

Photobiomodulation in Veterinary Medicine: Mechanisms, Clinical Applications, and Case Studies

Luca Giovagnoli¹, Jolanda Vermeulen²

¹Vet Center Conero, Castelfidardo, Italy

²Eindhoven, The Netherlands

Email: luke.2@hotmail.it

How to cite this paper: Giovagnoli, L. and Vermeulen, J. (2026) Photobiomodulation in Veterinary Medicine: Mechanisms, Clinical Applications, and Case Studies. *Open Journal of Veterinary Medicine*, 16, 27-36. <https://doi.org/10.4236/ojvm.2026.163003>

Received: November 10, 2025

Accepted: March 22, 2026

Published: March 25, 2026

Copyright © 2026 by author(s) and Scientific Research Publishing Inc. This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

Photobiomodulation (PBM) therapy represents a non-invasive, scientifically validated method that uses specific wavelengths of light to stimulate cellular repair, reduce inflammation, and modulate pain. In veterinary medicine, PBM has become an increasingly valuable tool for accelerating tissue healing and improving the quality of life in animals with acute or chronic conditions. This study presents three clinical cases treated at Vet Center Conero using *Elioslamp* PBM devices: a post-surgical wound in a dog, a cat affected by osteoarthritis, and an equine tendon lesion. Results showed accelerated healing, significant pain reduction, and structural recovery, confirming the clinical efficacy and safety of PBM in veterinary practice.

Keywords

Photobiomodulation, Laser Therapy, Veterinary Medicine, Elioslamp, Wound Healing, Pain Management

1. Introduction

Photobiomodulation (PBM) therapy, historically known as low-level laser therapy (LLLT), is an established modality that uses non-ionizing light sources such as lasers and light-emitting diodes (LEDs) to trigger photochemical and photophysical processes within biological tissues. Unlike ablative or thermal laser applications, PBM does not cause macroscopic heating or cellular damage; rather, it modulates biological activity through light-tissue interactions at the molecular level [1]. When photons in the red and near-infrared spectrum (600 - 1100 nm) are

absorbed by intracellular chromophores—primarily cytochrome c oxidase (CCO) in the mitochondrial respiratory chain—they promote electron transport, enhance ATP synthesis, and modulate the transient production of reactive oxygen species (ROS) and nitric oxide (NO). These reactions improve cellular metabolism, stimulate gene expression related to repair and regeneration, and reduce oxidative stress [2]. Furthermore, chip on board systems triple wave length such as 670 and 830 with high absorption efficiency and is optimal for superficial-to-intermediate tissues, whereas 850 nm mitochondrial absorption but superior water-based absorption, and enhanced photothermal modulation in musculoskeletal tissues.

The therapeutic effects of PBM have been demonstrated in numerous *in vitro*, *in vivo*, and clinical studies. At the s fibroblast proliferation, collagen synthesis, angiogenesis, and modulation of inflammation. These biological effects translate clinically into accelerated wound closure, improved tensile strength, reduced edema, and effective analgesia via both central and peripheral mechanisms. In veterinary medicine, PBM is now widely employed as an adjunctive treatment in soft-tissue surgery, musculoskeletal disorders, tendinopathies, degenerative joint disease, and neurologic rehabilitation in both small and large animal species [3].

The Elioslamp system, developed and manufactured in Italy, represents a technologically advanced PBM device specifically adapted for veterinary applications. It offers triple-wavelength emission at 670-830 and 980 nm, adjustable fluence (1-10 J/cm²), and emission modes (continuous or pulsed 1-100 Hz), enabling clinicians to select optimal parameters for tissue depth and target pathology. The 810 nm wavelength is particularly effective for stimulating mitochondrial chromophores in soft tissues is installed as a peripheral LEDs. Built-in safety mechanisms, including automatic power calibration and contact sensors, ensure reproducibility and user safety during repeated treatments. This combination of precision, safety, and clinical versatility makes Elioslamp a suitable platform for both research and daily clinical use.

Within modern veterinary practice, PBM has become a central component of multimodal therapeutic strategies. It is routinely integrated alongside pharmacologic analgesia, physiotherapy, and regenerative medicine approaches such as platelet-rich plasma (PRP) and stem cell therapy. Reported clinical benefits include shorter convalescence periods, reduced dependence on nonsteroidal anti-inflammatory drugs (NSAIDs), and improved patient comfort and mobility [4]. These outcomes align with the growing demand for non-invasive, evidence-based modalities capable of promoting healing while minimizing systemic drug exposure.

In summary, photobiomodulation with Elioslamp devices represents a scientifically grounded therapeutic innovation for small and large animals. By merging precise optical engineering with well-characterized biological mechanisms, PBM contributes to the advancement of integrative veterinary medicine and the refinement of patient-centered care.

2. Materials and Methods

2.1. Study Design and Setting

This prospective clinical observational study was conducted at the *Vet Center Conero* (Castelfidardo, Ancona, Italy) between January and October 2025. The objective was to evaluate the therapeutic effects of photobiomodulation (PBM) using Elioslamp devices in companion and equine patients with different soft tissue and musculoskeletal conditions. All procedures were performed in accordance with the European Directive 2010/63/EU on animal welfare and approved by the clinic's internal ethics committee. Written informed consent was obtained from all animal owners prior to inclusion. More precisely, based on sample size and absence of a control group, the design is best characterized as a prospective case series.

2.1.1. Equipment

Treatments were performed using Elioslamp PBM devices (Elioslamp, Italy), Class IV veterinary laser/LED systems designed for photobiomodulation.

Each device provides triple-wavelength emission (670-830-850) and extra leds at 810 nm (continuous and pulsed) and some extra LEDs as 630 nm (continuous or pulsed, 1-200 Hz), with adjustable fluence from 1 to 10 J/cm² and output power ranging between 0.5 and 3.0 W.

The beam diameter was standardized to a 1 cm² spot size. Integrated temperature control, contact sensors, and automatic power calibration were used to ensure safe, reproducible energy delivery.

Protective eyewear was worn by all personnel and, when feasible, by animal patients.

2.1.2. Patient Selection

A total of 18 animals (10 dogs, 5 cats, and 3 horses) were initially screened; 12 met inclusion criteria and were enrolled.

Selection criteria included: 1) confirmed diagnosis of a superficial or musculoskeletal condition amenable to PBM; 2) absence of systemic infection, neoplasia, or concurrent corticosteroid therapy; and 3) stable physiological status allowing outpatient management. Cases were divided into three representative groups:

- **Group A (Canine - Post-Surgical Wound Healing)**
- **Group B (Feline - Osteoarthritis and Chronic Pain)**
- **Group C (Equine - Superficial Digital Flexor Tendon Lesion)**

Baseline assessments included physical examination, pain scoring (modified Glasgow Composite Pain Scale), and photographic or ultrasonographic documentation.

2.2. Treatment Protocol

PBM was applied using standardized dosimetric parameters tailored to tissue depth and pathology (**Table 1**).

Treatment sessions were performed by a single experienced operator (Luca Giovagnoli, DVM MRCVS) to ensure protocol consistency.

Table 1. Summary of PBM parameters and outcomes.

Species	Condition	Wavelength (nm)	Fluence (J/cm ²)	Mode	Frequency	Duration	Outcome
Dog	Post-Surgical wound	Wavelength 670 - 830 - 850 nm plus 810 and 630 nm	4	Continuous s	1/day	9 days	Complete healing
Cat	Osteoarthritis	Wavelength 670 - 830 - 850 nm plus 810 and 630 nm	6	Pulsed 50 Hz	2/week	7 weeks	Pain ↓ 8 → 2
Horse	SDFT lesion	Wavelength 670 - 830 - 850 nm plus 810 and 630 nm	8	Continuous s	3/week	6 weeks	85% fiber recovery

- **Group A (Canine wounds):**

Wavelength 670 - 830 - 850 nm plus 810 and 630 nm, fluence 4 J/cm², continuous mode, once daily for 9 days. Beam applied in non-contact scanning mode at a distance of 1 cm, covering wound margins with 20% overlap.

- **Group B (Feline osteoarthritis):**

Wavelength 670 - 830 - 850 nm plus 810 and 630 nm, fluence 6 J/cm², pulsed 50 Hz, twice weekly for 7 weeks. Beam delivered in contact mode with gentle circular motion over affected joints.

- **Group C (Equine tendon lesion):**

Wavelength 670 - 830 - 850 nm plus 810 and 630 nm, fluence 8 J/cm², continuous mode, three sessions per week for 6 weeks.

Beam applied in contact mode along the lesion guided by ultrasonographic localization.

Ambient temperature (20°C - 22°C) and humidity (50% - 60%) were standardized during sessions. No sedation was required, and animals tolerated treatment without restraint or adverse reactions.

2.3. Outcome Evaluation

Clinical progress was assessed through both subjective and objective parameters:

- **Group A:** Wound area reduction (cm²) measured by planimetry on digital photographs every 3 days.
- **Group B:** Pain and mobility evaluated by owner questionnaires and the Glasgow Composite Pain Scale.
- **Group C:** Ultrasonographic echogenicity, cross-sectional tendon area, and lameness scoring (AAEP scale).

Data were recorded in electronic medical records and compared with baseline. No additional analgesics or physiotherapy were introduced during the PBM protocol to avoid confounding factors.

Safety endpoints included local erythema, edema, or discomfort during irradiation.

2.4. Data Analysis

Quantitative data were expressed as mean ± SD. For within-group comparisons (pre- vs post-treatment), the non-parametric Wilcoxon signed-rank test was used (p < 0.05 considered significant).

Descriptive statistics were employed for categorical data such as owner-reported improvement. Statistical analysis was performed using **GraphPad Prism 10.0** (GraphPad Software, San Diego, CA, USA).

Parameter	Specification
Manufacturer	Elioslamp (Italy)
Device Type	Class IV therapeutic laser/LED PBM system
Wavelengths	Wavelength 670 - 830 - 850 nm plus 810 and 630 nm continuous or pulsed (10 to 200 Hz)
Power Output	0.5 - 3.0 W adjustable
Spot Size	1 cm ²
Fluence Range	1 - 10 J/cm ²
Emission Modes	Continuous or Pulsed (1 - 200 Hz)
Cooling System	Passive aluminum sink + temperature control
Safety Features	Power calibration, contact sensor
Penetration Depth	2 - 5 cm (depending on tissue)
Clinical Uses	Wound healing, pain, inflammation, tendons

3. Case Studies

Case 1 - Post-surgical Wound Healing in a Dog Signalment and History:

Scott, a 7-year-old neutered male Labrador Retriever (32 kg) presented with a 12 cm linear wound on the right lateral thigh following surgical removal of a lipoma.

Sutures were intact, and mild serosanguinous exudate was present on postoperative day 2. The patient exhibited mild discomfort but maintained normal appetite and mobility.

Treatment Protocol:

Photobiomodulation therapy was initiated 48 hours after surgery using the Elioslamp Wavelength 670 - 830 - 850 nm plus 810 and 630 nm in continuous mode, with a fluence of 4 J/cm² and power output of 1.5 W.

Treatments were applied once daily for nine consecutive days, with the probe held 1 cm from the surface and overlapping passes to ensure even coverage of the wound margins and surrounding tissue (approx. 1 cm beyond incision line).

Clinical Outcome:

Wound contraction was measured using calibrated planimetry software.

By day 6, wound area had reduced by 52%, and by day 9, complete epithelialization was achieved with minimal scarring.

No erythema or hyper granulation was observed. The owner reported the dog's pain score (modified Glasgow Composite Pain Scale) decreased from 5/20 to 1/20 by day 5.

At a 3-week follow-up, the surgical site demonstrated normal elasticity and full hair regrowth.

Interpretation:

The accelerated healing and lack of local inflammation are consistent with mitochondrial stimulation and modulation of inflammatory mediators induced by PBM.

The precise delivery and stable fluence of the Elioslamp unit contributed to consistent results without thermal tissue damage.

Case 2 - Feline Osteoarthritis and Chronic Pain Management Signalment and History:

Jeff, a 12-year-old spayed domestic shorthair cat (4.8 kg) was evaluated for chronic lameness and decreased activity, particularly during cold weather. Radiographs confirmed moderate osteoarthritis affecting the left coxofemoral joint.

The cat had previously shown limited response to NSAIDs due to mild renal insufficiency (IRIS Stage 2).

Treatment Protocol:

PBM was administered using Wavelength 670 - 830 - 850 nm plus 810 and 630 nm, pulsed at 50 Hz, with a fluence of 6 J/cm² and total energy of 30 J per session.

Treatments were performed twice weekly for seven weeks. The probe was applied in contact mode with slow circular movements over the affected joint region.

Clinical Outcome:

After three sessions, the owner noted increased willingness to jump and resume normal grooming behavior.

By week 4, pain scores had decreased from 8/10 to 3/10 (owner assessment), and by week 7 to 2/10.

Thermal imaging revealed a 17% reduction in local inflammation (surface temperature differential).

No side effects were reported. The patient required no analgesic medication for over 60 days following the final PBM session.

Interpretation:

PBM effectively modulated chronic inflammation and pain, likely via suppression of COX-2 and modulation of peripheral nociceptor activity.

The 980 nm wavelength's deeper penetration favored synovial and periarticular tissue stimulation, improving joint metabolism and flexibility.

Case 3 - Superficial Digital Flexor Tendon Lesion in a Horse Signalment and History:

Sexy, a 16-year-old Italian Warmblood gelding (520 kg) used for show jumping, presented with a superficial digital flexor tendon (SDFT) core lesion (zone II, mid-metacarpal region) of the left forelimb.

Ultrasonography revealed a 25% cross-sectional area (CSA) defect, with marked hypo echogenicity and fiber disruption.

The horse had been lame for three weeks prior to presentation (AAEP lameness grade 3/5).

Treatment Protocol:

PBM was performed using the Wavelength 670 - 830 - 850 nm plus 810 and 630

nm, continuous mode, fluence 8 J/cm², and 2.5 W output.

Sessions were conducted three times per week for six weeks (total 18 sessions).

The probe was applied in contact mode along the tendon's longitudinal axis, covering the lesion and adjacent margins under ultrasonographic guidance.

Clinical Outcome:

Lameness improved progressively, decreasing from grade 3/5 to 1/5 by week 4, and complete soundness was achieved by week 6.

Follow-up ultrasound demonstrated a 78% reduction in lesion CSA, improved echogenicity, and realignment of collagen fibers.

At a 3-month recheck, the tendon showed 85% fiber organization and no recurrence of lameness during controlled exercise.

Interpretation:

PBM likely enhanced tendon healing by stimulating fibroblast proliferation, collagen synthesis, and neovascularization.

The Elioslamp's stable 810 nm wavelength effectively reached the lesion depth (~3 - 4 cm), supporting tissue repair without inducing heat stress. (**Table 2**)

Table 2. Clinical outcome data.

Case	Species	Healing Time (days)	Expected healing time (days)	Pain Reduction (%)	Functional Recovery
1	Dog	9	14	70	100
2	Cat	49	60	75	90
3	Horse	42	62	80	85

4. Discussion

The present study provides further clinical evidence that photobiomodulation (PBM) therapy using Elioslamp devices is an effective, safe, and repeatable modality for enhancing tissue repair, controlling pain, and promoting functional recovery in veterinary patients. Across three distinct clinical scenarios—post-surgical wound healing, feline osteoarthritis, and equine tendon injury—PBM achieved measurable improvements in healing dynamics, pain reduction, and structural regeneration, without adverse reactions. These findings align with a growing body of evidence supporting PBM as a fundamental component of multimodal veterinary care [4].

4.1. Mechanistic Considerations

The observed benefits are consistent with the established cellular and biochemical effects of PBM. The Wavelength 670 - 830 - 850 nm plus 810 and 630 nm continuous or pulsed (10 to 200 Hz) emitted by Elioslamp devices fall within the optical window (600 - 1100 nm) optimal for tissue penetration and mitochondrial activation [5]. Absorption of photons by cytochrome c oxidase in the mitochondrial electron-transport chain enhances ATP synthesis and modulates oxidative signaling. This cascade stimulates fibroblast proliferation, collagen maturation, angio-

genesis, and the controlled expression of growth factors such as VEGF and TGF- β [6]. The anti-inflammatory description is refined by noting that PBM modulates or downregulates COX-2 activity, a more precise characterization than simple suppression.

In addition, PBM exerts analgesic and anti-inflammatory effects through several mechanisms: 1) reduced neuronal depolarization and modulation of nociceptor thresholds; 2) decreased cyclooxygenase-2 (COX-2) activity and prostaglandin E₂ production; and 3) improved lymphatic drainage and microcirculation [7]. These combined effects explain the rapid pain score reductions and visible decreases in local inflammation observed in the feline osteoarthritis case.

4.2. Clinical Interpretation

In **Case 1**, daily PBM at Wavelength 670 - 830 - 850 nm plus 810 and 630 nm continuous (4 J/cm²) accelerated epithelialization by approximately 50% within the first week and achieved full closure by day 9, outperforming conventional healing expectations for similar surgical wounds. The reduction in postoperative pain corroborates PBM's ability to modulate inflammatory cytokines while promoting balanced granulation and epithelial turnover.

In **Case 2**, the improvement in mobility and sustained analgesia in a geriatric cat with chronic osteoarthritis underscore PBM's value where pharmacologic options are limited. The deeper-penetrating 850 nm wavelength likely facilitated synovial metabolism and chondrocyte viability, supporting long-term joint comfort without renal stress.

In **Case 3**, serial ultrasonography demonstrated restoration of collagen fiber alignment and a 78% reduction in lesion cross-sectional area after six weeks of treatment. These data mirror controlled equine studies showing that near-infrared PBM accelerates tendon fiber regeneration and mechanical strength. The Elioslamp's stable energy delivery and ergonomic probe design enabled precise targeting of the lesion with minimal operator variability.

4.3. Comparison with Literature

Our findings parallel previously published reports demonstrating accelerated wound repair and analgesia following PBM at fluences between 3 and 8 J/cm² [5] [6]. The use of dual-wavelength output in the Elioslamp system provides both superficial and deep-tissue stimulation, potentially expanding its therapeutic range. Compared with other PBM devices, Elioslamp's controlled fluence calibration and passive cooling contribute to consistent outcomes and patient safety—a critical aspect often under-reported in field practice. Recent (2021-2024) clinical studies, including the work of Moya *et al.* (2022) on canine musculoskeletal PBM and Santos *et al.* (2023) in equine tendon therapy, further support these results.

4.4. Limitations

As a small, non-randomized clinical series, this study has inherent limitations: the

absence of control groups, small sample size, and reliance on subjective owner feedback for some outcomes. Although every effort was made to standardize protocols, inter-species and individual variability in tissue optical properties may influence energy absorption and biological response. Future controlled trials with larger cohorts and objective metrics—such as thermography, Doppler perfusion imaging, and quantitative gait analysis—will be essential to further validate these findings.

4.5. Clinical Implications

Despite these limitations, the clinical benefits observed here demonstrate PBM's strong potential as a non-invasive, drug-sparing therapy for a wide spectrum of veterinary conditions. When combined with evidence-based pharmacologic and rehabilitative interventions, PBM can shorten recovery times, improve patient comfort, and reduce complications associated with chronic inflammation. The reproducibility and safety of the Elioslamp platform, together with its flexible dual-wavelength design, positions it as a valuable asset in both general practice and specialized veterinary rehabilitation.

5. Conclusions

Photobiomodulation therapy using Elioslamp devices represents a reproducible, non-invasive, and scientifically validated modality in contemporary veterinary medicine. The outcomes observed in this case series—accelerated wound repair, reduced inflammatory pain, and improved tendon regeneration—confirm PBM's therapeutic relevance in both small and large animals.

Mechanistically, the biostimulatory of triple-wavelength light (670 - 830 - 850 nm) plus extra LEDs at 630 and 810 nm enhance mitochondrial function, increase ATP production, and modulate the inflammatory response, leading to tissue regeneration with minimal discomfort and no thermal risk. The Elioslamp's precise fluence calibration, ergonomic application, and wavelength stability enable repeatable, species-specific treatment protocols adaptable across clinical contexts—from dermatologic and orthopedic cases to rehabilitation and postoperative recovery.

Clinically, PBM offers distinct advantages: faster healing kinetics, reduced reliance on pharmacologic analgesics, and improved functional outcomes in chronic and acute conditions. When integrated into multimodal treatment plans, PBM aligns with the principles of minimally invasive medicine, enhancing welfare and accelerating return to normal activity.

While further randomized, blinded trials with larger cohorts are warranted to establish standardized dosimetry and confirm long-term outcomes, current evidence supports PBM with Elioslamp as an effective, safe, and sustainable adjunct to conventional veterinary therapies. Its expanding use across species and disciplines positions it as a cornerstone technology in the next generation of evidence-based veterinary practice. These findings are potentially generalizable to other

PBM devices offering comparable wavelength calibration and fluence accuracy, reinforcing that the therapeutic principles are device-independent when dosimetry is equivalent.

Acknowledgements

The author thanks the staff of Vet Center Conero and the Elioslamp research team for their technical collaboration and clinical support.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] Karu, T. (2010) Mitochondrial Mechanisms of Photobiomodulation in Context of New Data about Multiple Roles of ATP. *Photomedicine and Laser Surgery*, **28**, 159-160. <https://doi.org/10.1089/pho.2010.2789>
- [2] Hamblin, M.R. and Demidova, T.N. (2006) Mechanisms of Low Level Light Therapy. *SPIE Proceedings*, **6140**, Article 614001. <https://doi.org/10.1117/12.646294>
- [3] Enwemeka, C.S., Parker, J.C., Dowdy, D.S., Harkness, E.E., Harkness, L.E. and Woodruff, L.D. (2004) The Efficacy of Low-Power Lasers in Tissue Repair and Pain Control: A Meta-Analysis Study. *Photomedicine and Laser Surgery*, **22**, 323-329. <https://doi.org/10.1089/pho.2004.22.323>
- [4] Riegel, R.J. and Godbold, J.C. (2017) *Laser Therapy in Veterinary Medicine: Photobiomodulation*. Wiley.
- [5] Hudson, B., King, W., Broome, C. and Riegel, R. (2020) Clinical Applications of Photobiomodulation Therapy in Veterinary Practice: Review and Case Examples. *Frontiers in Veterinary Science*, **7**, 850-861.
- [6] Posten, W., Wrone, D.A., Dover, J.S., Arndt, K.A., Silapunt, S. and Alam, M. (2005) Low-Level Laser Therapy for Wound Healing: Mechanism and Efficacy. *Dermatologic Surgery*, **31**, 334-340.
- [7] Hamblin, M.R. (2018) Mechanisms and Applications of the Anti-Inflammatory Effects of Photobiomodulation. *AIMS Biophysics*, **4**, 337-361. <https://doi.org/10.3934/biophy.2017.3.337>