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Management of an avulsion wound of the footpad in a Bengal tiger (*Panthera tigris tigris*) using low-level laser therapy (LLLT)

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Abstract

A traumatic avulsion wound of the footpad in a 12-year-old male Bengal tiger (Panthera tigris tigris), housed at the Thrissur Zoo, was sutured under general anaesthesia. Following disruption of sutures and gaping of the wound, it was treated with low-level laser therapy (LLLT) at a dose of 4.19 J/cm^2 for four consecutive days. There after it was treated with topical medications. The area of the wound reduced slowly and complete healing was observed in a period of two months.

Keywords: *Panthera tigris tigris, avulsion wound, low-level laser therapy*

A male Bengal tiger (*Panthera tigris tigris*) belonging to Thrissur Zoo, had injured its left forelimb and lost its claw on the lateral digit. The wound persisted despite local treatment and bled intermittently upon accidental trauma caused due to the movements inside the cage and the open paddock. The tiger, approximately 12 years old, again had a traumatic injury from the iron bars of its cage which caused an avulsion wound of the foot pad on that digit. It was decided to suture the foot pad under general anaesthesia.

The body weight was estimated at 175 kg and a consent was obtained from the Zoo authorities for anaesthetising the tiger. The tiger was anaesthetised using a multimodal protocol with inj. xylazine hydrochloride at the dose rate of 0.5mg/kg, inj. butorphanol at the dose rate of 0.05mg/kg, inj. ketamine hydrochloride at the dose rate of 3.0 mg/kg and inj. midazolam at the dose rate of

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0.05mg/kg. The tiger was controlled in a squeeze cage and pre-medicated with the cocktail of xylazine and butorphanol intramuscularly at the gluteal region. Ten minutes later the cocktail of ketamine and midazolam was also administered intramuscularly at the same site. The tiger attained lateral recumbency in 10 minutes.

The affected paw was pulled out of the cage between the iron bars. The wound was irrigated with normal saline and scarified the edges using a scalpel blade (Fig. 1). The edges of the wound were sutured using 1-0 Vicryl® in simple interrupted pattern (Fig. 2). The wound was dressed using dressing powder (1:1:1 of boric acid, zinc oxide and sulphanilamide powder). Blood was collected for haematological and serum biochemical evaluation, the results of which are given in Table 1 and 2. Shrivastav and Singh (2012) had reported the reference values for haematological and serum biochemical parameters in tigers. The results were compared with the reference values which showed leukocytosis with neutrophilia and lymphopenia. The serum biochemical parameters were within the normal range. The buffy coat and blood smear examination did not reveal the presence of any haemoparasites. The anaesthesia lasted for an hour, after which it started responding to stimuli and showed voluntary movements of the head and limbs. In two hours, it stood up and moved to its cage. Gunkel and Lafortune (2007) had given various combinations for anaesthesia in tigers which helped to reduce the dosage of individual drugs, provide adequate analgesia and muscle relaxation. The multimodal approach in this case helped to minimise the drug doses, provided adequate time for the completion of the procedure and the recovery was smooth.

Post-operatively the tiger was administered with inj. Fortivir® 5.0 mL and inj. Rumeric® 5.0 mL intramuscularly which was repeated on the third day. Topical dressing was continued with Topicure pet™, Povidone iodine and dressing powder once daily before releasing into the open paddock.

Table 1. Results of haematological examination

Parameter	**Result**	**Reference range** (Shrivastav and Singh, 2012)
WBC	17.47 x 10^9/L	6.2–11.05
Lymphocyte %	5.32%	18–35
Monocyte%	3.69%	2– 6
Neutrophil%	87.27%	57–75
Eosinophil%	3.48%	2–6
Basophil%	0.24%	0–4
RBC	5.57 x 10^6/µL	4.66–9.15
HGB	11.3 g/dL	7.8–13.8
HCT	36.5%	36–45
MCV	65.7 fL	
MCH	20.2 pg	
MCHC	30.9 g/dL	
PLT	198 x 10^3/ µL	

Table 2. Results of serum biochemical examination

Parameter	**Result**	**Reference range** (Shrivastav and Singh, 2012)
BUN	34.901 mg/dL	6.5–48.2
Creatinine	2.127 mg/dL	1.6–4.6
ALP	32.49 IU/L	
AST	21.09 IU/L	14.4–84.0
ALT	20.29 IU/L	21.2–109.0
Total protein	7.553 g/dL	3.7–8.7
Albumin	3.253 g/dL	2.1–4.6
Globulin	4.300 g/dL	

On the third day it was observed that there was disruption of sutures and gaping of the wound (Fig. 3). The wound was granulating and it was decided to allow the wound to heal by second intention. The topical medication was continued but the wound did not show any sign of healing even after two weeks. Hence it was decided to try low-level laser therapy (LLLT) to promote healing of the wound.

Low-level laser therapy was administered for four consecutive days using Gallium -Arsenide (Ga-As) laser (Digi laser pro®, BMS, Chennai) at a dose rate of 4.19 J/cm^2 in an off-contact mode kept at a distance of about a metre, with the tiger restrained in the squeeze cage. The dosage was set for a wound area of 10cm^2. The dosage was based on the observations of Varghese (2002), who suggested an energy density of 4 J/cm^2 for the healing of chronic wounds in dogs using Helium-Neon laser. But the author used the probe in close proximity to the wound which was not practical in this case. The therapist wore protective goggles and care was taken to avoid unwanted exposure to the tiger's eyes (Fig. 4 and 5).

The topical dressing was continued. It was observed that the initial red coloured granulation was further replaced with a whitish connective tissue and the wound edges seemed to be closing in, to complete the healing process by two months as evidenced in the serial photographs (Fig. 6, 7 & 8).

Baker (2002) reported the use of a combination therapy of Fluoxetine and acepromazine to eliminate pacing behaviour, daily application of moisturising ointment, and oral vitamin E supplementation for curing foot pad ulcers in a captive Bengal tiger. The author reported that the ulcers were caused due to the hard concrete flooring. Environmental enrichment devices were also to be installed in the enclosures to modify the behaviour of the

Fig. 1. Avulsion of foot pad

Fig. 2. Sutured wound

Fig. 3. Disrupted sutures

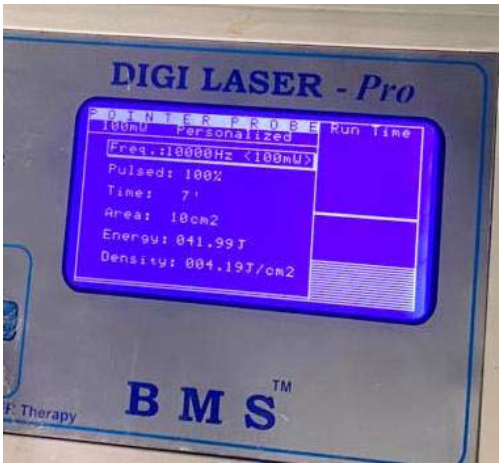

Fig. 4. Parameters for LLLT

Fig. 5. LLLT being performed

Fig. 6. After two weeks

Fig. 7. After one month

Fig. 8. After two months

animal. The enclosure at Thrissur Zoo already had an open paddock with a wallowing tank and scratch poles in place. Accidental trauma was the cause of repeated wounding of that digit. No medication was provided in this case to eliminate pacing behaviour.

There are only a limited number of peer-reviewed studies on the efficacy of low-level laser therapy in non-domesticated species. The wide range of anatomical differences make dosing of the therapy difficult. Most often, the therapeutic doses used in the domestic species are being extrapolated for use in the wild animals. A wavelength of 635nm can be used to treat superficial wounds and are typically dosed from 1-4 J/cm^2 in dogs (Varghese, 2002; Dadone and Harrison, 2017). In this case we have used a Ga-As laser (Class 3B) with a wavelength of 650nm and100mw output. The energy density delivered to the wound was 4.19 J/cm^2.

Dadone and Harrison (2017) opined that operant conditioning is beneficial in treating large patients or those which are too dangerous to restrain manually. In this case, the LLLT was performed while the tiger was restrained in the squeeze cage. It did not exhibit any discomfort during the therapy. The off-contact mode helped in maintaining a safe distance for the therapist as well as reducing distress to the animal. The properties of laser like monochromaticity, coherence and collimation helped to deliver large amounts of photons to a small region in a short period of time (Low and Reed, 2000). Hence, this method can be tried for treating superficial wounds in non-domesticated animals in captivity, though more evidence is needed for standardising the dosage in various species.

Bohling *et al*. (2004) reported that wound healing in cats is delayed compared to dogs and that cutaneous wounds in cats healed primarily by contraction of wound edges. This might be the reason for the delayed wound healing in tigers as well. Majie *et al*. (2013) described the management of a chronic penetrating wound in a Sundarban tiger with topical dressing and systemic antibiotics. The authors described the wound healing process as "eventful" which indicated the difficult nature of the wound. Moreover, in the present case, as the wound involved the foot pad, which differs from other cutaneous wounds, the scope for wound contraction was limited and the mobility of the region added to the delay in healing.

Summary

A 12-year-old male Bengal tiger with an avulsion wound of the footpad was managed surgically under multimodal anaesthesia. The sutures were disrupted on the third day and thereafter the wound was subjected to low-level laser therapy at the dose rate of 4.19 J/cm^2 for four consecutive days. Topical wound dressing was continued until complete healing, which took two months. It can be concluded that wound healing in felines is generally delayed and low-level laser therapy can help in healing of chronic cutaneous wounds in wild felids.

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Conflict of interest

The authors declare that they have no conflict of interest.

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