Vulnus morsum felis* with a fausta prognosis. Treatment was carried out by applying three principles of wound care; cleansing, debridement, and wound closure. In addition to surgical procedures, post-surgery antibiotics and anti-inflammatory drugs were given. The wound was treated and cleaned daily using an antiseptic to help the healing process. The wound found in the case cat were healed after surgical procedures and 12 days of treatment.

Keyword: *Vulnus morsum felis*, cleansing, debridement, wound closure

INTRODUCTION

A wound (*Vulnus*) is a break in the continuity of the anatomical structure of various body tissues, ranging from the simplest such as the epithelial layer of the skin to deeper layers such as subcutaneous tissue, fat, muscle, and bone (Primadina *et al*., 2019). Based on the anatomy of the skin or the depth of the wound, it is classified as stage I (skin is still intact with the wound area

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experiencing erythema that cannot be removed soon), stage II (loss of part of the skin and showing part of the dermis), stage III (loss of the skin deep enough to reveal fatty tissue), stage IV (loss of the skin and some tissue showing fascia, muscles, tendons, ligaments, cartilage or bone), and unstageable (loss of the skin and some tissue which cannot be assessed clearly because the wound is obscured by dead tissue) (Edsberg *et al*., 2016). Meanwhile, based on the character of the tissue wound, it can be divided into *Vulnus contussum* (bruise), *Vulnus abrasion* (abrasions), *Vulnus laceratum* (torn wounds), *Vulnus punctum* (stab wounds), *Vulnus sclopetum* (gunshot wounds), *Vulnus morsum* (bite wounds), and *Vulnus incisivum* (cuts) (Lazarus *et al*., 1994).

Pets like cats often experience physical trauma, from fighting or from human activities. Cats have agonistic behavior or challenging behavior that will appear when they feel disturbed and cause cats to fight with other cats (Ncalc, 2021). These fights will usually cause injuries to the cat's body, one of the most common injuries is a bite wound or *Vulnus morsum*. *Vulnus morsum* is a mechanical wound caused by an animal bite. The resulting wound has a torn nature resulting from the bite of a torn animal (Chrisnanta *et al*., 2018). The most common *Vulnus morsums* are *Vulnus morsum serpentis* (due to snakes), *Vulnus morsum canis* (caused by dogs), *Vulnus morsum felis* (caused by cats), *Vulnus morsum macaques* (caused by monkeys), *Vulnus morsum sapiens* (caused by humans), and *Vulnus morsum scorpion* (caused by scorpions).

Vulnus morsum felis with a wide wound, if left unchecked, the lost tissue will not close and allowing secondary infection to myiasis and can be more dangerous to the patient, so treatment is needed as soon as possible. *Vulnus morsum felis* has the opportunity to transmit bacteria that normally exist in the cat's oral cavity. The bacterial genera normally found in the cat's oral cavity i.e., *Staphylococcus spp., Pasteurella spp., Clostridium spp., Micrococcus spp., Streptococcus spp., Yersinia spp., Bacillus spp., Listeria spp., Corynebacterium spp., Actinomyces spp., Moraxella spp., Thermomonas spp., Neisseria spp., Propionibacterium spp., Bacteroides spp., Wolinella spp., Fusobacterium spp.,* and *Porphyromonas spp.* (Love *et al*., 1990; Roy *et al*., 2007; Magaji *et al*., 2008; Sturgeon *et al*., 2014). Treatment that can be given to cats experiencing *Vulnus morsum felis* is by applying the three principles of wound management; cleansing, debridement, and wound closure (Mickelson *et al*., 2016). The writer hoped that this case report can add references to action and evaluation of treatment in cases of *Vulnus morsum felis* in cats.

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MATERIALS AND METHODS

Signamelent and Anamnesis

The male case cat named Sinto was approximately one year old and weighed 2.4 kg on 20th November 2022 with a torn wound on his right leg after fighting with another cat five days earlier. The case cat's wound was treated by the owner by cleaning it using an antiseptic containing Etacridine lactate 0.1% (Rivanol OneMed®, PT. Jayamas Medica Industri, Sidoarjo, Indonesia) and given an antiseptic containing Povidone-Iodine 10% (Betadine®, PT. Mundipharma Healthcare Indonesia, Jakarta, Indonesia) once a day. There was no healing progress that occurred after being treated for five days by the owner. The case cat is still active and has a normal appetite and drinks. The owner feeds a mixture of dry food and home-made food such as sardines. There was no change in the cat's defecation and urination. Vaccination has never been done and the last deworming was given two months ago. The vaccination status of other cats that fight with case cats was said to be complete (feline calicivirus, feline panleukopenia, and feline rhinotracheitis).

Physical Examination

In general, the case cat had a nutritional status (body condition score) of 4/9 (using the Royal Canin® standard body condition score), with an alert temperament and an attitude of always lowering its tail to protect the wound. The examination of case cats (Table 1) showed the following physiological data; heart rate 186 beats per minute, pulsus 178 beats per minute, capillary refill time (CRT) under two seconds, respiration 37 times per minute, and body temperature 39.8 ^{o}C. On physical examination, the case cat had a *Vulnus morsum* on the right hind right leg (Figure 1). In addition, the other examinations such as mucosa, circulation, respiration, digestion, urogenital, musculoskeletal, nerves, lymph nodes, ears, and eyes were normal.

Table 1. The results of the examination of the cat

No	Examination	Value	Reference Value*)	Result
1	Body temperature (^{o}C)	39,8	37,5-39,2	High
2	Heartbeat (beats/minute)	186	70-220	Normal
3	Pulsus (times/minute)	178	70-220	Normal
4	Respiration (times/minute)	37	25-40	Normal
5	*Capillary Refill Time*/CRT (second)	<2	<2	Normal

*) Sources: Sturgess, 2012

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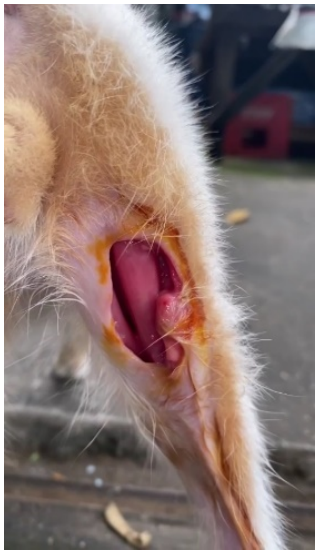

Figure 1. The condition of *Vulnus morsum felis* (white arrow) on the right hind right leg of the case after a fight and cleaning with rivanol by the owner

Clinical Examination

A complete blood count was carried out in this case, to evaluate the condition of the cat before surgery. The results showed that the case cat had leukocytosis, granulocytosis, and thrombocytopenia (Table 2).

Table 2. Complete blood count results in case cats

Parameter	Unit	Value	Reference Value*)	Result
WBC	$10^3/\mu L$	23,1	5,5-19,5	High
Limfosit	$10^3/\mu L$	4,9	1,5-7,0	Normal
Monosit	$10^3/\mu L$	1,0	0,0-1,9	Normal
Granulosit	$10^3/\mu L$	17,2	2,5-12,5	High
Eosinophil	%	2,8	0,0-4,0	Normal
RBC	$10^6/\mu L$	8,36	5,0-10,0	Normal
HGB	g/dL	12,4	9,8-15,4	Normal
MCHC	g/dL	33,7	30,0-36,0	Normal
MCH	pg	14,8	13,0-17,0	Normal
MCV	fL	43,9	39,0-55,0	Normal
RDW	%	14,5	13,0-17,0	Normal
HCT	%	36,7	30,0-45,0	Normal

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PLT	$10^3/\mu L$	110	300-800	Low
MPV	fL	9,1	12,0-18,0	Normal
PDW	fL	15,3	10,0-18,0	Normal
PCT	%	0,1	0,1 – 0,5	Normal

Description: WBC (*White Blood Cell*); RBC (*Red Blood Cell*); HGB (*Haemoglobin*); MCV (*Mean Corpuscular Volume*); MCH (*Mean Corpuscular Haemoglobin*); MCHC (*Mean Corpuscular Haemoglobin Concentration*); RDW (*Red Cell Distribution Width*); HCT (*Hematocrit*); PLT (*Platelet*); MPV (*Mean Platelet Volume*); PDW (*Platelet Distribution Width*); PCT (*Platelecrit*)

*) Sources: Fielder, 2022

The complete blood count results reveal that while the hemoglobin and red blood cell counts fall within the normal reference ranges, the patient exhibits a high white blood cell count and a low platelet count. Nevertheless, the surgical procedure remains suitable for the patient.

Diagnosis and Prognosis

Based on the results of anamnesis, physical examination, and clinical examinations, the case cat was diagnosed with stage IV *Vulnus morsum felis*. Judging from the severity of the injuries caused by fighting with other cats, this cat with *Vulnus morsum felis* has a fausta prognosis because the wound can still be repaired with wound closure surgery. The case cat was scheduled for treatment on November 23, 2022.

Treatment

Before the surgery, pre-operative procedure was carried out. This included preparing the operating room and getting the operating tools ready. The tools and materials used during the operation were sterilized first using an autoclave. Patients were also prepared before surgery by taking anamnesis, conducting physical examinations, and completing clinical examinations, including a complete blood count. Furthermore, patients who were going to be operated on were fasted from food for 12 hours and from drinking for 8 hours before the surgery. Cleaning the area of the wound to be operated on was done by shaving the hair to ensure it did not interfere with the operation process. The case cat was given premedication in the form of 0.25 mg/mL Atropine sulfate (Atropine Sulfate®, PT. Ethica Industri Farmasi, Bekasi, Indonesia) at a dose of 0.04 mg/kg BW which was injected subcutaneously. After 15 minutes, it was followed by administration of Xylazine (Xyla®, Interchemie, Venray, The Netherlands) at a dose of 3 mg/kg BW which was injected subcutaneously. Ten minutes later, it was followed by

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administration of Ketamine (Ket-A-100®, Agrovet Market, Lima, Peru) at a dose of 11 mg/kg BW which was injected intramuscularly. When the case cat began to be anesthetized, the cat was laid in dorsal recumbency on the operating table and then followed by inserting an intravenous catheter to be given an infusion of 0.9% NaCl (0.9% Sodium Chloride, PT. Widatra Bhakti, Pasuruan, Indonesia) as a maintenance fluid during the operation as much as six drops per minute.

After the case cat was fully anesthetized, surgical management of the wound was carried out by cleaning the wound area (cleansing) using 0.9% NaCl solution and Rivanol OneMed® (Figure 2), then removing dead or damaged tissue (debridement) so that the wound could reunite and then separating the skin from the subcutaneous tissue so that it was easy to suture (Figure 3). Next, the wound is closed by suturing the skin (suturing) using Silk 3/0 thread (Silk Braided GEA Medical®, PT. Mega Pratama Medicalindo, Jakarta, Indonesia) on the skin with a simple interrupted suture pattern (Figure 4). After the wound was closed, it was followed by administering the Rivanol OneMed® antiseptic to speed up the wound healing process, then the wound was closed using sterile gauze (Figure 5) and the case cat was also given an Elizabethan collar to protect the wound from being bitten by the case cat so that the stitches did not come off.

Post-operative care was carried out by administering antibiotics and anti-inflammatories which aim to prevent infection from occurring while the healing process is taking place. The antibiotics given were Amoxicillin injection (Intramox-150®, Interchemie, Venray, The Netherlands) at a dose of 15 mg/kg BW intramuscularly and anti-inflammatory Dexamethasone injection (Dexaharsen®, PT HARSEN, Jakarta, Indonesia) at a dose of 0.5 mg subcutaneously. Apart from that, take-home medication were given in the form of the antibiotic Amoxicillin syrup (Yusimox®, PT. IFARS Pharmaceutical Laboratories, Karanganyar, Indonesia) at a dose of 20 mg/kg BW, PO, q12h for nine days and Dexamethasone tablets (Dexaharsen®, PT HARSEN, Jakarta, Indonesia) at a dose of 0.5 mg, PO, q24h for six days and the owner was advised to clean the wound every day using Rivanol OneMed®.

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Figure 2. Wound condition after cleaning

Figure 3. Removal of dead or damaged tissue (debridement)

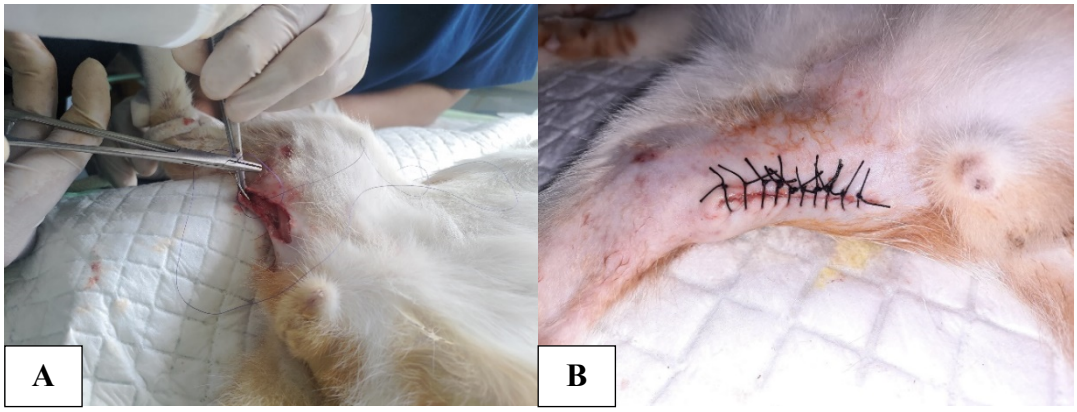

Figure 4. Suturing the wound (suturing) (A), results of suturing the wound (B)

Figure 5. Wound closure after suturing using sterile gauze

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RESULTS AND DISCUSSION

Based on the results of the anamnesis and physical examination, the case cat was diagnosed with stage IV *Vulnus morsum felis*, because the lacerations were deep and exposed the muscles and bones but did not penetrate the muscles and bones. The case cats required a surgical treatment because the wounds were large enough which hard to recover the wound properly, moreover the procedure can accelerate wound healing, and prevent secondary infection. The surgical procedure performed on *Vulnus morsum felis* was based on three principles of wound management, cleaning the wound (cleansing), removal of dead or damaged tissue to create a new wound so that the sides of the wound can be reunited with each other (debridement), and wound closure (suturing).

The first procedure was cleansing which in this case used physiological NaCl and Rivanol OneMed®. The main goal of this procedure was to remove or reduce the pathological agents present on the wound surface, as well as to clean the remaining necrotic tissue attached to the wound (Sartika, 2010). Physiological NaCl is an isotonic fluid to body tissues and used for cleaning contaminated wounds while Rivanol OneMed® is used as an antiseptic. Furthermore, debridement was carried out to removed the dead or damaged tissue by making a new wound so that the sides of the wound can be reunited. This debridement action is performed to remove abnormal wound bed and wound edge tissue as well as necrotic dermal tissue, debris, and pathological agents that can inhibit wound healing. Debridement also plays a role in helping the wound healing process through the production of granulation tissue (Perdanakusuma, 2010). Wound closure was performed with sutures (suturing) using 3/0 silk thread on the skin. This suturing aims to limit the contact of the wound with the outside environment and glue the two edges of the wound so that the two edges of the wound can meet and prevent secondary infection. This procedure can speed up the wound healing process.

Atropine is a plant alkaloid that has been used extensively in most animal species. This agent is usually used premedicated with other anesthetics in veterinary practice to prevent or minimize vagal effects that can cause bradycardia. Prevention of bradycardia is very important during surgical procedures. This drug reduces the spasm potential of smooth muscle, gastrointestinal motility and secretions, saliva, and respiratory secretions of animals during anesthesia and surgery (Haque *et al*., 2019). In addition, the general purpose of giving premedication is to reduce pain, make the recovery period more calm, reduce the dose of anesthetic needed, and accelerate the effects of anesthesia (Kristina *et al*., 2003). Xylazine can block nerve conduction in the central nervous

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system which causes muscle relaxation and sedation while ketamine provides an analgesic effect. These two drugs are combined agents that complement each other's analgesic and muscle relaxant effects (Yudaniayanti *et al*., 2010).

The results of a complete blood count in the case cat showed the cat had leukocytosis, granulocytosis, and thrombocytopenia. Leukocytosis and granulocytosis here indicated that an inflammatory process has occurred, considering that the wound has benn formed for several days and treated the wound by cleaning the surface of the wound without closing it (Primadina *et al*., 2019). Leukocytosis in general describes an increase of white blood cells in a cat's body as a response to infection and causes inflammation due to other cat bites. The granulocytosis described by the complete blood count machine confirmed the infection that occurs in the cat's body, which is caused by bacteria. This can happen because in the cat's oral cavity, there are bacteria of the normal flora, which can become opportunistic pathogens. The bacteria that most often can cause infection if bitten by a cat are Pasteurella, Clostridium, Prevotella, Fusobacterium, and Porphyromonas (Nocera *et al*., 2014; Roy *et al*., 2007; Love *et al*., 1990) with Pasteurella as the most abundant bacteria in the cat's oral cavity (up to 90%) (Banovic *et al*., 2013). Whereas the cause of thrombocytopenia in cat in this case was unknown specifically because no further examination was carried out. Common causes of thrombocytopenia in cats include infectious diseases, neoplasia, heart disease, congenital diseases, and immune-mediated diseases (Kohn, 2006).

The case cat was given an intramuscular injection of amoxicillin for post-surgery treatment. Amoxicillin is a semi-synthetic drug that belongs to the penicillin class of antibiotics. This drug is known to have a broad spectrum against Gram-positive and Gram-negative bacteria in humans and animals (Kaur *et al*., 2011). Amoxicillin is a bactericidal agent that works by inhibiting cell wall synthesis. Oral administration of amoxicillin is the most frequently chosen treatment and is successful in treating cats with wounds or abscesses infected with Pasteurella and obligate anaerobic bacteria (Roy *et al*., 2007). In addition to giving antibiotics, anti-inflammatory dexamethasone injection was also given intramuscularly. Dexamethasone is a glucocorticoid anti-inflammatory drug that generally aims to suppress inflammation. Glucocorticoids work by inhibiting fibroblast proliferation and the cellular response of inflammatory mediators. Glucocorticoids increase the number of circulating platelets in the blood, neutrophils, and red blood cells however, platelet aggregation is inhibited (Plumb, 2012). Apart from being given by injection, administration of anti-inflammatory drugs was continued for six days with oral drugs and oral antibiotics were continued up

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to nine days postoperatively until the wound was dry. In addition to oral treatment, wound care was also carried out by cleaning the wound and administering antiseptic every day to help speed up the wound healing process and prevents secondary infections.

The case cat was placed in a dry and clean cage with Elizabeth's collar put on while the wound healing process was observed. On the first, second, and fourth postoperative days, the skin around the surgical wound looks red, this was an indicator of an inflammatory process (inflammatory phase) (Figure 6). The inflammatory phase is characterized by rubor (redness), calor (heat), tumor (swelling), dolor (pain), and functional disturbance (functio laesa) in the inflamed tissue. On the second and fourth day after the operation, the stitches on the wound still looked wet and the skin did not appear to be reattached. On the sixth day after the operation, the skin began to look reattached but the stitches on the wound still looked wet. On the eighth day after the operation, the stitches began to dry, and it was decided to remove the stitches on the ninth day. On the 12th day postoperatively, the skin was healed.

The wound healing process is a complex process with several phases including hemostasis, inflammatory phase, proliferative phase, and remodeling phase. Hemostasis occurs immediately after the injury (5-15 minutes) with the mechanism of vasoconstriction and activation of blood clotting by platelets which causes clotting by fibrin (clotting) that fills the wound cavity forming a provisional matrix as a scaffold for the migration of inflammatory cells in the inflammatory phase. This fibrin clot is an important stage for the next phase, the inflammatory phase to occur. The inflammatory phase (Figure 6A, Figure 6B, and Figure 6C) can occur from 24-48 hours post-traumatic, in general, it can occur up to day 5 post-traumatic and maximum of two weeks with the mechanism of increased capillary permeability and infiltration of neutrophils, macrophages and lymphocytes in the wound area. The main objectives of this phase are to remove dead tissue and prevent colonization or infection by pathogenic microbial agents. In the presence of inflammatory cells, an inflammatory response begins which is characterized by the so-called cardinal symptoms, i.e., rubor, calor, tumor, dolor, and functio laesa.

The proliferative phase (Figure 6C, Figure 6D, and Figure 6E) begins from day 3 to 14 days post-trauma, a maximum of 21 days with three mechanisms, i.e., fibroplasia, angiogenesis, and epithelialization. Fibroplasia is a process of wound repair involving connective tissue (fibroblasts). Fibroblasts proliferate, migrate, and differentiate into myofibroblasts. Fibroblasts are

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important in the production of the extracellular matrix, which is composed of collagen, glycosaminoglycans, proteoglycans, fibronectin, and elastin. Angiogenesis is the growth of new blood vessels that occurs naturally in the body, both in healthy and pathological conditions. The formation of new blood vessels looks reddish in color (erythema) due to the formation of capillaries in the wound area. Epithelialization is the resurfacing of the wound with new epithelium. Epithelialization involves the proliferation and migration of epidermal keratinocytes from the wound edges, differentiation of epithelial progenitor cells into the epidermis, and repair of the basement membrane that connects the epidermis to the underlying dermis. These epithelial cells will go to the center of the wound and meet in the middle of the wound.

The remodeling phase (Figure 6E, Figure 6F, Figure 6G, and Figure 6H) begins a few days post-trauma (generally lasts for one-week post-trauma), a maximum of two years with the mechanism of collagen deposition in the wound area. During this phase, the newly formed collagen is strengthened and remodeled. The end result of this phase is scar tissue that is pale, thin, limp, and easily moved from its base. The tissue remodeling phase is the longest phase of the wound healing process. The strength of normal tissue will not fully return to 100%, but only about 80% of the strength of normal tissue before the injury occurs, because collagen fibers can only recover as much as 80% (Mickelson *et al*., 2016; Primadina *et al*., 2019).

Figure 6. Post-operative wound healing process; 1st day post-surgery (A); 2nd postoperative day (B); 4th postoperative day (C); 6th postoperative day (D); 8th postoperative day (E); 9th postoperative day before the sutures were removed (F); 9th postoperative day after the sutures were removed (G); 12th day post-surgery (H)

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CONCLUSIONS

Vulnus morsum or wound caused by an animal bite is a wound that can cause infection if not treated immediately. Treatment, care, and evaluation must be carried out every day until the wound healed. In this case, surgical wound care was performed, using standard wound care surgery, i.e., cleaning the wound (cleansing), removing dead tissue (debridement), and closing the wound (wound closure) with sutures (suturing). For the therapy of post-surgery, the case cat was given an antibiotic injection of amoxicillin (Intramox-150®) and an anti-inflammatory dexamethasone injection (Dexaharsen®), followed by administration of oral amoxicillin (Yusimox®) and oral dexamethasone (Dexaharsen®) and also cleaning the wound with an antiseptic every day to help the wound heal. The case cat showed wound healing after being treated for 12 days post-surgery.

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