

Using Photobiomodulation Therapy

To Heal A Crushing Injury To The Carpus From A Leg Trap

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Introduction

This case report will demonstrate how Photobiomodulation Therapy (PBMT) used as an adjunct to traditional veterinary medicine to heal a crushing injury to the carpus of a canine patient, which in turn caused severe tendon contracture. In this case, the addition of PBMT proved to be the keystone, and the turning point, for a patient not effectively responding to standard of care. It is important to understand that PBMT is not intended to replace other standard of care treatments but is a very valuable and effective modality to consider alongside these treatments.¹ It is very safe, with no known side effects, when the treatment is carried out appropriately and at an appropriate total target dose for the specific site and condition. Tissues, which are painful, inflamed, or in need of healing are all valid candidates for PBMT.² The photobiomodulation of tissues treated with this modality will potentiate the body's ability to heal itself, and will enable the patient to recover much more quickly and prevent or lessen the degree of maladaptive pain experienced.

What is known as PBMT is the technical term when referring to cold laser, low level laser, or low intensity laser. To simplify the cascade of physiological events induced by PBMT, an analogy of photosynthesis in plants can be made. Simply put, energy, in the form of very specific light wavelengths, is absorbed by tissues and this photonic energy is modulated into chemical processes which reduce pain, decrease inflammation, and thus promote active tissue repair.

This case presentation was monitored by multiple, short video clips, which show the visual “glide path” of progression as this patient underwent PBMT and responded by photobiomodulation of tissues treated with the modality. Several video screenshots have been used to document the patient's progression.

Patient Presentation / Chief Complaint, And Recent History “Nilla”, 8-year-old, female (spayed) Great Pyrenees. (67.4Lb.)

The patient had been healthy prior to this traumatic event; she was not on any pharmaceuticals and had no history of any pre-existing conditions to be considered.

The patient presented the morning after having been cared for at the local emergency clinic. She was limping, painful, non-weight bearing on the right thoracic limb extremity with a pronounced contraction of the carpal joint. Marked inflammation with discoloration and tissue edema ranging from the carpus and continuing distally and circumferentially including the metacarpals and all digits was present. The patient was self-mutilating by licking/nibbling at the site actively and had an overall reduced comfort level and ability to ambulate.

The patient had been missing in the Nevada desert for four days when the owner found her with her right front leg caught in a steel trap. The owner noted the right front paw was very swollen and the patient was only toe-touching lame on that limb. The owner gave the patient a human

adult dose of aspirin and took her to the local emergency overnight hospital. The DVM at the emergency clinic was unable to accurately palpate the metacarpals and phalanges due to the amount of soft tissue swelling. The affected site was reported to be warm, with the skin having no visible laceration but very red over the metacarpal area and more purple in color over the digits. The primary concern was for vascular compromise. At that time, it was determined that the patient may require surgery (or even multiple surgeries) to debride necrotic tissues. Radiographs taken at the emergency clinic revealed soft tissue swelling of the carpus, metacarpals, and digits. Complete assessment of the radiographs was limited by oversaturation of the distal phalanges. The owner was advised that it may take several days for the wound and extent of injury to fully declare itself. The patient was hospitalized for overnight care but remained markedly lame on the right thoracic limb until being released the following morning. At the time of release from the emergency clinic, the owner was advised to seek continued care with his regular veterinarian and that follow-up radiographs should be repeated in ten to fourteen days to re-evaluate the skeletal structures for evidence of septic periostitis or osteomyelitis.

The patient presented the following day for continued care. The client reported that the swelling at the paw has gotten worse since being discharged from the emergency clinic the previous day and that the paw remains hot to the touch and with a red discoloration to the skin. At presentation, the

BOX 1. Conventional Therapy

Presentation at emergency clinic: (February 3rd)

- > Tramadol 125mg PO BID/TID
- > Withhold NSAID for washout period for aspirin
- > Epsom salt soaking

Initial presentation at BBVH: (February 4th)

- > Tramadol 125mg PO BID/TID
- > Carprofen 100mg PO SID
- > Epsom salt soakings
- > Ice pack treatments
- > Elizabethan collar

Second presentation at BBVH: (February 18th)

- > Tramadol 125mg PO BID/TID
- > Carprofen 100mg PO SID
- > Epsom salt soakings
- > Ice pack treatments
- > Gabapentin 100mg PO SID/BID
- > PBMT 8-10J/cm² SID/EOD

patient showed significant weight bearing lameness with the digits warm and the palmar surface a bit moist and effusive to the touch with a yellowish hue to the skin. There were no obvious necrotic areas. The client was advised to start an NSAID that evening, along with Epsom salt soakings, and start ice treatments. The client was also given the option to start PBMT if there was little or no improvement over the next 48 hours.

The patient presented the second time fourteen days later. At this time, she had remained non-weight bearing on the right thoracic limb since the initial insult two weeks prior. The affected region remained



Figure 1: Secondary presentation (post 2 weeks of non-response to standard modalities).

fairly swollen as the patient continued to receive Tramadol and Carprofen (Box 1). The right front paw remained in a contracted position and the patient walked on the dorsal surface at times. The patient did not lay the paw flat out to walk, was visibly limping, and was mildly painful in that area. The DVM concluded that the crushing injury had likely caused tendon contracture and residual neuropathy. The client was advised to continue ongoing medications, start Gabapentin, and start PBMT (Box 1).

Photobiomodulation Therapy

PBMT was initiated after two weeks post-insult to tissues after continued lack of improvement was seen from conventional medical care (Figure 1). The application of PBMT would be used as a palliative tool which also enabled the patient to physically remodel damaged tissues. The photonic energy delivered by the therapy laser is absorbed by the tissues and is used at a cellular level to nourish damaged tissues to return to normal function.³

The approximated tissue surface area

of 100 cm² (including the carpus and all distal structures) was treated with a total target dose of 987 Joules per treatment, thus 9.87 J/cm². This dosage (fluence – J/cm²) is designed to treat deep tissue structures and helps to account for the amount of tissue inhomogeneity at the target site. We utilized the CTS-15 model therapy laser platform, manufactured by Companion Animal Health (the veterinary division of LiteCure, LLC), which operates at dual wavelengths of near-IR light (808nm and 980nm). A series of varying beam emission was utilized during the treatments, this included incorporating several pulsing frequencies as well as a continuous wave of emission.

The site was treated with a contact massage technique to maximize absorption and in a circumferential manner while putting the joint through a range of motion during the entire treatment as best as the patient would allow without undue pain or resistance to manipulation. Fully and evenly saturating the target tissue site with the therapeutic light was imperative in ensuring an effective patient response. To do this, a linear scanning technique was

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applied during beam emission (moving the hand piece in a scanning fashion up/down and left/right). Also, an initial light contact technique was adjusted to a massage like technique as the patient responded to therapy and became less reactive and painful to normal stimuli and manipulation.

Initially, treatment frequency was planned to be daily until a clinical effect was seen in a palliative way (decreased lameness, improved gait with adequate weight bearing, improved range of motion, and body language indicating an acceptable level of comfort), then every other day until resolution or a peak effect was seen in both pain management and mobility improvement. This treatment frequency was planned to potentiate an accelerated course of tissue normalization and promoting function / use of the joint and distal extremity.

Due to scheduling constraints from the client, treatments were carried out as such shown in Table 1.

Results

Even though the treatment schedule was not carried out at an optimal frequency, the

patient proved to greatly benefit from PBMT as demonstrated in physical exam, by the videos and feedback from the client.¹ The patient was very cooperative for treatments, allowed steady contact without overt reaction to treatment but very resistant to ROM initially—all these symptoms of sensitivity and amount of ROM restriction steadily decreased in a continuous manner as the treatment course was completed. Also, initial applied use of Elizabethan collar in the early stage of treatments since patient had been self-mutilating the paw prior to starting PBMT, could also be discontinued as the patient progressed through the PBMT treatments.

The client's positive reports of daily routine progression, visual documentation by videos reflect the same, and visual/manual assessment by the laser unit operator at each treatment all confirm a positive glide path as the patient progressed through the pulsed treatment phase.

Per the client's assessment, patient showed immediate improvement in weight bearing and unstable gait, as well as decreased pain after initial treatment. By the third treatment (Figure 2), the patient was increasingly bearing weight at standstill and when walking. There was minimal remaining heat and inflammation to the treatment site at this time, as well as the scabbed areas around the circumference of the metacarpus appearing to be healing well. By the fifth treatment, there was only mildly evident contracture remaining with inflammation/swelling being almost nonexistent and the previously circumferential scabbing to the metacarpus was only present on the dorsal aspect at this point (Figure 3). The client reported



Top: Treatment # 3: Positive glide path of response to PBMT established.

Bottom: Treatment # 5: Minimal residual mobility restriction.

the patient was willingly able to jump out of and back into truck without hesitation, pain or instability as early as the fifth treatment. The patient showed significant and consistent improvement after the initial treatment and continued to show an accelerated rate of palliative and healing responses to PBMT therapy on a continual basis without any setback or sequelae (Figure 4). The final client's telephone communication reported the patient had no setbacks and remained pain-free and active. The patient had resumed normal activity

TABLE 1. Treatment Frequency

Treatment #	Date
1	2/18
2	2/19
3	2/20
4	2/21
5	2/23
6	2/24
7	2/25
8	2/27
9	3/2
10	3/4
11	3/6
12	3/10



Figure 4: Final Treatment: Resolution attained.

and historical behaviors specific to her, which she had been unable to do since prior to the injury event.

Discussion

While PBMT was used as an adjunct, it is important to note the lack of improvement and, in fact, worsening on the patient's part for several weeks after traditional modalities had been initiated. Once PBMT was initiated, it was at that time that the patient's status immediately and consistently followed a positive glide path until resolution was attained. PBMT proved to be the turning point for a patient not effectively responding to conventional medical modalities. The advent of PBMT had taken veterinary medicine to a new level in the ability to ameliorate conditions involving tissues which are painful, inflamed, or need to be healed. PBMT is a modality with the ability to improve an array of conditions ranging from the acute and superficial to the chronic and involving deep tissue structures, as well as for end of life palliative care. Photobiomodulation therapy is at this point in its adolescence of

development. It will remain on the leading edge of veterinary medicine as it continues to evolve and show its value in the field.⁴

Conclusion

By using PBMT, resolution was attained for this patient who did not respond effectively to conventional medicine. The injured site (which was initially painful, damaged, and not functional) healed well and the patient regained her full quality of life via a palliative response. She also regained her mobility and full use of the limb. Resolution was attained, and the patient continues to do well without any reports of any setbacks since her last assessment over one year ago. Photobiomodulation therapy is a science with proven results. This is a very dynamic field and it continues to evolve and develop rapidly as we gather more data from studies and treatments being performed in practice. PBMT has proven itself to be very safe and effective when the treatment dose is calculated and applied correctly. While it is not a "magic wand" or panacea, it is the closest thing to such for some patients, especially the ones with limited options

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due to concurrent organ debilitation or the ones who are not effectively responding to traditional medical modalities. Although we have come a long way since research and delivery were initiated, we still have much to learn to fully harness the potential of this modality.

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