Photobiomodulation (PBM) for Pain Management

TABLE OF CONTENTS

What is PBM?
How Does it Work on Pain
Applications of PBM for Pain
Scientific Studies
Case Studies
Additional PBM & Pain Resources
Companion
Photobiomodulation therapy is defined as a form of light therapy that utilizes non-ionizing light sources, including lasers, light emitting diodes, and/or broadband light, in the visible (400 - 700 nm) and near-infrared (700 - 1100 nm) electromagnetic spectrum. It is a nonthermal process involving endogenous chromophores eliciting photophysical (i.e., linear and nonlinear) and photochemical events at various biological scales. This process results in beneficial therapeutic outcomes including but not limited to the alleviation of pain or inflammation, immunomodulation, and promotion of wound healing and tissue regeneration. The term photobiomodulation (PBM) therapy is now being used by researchers and practitioners instead of terms such as low level laser therapy (LLLT), cold laser, or laser therapy.

The fundamental principles that underpin photobiomodulation (PBM) therapy, as currently understood in the scientific literature, are relatively straightforward. There is consensus that the application of a therapeutic dose of light to impaired or dysfunctional tissue leads to a cellular response mediated by mitochondrial mechanisms that reduce pain and inflammation and speed healing.

References


2. Frydrych. The Evolution of Photobiomodulation

Photobiomodulation (PBM) therapy is a form of light therapy that utilizes non-ionizing light sources in the visible (400 – 700 nm) and near-infrared (700 – 1100 nm) electromagnetic spectrum. It is a nonthermal process involving endogenous chromophores eliciting photophysical (i.e., linear and nonlinear) and photochemical events at various biological scales.

Appropriate dosing is an important factor in determining the relative success of PBM therapy treatments. To achieve adequate dosing, there are 3 key parameters that must be considered:

1) The condition being treated
2) The absorption characteristics of any intervening tissues between the light source and the target tissue
3) The mechanism of delivery

Watch It Now: www.LiteCureInfo.com/PBMDosingTissue
Pain management has been getting increased attention in the U.S. health-care market due to the current opioid epidemic. Most healthcare providers are looking for alternatives to pharmaceutical therapies when addressing various musculoskeletal (MSK) pain conditions. Laser therapy is a non-invasive modality that can have effects on both chronic and acute pain through the process of photobiomodulation (PBM).

PBM occurs when an effective dose of light energy is applied to injured tissue. The general mechanism for PBM involves biochemical stimulation of the electron transport chain in eukaryotic cells, which triggers several positive biochemical changes in injured tissue. These changes to MSK tissue and nerve tissue can decrease pain and inflammation, and accelerate tissue healing.1-6

Most clinicians understand that by decreasing inflammation and the associated pain mediators, pain can be managed effectively. This is why ice and anti-inflammatory medications are commonly used for acute MSK injuries. But are those the best treatments? While those methods are effective for joint effusion, there is growing debate about the use of ice and nonsteroidal anti-inflammatory drugs (NSAIDs) on injuries to muscle tissue. NSAIDs block the inflammatory cascade at the COX-2 level, which has been shown to have negative effects on the tensile strength of repaired muscle tissue and increases the chances of re-injury.2

Although ice delays the inflammatory process by restricting blood flow for a period of time, it may actually slow the process of tissue recovery by restricting blood flow to injured areas that need metabolic activity to recover. A 2016 study looked at delayed-onset muscle soreness where subjects were treated with either ice, laser, or ice used in conjunction with laser after eccentric muscle contractions. When used independently, laser was the best modality for enhancing restitution post-exercise, which led to faster recovery 24 hours after treatment.7

Laser research that investigates the mechanisms involved with reducing inflammation at a glance looks similar to pharmacological studies because they impact the inflammatory cascade at similar points. These include reduced COX-2 levels, reduced Bradykinin levels, reduction in interleukin-1 levels, and reduction in Prostaglandin E2 (PGE2).8-11

However, understand that these reductions are fundamentally different from PBM in that they stem from intrinsic, anti-inflammatory signaling.
generated by better cell metabolism and improved microcirculation at the level of the injured tissue.

When considering laser, there are different classes available in the U.S. that are determined by the power of the unit. So what type of laser is best used to treat pain? A common misconception is that higher-powered Class 4 lasers cannot treat acute conditions because surface heat is produced during treatment. Lower-powered lasers under the threshold of 500 milliwatts have commonly been referred to as “cold lasers” or low level laser therapy (LLLT) because they do not produce any heat on the skin surface when applied.

Regardless of power, PBM is the primary desired mechanism of action when lasers are applied to tissue. They effectively hasten the body’s ability to process inflammation, which makes laser treatment in general an appropriate treatment option to address pain. While they are both appropriate for use over acute and chronic inflammation, a benefit of Class 4 lasers is that they allow therapeutic doses of photons to be applied over broader areas and to deeper tissues in smaller windows of time, which is a significant consideration for most clinicians.

Some practitioners might wonder why they would want to heat up the skin surface with a higher-powered laser if they could use a lower powered laser to get the same effect. While both types of lasers can help with inflammation, which is significant in the bigger picture of tissue healing, there is an important difference between the two when it comes to pain modulation.

Recent research has shown that treating afferent nerves with higher power densities (irradiance) significantly impacts pain perception.1,12 When the laser is applied in higher doses, it can slow down conduction rates and increase the size of the action potentials in both C and A delta afferent nerves.1,12 This can result in quick changes in patients’ pain complaints via true analgesia, which is a phenomenon that cannot be easily accomplished with lower powered lasers.

What does this mean to you, the practicing clinician? The analgesic effect from higher powered lasers can open the door to more manual options on the same day when it is applied prior to manual treatments. Clinicians are faced daily with acute and semi-acute presentations that are challenging to treat in the early stages due to muscle guarding and subjective complaints that limit treatment options.

Class 4 laser therapy can help address this problem in the clinic with treatments that take less time to perform in most cases than a standard ultrasound. The second benefit of using laser in the clinic is that it will help accelerate tissue healing, reducing the time needed to return patients to functional activities.

With virtually no side effects and a short list of contraindications, laser therapy is something that should be considered in any plan that involves reducing inflammation. Special consideration should be given to higher powered lasers if immediate pain relief is being targeted or if larger areas of tissue are being treated on a regular basis in your practice.

Understanding the similarities and differences of different laser platforms could be a key to helping your patients move away from their current pharmacological methods of dealing with pain and provide a powerful, new avenue for treating painful conditions in your clinic for both short- and long-term relief.

MARK CALLANEN, PT, DPT, OCS, is the director of clinical development for LightForce Therapy Lasers. He has treated orthopedic patients for 18 years and has been board certified as an Orthopedic Clinical Specialist by the APTA since 2003. Mark graduated with his doctorate in physical therapy in 2007 from Marymount University. He can be contacted through litecure.com.

References
8 Prianti ACG, Salva JA, dos Santos RF, Rosseti IB, Costa MS. Low-level PBMT (LLLT) reduces the COX-2 mRNA expression in both subplantar and total brain tissues in the model of peripheral inflammation induced by administration of carrageenan. Lasers in Medical Science. 2014;29(4):1397-1403.
Elevating the Multimodal Treatment Approach by Integrating Laser Therapy

Next to its unique characteristics allowing patient stress, fear, and pain to be reduced, photobiomodulation therapy (PBMT) also has the ability to be utilized as an adjunct to standard of care for a myriad of conditions affecting species ranging from the smallest avian to the biggest elephant. PBMT offers us not only a noninvasive and painless tool, but it also affords the operator certain flexibility in its applications, as per the level of tissue disruption involved.

Certainly, each case is an individual instance and must be approached with an individual treatment design and delivery plan. Just as no two patients are the same, neither are the specifics surrounding the etiology / progression / current status and treatment care / etc. of each case. PBMT offers us the flexibility of addressing cases where there is any level of pain, inflammation, and/or tissue disruption. Most, if not all the patients we see, regardless of species, are likely to fit the bill in at least one of the three categories cited. Let’s take a look at some of the commonly-used ways in which a clinic can implement a successful PBMT program as an adjunct to standard of care.

Typically, a new adopter the modality will begin by using it for cases responsive to a short treatment course. Usually, these include acute conditions involving superficial tissues, such as pyotraumatic dermatitis and post-operative incisions. Naturally, as the operator’s knowledge base grows, so will the daily applications of the modality. Most operators report a positive experience in delivering this level of care. It is as therapeutic for the operator to provide this leading-edge level of care as it is for our patients to undergo it. The most challenging part of starting a successful and multifaceted PBMT program in a clinical setting is to overcome inertia. Once the ball gets rolling, it will naturally pick up speed.

Once the operators have applied the early stages of making PBMT a core part of their multimodal approach to pain management, then the next natural evolution is to incorporate it with routine anesthetic procedures. Here, we see patients undergoing either a surgical or dental health procedure. In this setting, the therapy laser platform can again be utilized in a series of ways, from conditions such as gingivitis (the only reversible dental disease), going all the way up to multiple extraction sites or stomatitis. With surgical procedures somewhat more involved, like an extracapsular cruciate repair, a pre-op and post-op treatment would also prove to be of value. PBMT should also be highly considered as part of a convalescent care plan, especially when dealing with invasive or orthopaedic procedures (e.g. - FHO, TPO, TPLO, TTA, limb amputation, etc).
As with anesthetic patients, hospitalized patients should be given specific consideration and be offered the benefits of PBMT, especially while they are on location. Such examples that have shown the value of PBMT to standard of care include pancreatitis, HBC, degloving injuries, and snakebites, just to name a few. Typically speaking, “time is tissue” when it comes to injury to tissues (both soft and dense). The savvy laser operator is able to embrace this concept and thus understands to have a certain window of fluidity in the application of the modality. The operators’ knowledge base in PBMT and ability to be flexible with an in-patient approach treatment design and delivery, enables them to best address the individual needs and caveats of each case as a separate application (i.e. special considerations such as: active hemorrhage, neoplasia, or active growth plates).

Once a practice has reached this level of understanding and has applied a level of commitment in incorporating PBMT with their core values and message, and confident in its application, the final step is to incorporate it with long-term care plans. In this setting, the focus is on outpatient appointments, scheduled much as they would be for a DVM seeing outpatients. These are the long-term patients with incurable conditions where our goal (and reasonable expectation) is to manage the condition and prevent an active decline. Often, once a clinic gets to this level of focused care, a specific “daily designated laser operator” is usually assigned to the task of handling the daily appointments (larger practices with a sizeable technical staff will incorporate a rotation of daily operators so as to have everyone remain proficient in their technique).

Most practices successful in their integration and implementation of PBMT within their departmental daily modus operandi, in addition to the current standard of care, have proven the modality a synergistic behemoth in our ability to continue to adapt to, adopt, and successfully implement a dynamically evolving aspect of veterinary medicine. The successful and practical applications of PBMT are limited only by the specifics of the case and the ability of an operator to perceive the modality’s application for a specific case presentation. The initial inertia previously mentioned is quickly overcome and replaced by a momentum which will help propel any practice to the next level of patient care when PBMT is allowed to fully develop as a medical modality in clinical practice.
The new AAHA/AAFP Pain Management Guideline state that pain management should include pharmaceutical as well as non-pharmaceutical modalities. MultiModal Pain Management is the new Standard of Care for painful patients.

First, check laboratory values (CBC/Chem/UA, BP, and imaging). This is not an exhaustive review of the subject, just a quick summary to act as a checklist of items to study and consider.

DJD is rarely evident on radiographs of cats. Look for muscle atrophy, lack of jumping and lack of activity as the main indicators of joint pain.

1. **NSAIDs (COX Inhibitor):** Meloxicam is our drug of choice for safety, ease of use, and the ability to titrate or adjust the dose (0.02-0.03 mg/kg SID). This is an off-label use in the US, but an approved use in Europe and Australia.

2. **Laser Therapy (decrease pain, decrease inflammation):** With contact head administration—3X per week for 4 weeks then 1X week for 1 month then once every 2-4 weeks. Treat at 10-15 J/cm² depending on severity.

3. **Weight Loss—Hill’s Metabolic Diet:** Weight loss is equally effective as NSAIDs for pain relief in arthritic patients. This is often an overlooked but important consideration for geriatric cats.

4. **Adequan:** Twice weekly for 6-8 doses (0.5 to 2.5 mg/lb IM or SQ). Then every 4 months administer twice weekly for 4 doses—this protocol stimulates up regulation of the chondrocytes that will not occur with once monthly injections. This is a much preferred and more effective joint therapy than oral supplements. This the only disease modifying drug we have to use.

5. **Gabapentin (Ca Channel):** Amantadine (NMEDA), Amitriptyline (NE/Serotonin RUI), Bupirnex (Opiod). All 4 agents block the pain pathway at different and unique locations, so they can be used in combination for added effect as needed. Look into the dosages and combined use of these meds as a more advanced extension of this discussion.

6. **Omega 3 Fatty Acids/Fish Oil (reduce Arachidonic Acid):** High EPA content and high quality. WelActin is our nutriceutical of choice in this category. We give a double dose (640 mg EPA/day/10# Cat) for the first 30 days and then reduce to a maintenance dose (320 mg EPA/day/10# Cat).

7. **Environmental Modification:** Ramps, steps, lower litter box barriers, rug runners—all help painful kitties get where they want to go with less discomfort.

8. **Physical Rehabilitation:** Yes! Cats are candidates for rehab, too. Underwater Treadmill, Massage, Passive Range of Motion, Strengthening Exercises, Core Exercises. This is a rewarding and exciting aspect of veterinary medicine to develop. Clients LOVE bringing their pets to rehab!

Consider advanced training such as the CCRP certification offered by the University of Tennessee or consult Darryl Millis’ Canine Rehabilitation Textbook.
Therapeutic Photobiomodulation: A Necessary Component of a Veterinary Pain Management Strategy

By Ronald J. Riegel, DVM
For The Education Series

The primary role of the veterinarian is to control pain and suffering, and the range of tools and methods to accomplish this is ever-increasing. Therapeutic photobiomodulation, such as provided by therapy lasers, has become an important element in a multimodal approach to pain management.

The analgesic effects achieved with the administration of therapeutic photobiomodulation are well documented in the literature. The first of the peer-reviewed papers appeared in 1991 with the bulk of the documentation detailing the mechanisms and the effectiveness of this modality being presented from 2009 to 2012.

Practicing scientific, evidence-based medicine does not allow us to merely believe: “Photons enter, a miracle happens, and then the pain is gone!” The mechanisms resulting in this physiological achievement are clearly understood.

Photons, within the infrared spectrum, act on the endogenous photoreceptors, or chromophores, of the individual cells resulting in a biochemical cascade of events. A combination of localized and systemic enzymatic, chemical and physical events effectively produce a state of analgesia.

Increased Endorphin Release

Once the target cells receive a therapeutic dosage of photonic energy, there is a release of endorphins. “Endorphin” comes from the words endogenous + morphine. These endogenous peptides attach to the receptors in the brain, spinal cord and other nerve endings that would accept morphine and act presynaptically to inhibit the release of the inhibitory neurotransmitter GABA (gamma-aminobutyric acid).

The almost instantaneous clinical result is a reduction in pain perception coupled with a mild euphoria.

Increased Nitric Oxide

Nitric oxide, produced in the mitochondria, can inhibit respiration by binding to cytochrome c oxidase, thus competitively displacing oxygen. This is especially true in stressed or hypoxic cells. Following therapeutic photobiomodulation there is a photodissociation of nitric oxide from cytochrome c oxidase, thereby reversing the mitochondrial inhibition of the respiratory rate due to excessive nitric oxide binding.

This increased level of nitric oxide has multiple pain-relieving effects for the patient:

- Nitric oxide serves as a neurotransmitter between nerve cells, part of its general role in redox signaling. Unlike most other neurotransmitters that only transmit information from a presynaptic to a postsynaptic neuron, the small, uncharged and fat-soluble nitric oxide molecule can diffuse widely and readily enter cells. Consequently, it can act on several nearby neurons, even on those not connected by a synapse. At the same time, the short half-life of nitric oxide means that such action will be restricted to a limited area, without the necessity for enzymatic breakdown or cellular reuptake.

- Increased levels of nitric oxide result in a decrease of conductivity in sensor nerves as a result of hyperpolarization of nerve endings and changes in potential of neuron membranes.

- There is an activation of metabolic processes in mitochondrial nerve endings. This results in changes within the conduction of stimuli in cholinergic synapses.

- A reflexive inhibition of ascending pain conduction tracts and activation of secretion of endorphins within the CNS by laser stimulation of acupuncture points.

Decreased Bradykinin Levels

Bradykinins, released from plasma protein at the site of injured tissue, elicit pain by stimulating nociceptive afferents in the skin and viscera.

Mitigation of these elevated levels through therapeutic photobiomodulation will therefore result in a reduction of pain. The photobiomodulated induced decrease in plasma kallikrein, increase in kininase II and the increases in nitric oxide are considered the contributors to the decrease in bradykinin levels.

Blocked Depolarization of C Fiber Afferent Nerves

Another extremely important analgesic event occurs when therapeutic photobiomodulation results in the blockage of the C fiber afferent nerves. These non-myelinated fibers convey input signals from the peripheral to the central nervous system and respond to various stimuli that can be thermal, mechanical, or chemical in nature.

Photoreceptors within the neuronal mitochondria absorb photonic energy which is then mediated and transduced into electrochemical changes. This results in a secondary cascade of intracellular events within the neuron that initiates a decrease in the following: mitochondrial membrane potential, available ATP required for nerve function and the maintenance of microtubules and molecular motors, dyneins and kinesins that are responsible for fast axonal flow.

Therefore, it is a photonic induced neural blockade that slows the conduction velocity and reduces the amplitudes of the compound action potentials. This photobiomodulatory reaction and consequential blockade is the mechanism that reduces noiceptive pain.

Increased Release of Acetylcholine

There is an increase in the reaction time in the formation of acetylcholine following therapeutic photobiomodulation. The increased availability of this neuromodulator allows for a normalization of nerve signal transmissions within the peripheral and central nervous systems.

Axonal Sprouting Several studies have documented the ability of laser therapy to induce axonal sprouting and some nerve regeneration in damaged nerve tissues. Where pain sensation is being magnified due to nerve structure damage, cell regeneration and sprouting assist in alleviating this maladaptive neuropathic pain.

Therapeutic Dosage

Therapeutic photobiomodulation is dependent upon the delivery of a therapeutic dosage of energy to the target nerve cells. Wavelength determines the depth of penetration and the power of the laser determines the delivery of the dosage. The current literature states that a physiological and biological response within the cells is achieved at a dosage of 2 to 12 Joules/cm2.

Prevention and treatment of superficial acute pain should be dosed at 2 to 6 Joules/cm2. A post-op incision site of 2 inches by 3 inches would require: 5.08 cm X 7.62 cm = 38.7 cm2

38.7 cm2 X 2 Joules/cm2 = 77.4 Joules/treatment

Chronic pain that is deep within the tissues would require a dosage in the range of 7–12 Joules/cm2.

Treatment of a 40-pound dark skinned, long haired dog with chronic hip dysplasia would require: 8 cm X 6 cm = 64 cm2

64 cm2 X 8 Joules/cm2 = 512 Joules/treatment

Frequency of Treatment

Acute pain:
Aggressive phase: each day for three to four treatments
Transitional phase: every other day or twice per week until condition is resolved.

Chronic pain:
Aggressive phase: each day or every other day for three to four treatments.
Transitional phase: every other day or twice per week until therapeutic goal has been achieved.

Maintenance phase: as often as needed to control pain and maintain a satisfactory quality of life.

Conclusions

Therapeutic photobiomodulation is a scientifically proven modality that is an extremely effective tool for the management of pain. It is one that is easily woven into pain management protocols that already exist in the practice. For many practices, it has become part of the standard of care, and not simply reserved for those cases that fail to respond to traditional methods.

Dr. Riegel is a director and one of the founders of the American Institute of Medical Laser Applications. He is the author of “Laser Therapy in the Companion Animal Practice” and co-author of “Laser Therapy for the Equine Athlete.”

This Education Series article was underwritten by Companion Therapy Laser of Newark, Del.
Laser therapy and its role in pain management and rehabilitation

By Jennifer F. Johnson, VMD, CVPP

Lasers have been used for a variety of medical, industrial, and computer applications for decades. Most consumers are familiar with the medical applications of various lasers – to remove hair, to correct vision, to remove tattoos or scars – and in surgery, to cut tissue. However, the use of therapy lasers, while approved by the FDA in the early 1990s, has only recently been utilized with much success in the human and veterinary arena.

Laser therapy works by utilizing near infrared light to stimulate cellular change, in a process called “photobiomodulation”. This specific wavelength of coherent and collimated light penetrates cells deeply. It exerts effects on all chemical processes within all types of cells. It increases the tissue release of endorphins, decreases prostaglandin and inflammatory mediators, increases macrophage activity, dilates lymphatics, increases blood flow, promotes angiogenesis, increases cytokine release, stimulates fibroblast activity, and increases collagen production. Chromatophores within the cells absorb the infrared light, causing an increase in ATP. Because of this increase in ATP, enzymes begin the signaling and protein synthesis cycles. The unique quality of laser light stimulation promotes and enhances healing by reducing inflammation and promoting proliferation, remodeling, and maturation of tissues. This is truly regenerative medicine, not just something that treats the symptoms!

**Dosing and application**

The dose of energy needed to achieve photobiomodulation at the target injured cell varies depending on the area of the body that one wishes to treat. Superficial conditions, such as skin wounds, or mouth pain, will require a lower dosage, while the dose for deep musculoskeletal or visceral pain is much higher. When we try to calculate the dose in a clinical setting, the absorption of photons by body mass, skin and coat colour, and thickness of the hair coat factors into our calculation. Most therapy lasers have established protocols and computer programs to help standardize these factors, taking the “guess-work” out of calculating a proper dose.

Dosing and treatment times are directly related to the wattage – or the amount of power that can be delivered to the cells. For example, if we determine that we need a total dose of 3000 joules, we can deliver it in a short time with a higher wattage machine versus over a long time using a lower wattage. The difference between the older therapy lasers and the current therapy lasers has to do with the amount of watts the laser provides. Class III therapy lasers, or “Low Level Laser Therapy” (LLLT) are lasers with a maximum power output of 0.5 watts. Class IV therapy lasers, or High Powered lasers, provide from 0.5 watts up to 15 watts of power. With proper technique, it is now possible to deliver a therapeutic dose into the cells in a shorter amount of time, obtaining better treatment success using the higher powered lasers. If a LLLT laser is used, you may still get a cellular response, it will just take much longer to achieve an appropriate dose.

Penetration of the laser light to deep cells also depends on the wavelength of the infrared light. Too high a wavelength and the photons are absorbed by water; for example, the high wavelength light that is utilized in surgical lasers. Too low a wavelength and the photons are absorbed by hemoglobin and melanin and there is less total energy to stimulate cellular function. Current research suggests that the optimal wavelength for appropriate photobiomodulation is 810-980nm.

Recommendations for therapeutic laser treatment depend on the type of injury. For acute pain conditions, one treatment daily or every other day for 1-3 treatments will commonly resolve an acute and/or superficial condition. For chronic conditions and deep pain conditions, once a day or every other day treatment for the first week or two is recommended, followed by a transitional phase where the patient has treatment 2-3 times a week until the therapeutic goal has been achieved. Once we see treatment success, chronic patients continue with laser therapy as often as needed to control pain and maintain satisfactory progress. For example, in cases of chronic osteoarthritis of the hips, a common treatment plan begins with treatments 2-3 times a week for 2-4 weeks, then once a week for 2-4 weeks, then every other week, and finally, once every 4-6 weeks. As photobiomodulation continues to create normal cellular respiration within the cells, less therapy is required to maintain tissue homeostasis and overall body wellbeing.

We apply the laser therapy over the area of injury using skin contact heads for deep organ and musculoskeletal conditions and non-contact heads for superficial or wound conditions. During the application of the appropriate dose, the therapy technician will apply the laser perpendicular to the body, moving the laser continuously to bathe all the tissue as well as tissue adjacent to the obvious injury. Better treatment success is achieved with application of the dose from all possible angles toward the target tissue; for example, when treating a stifle, we apply the dose from medial, lateral, and cranial angles, keeping the handpiece perpendicular to the skin.

**Laser therapy and pain management**

The therapy laser is an essential tool in veterinary medicine’s pain-management arsenal. Pain turns on the body’s stress response, increasing cortisol, delaying healing, causing GI dysfunction, clotting dysfunction, and overall poor health. One can extrapolate that continued pain will also contribute to patient morbidity and mortality. Our first objective as clinicians is to acknowledge the adverse consequences of pain in our patients and use every modality possible to reduce pain so that we can keep our patients their healthiest.

We incorporate laser therapy into established perioperative pain management for routine and non routine surgeries as well as acute and chronic pain conditions. Multi-modal analgesia can be combined with laser therapy for continued cumulative effect. Essentially anything that is considered a painful or inflammatory condition can benefit from laser therapy. Some examples of common conditions that have responded to laser therapy are asthma in cats, pancreatitis, urinary tract disease, acute and chronic skin conditions, and acute and chronic musculoskeletal disorders. Contraindications are direct exposure to the retina of the eye and neoplasia conditions. Research has not been able to determine neoplastic cellular response to laser light therapy, as the response varies between cells.

Therapy laser is easily incorporated into a veterinary pain management and rehabilitation program. In human practice, sports-medicine and physical therapy professionals continue to be at the forefront of laser therapy research and application. Post surgical rehabilitation that includes the use of laser therapy results in faster return to normal function and it can be utilized concurrently with passive range of motion exercises, myofascial trigger point work, treadmill and proprioceptive work, acupuncture, and therapeutic massage. Interesting research continues to study the positive effect of photobiomodulation on exercise performance, showing an increase in muscle healing and improved performance after the use of laser therapy prior to athletic activity.

**Summary**

Veterinarians need to use any and every treatment available to reduce pain in our patients to improve their health, welfare, and quality of life. Photobiomodulation is a great addition to our arsenal, and incorporating the use of laser therapy in practice adds an indispensable tool, creating positive outcomes and improved healing.

After receiving her B.S. in Chemistry/Biology from West Chester University of PA and graduating from the University of Pennsylvania, School of Veterinary Medicine in 1993, Dr. Johnson worked as an associate veterinarian for 14 years before becoming the sole owner of Stony Creek Veterinary Hospital in 2007. The AHA-accredited hospital employs six veterinarians and 35 team members.

Pain management has always been a priority in her practice and Dr. Johnson is always looking for new treatment modalities to help her patients. Her special interest is in the use of therapeutic laser for the treatment of pain. Since 2006, Dr. Johnson has worked with Zoetis to teach acute and chronic pain management and analgesia. In 2013, she achieved Certified Veterinary Pain Practitioner (CVPP) qualification through the International Veterinary Academy of Pain Management. Dr. Johnson speaks nationally on pain management, laser therapy and general orthopedic surgery and is the author of numerous articles on laser therapy and pain management.

Dr. Johnson lives in Morton, PA, with her husband, two daughters, and a rescue pit bull. In her spare time, you will likely find her cheering on her daughter’s soccer team or boating on the Chesapeake Bay.
Presented by:
John C. Godbold, Jr., DVM
Ronald Riegel, DVM

In this webinar learn about the following key points:

• Identification of all areas necessitating laser therapy throughout the entire patient thus ensuring a higher successful treatment outcome.

• A communication tool between the veterinarian and the client to help the client understand the need for laser therapy and to help insure client compliance.

• A monitor to assess the application of laser therapy to ensure that all areas receive sufficient photonic saturation of the target tissues.

• An evaluation of the therapeutic progress upon subsequent visits.

Watch it Now:
http://www.litecureinfo.com/SeeThePainTreatThePain
The mechanistic basis for photobiomodulation therapy of neuropathic pain by near infrared laser light

Authors: Holanda VM, Chavantes MC, Wu X, Anders JJ

This study investigated the mechanistic basis of photobiomodulation therapy (PBMT) for the treatment of neuropathic pain. Cell studies were conducted at an irradiance of 300 mW/cm², then penetration measurements were conducted to determine the treatment power needed to deliver an irradiance of 270 mW/cm².

Finally, a pre-clinical investigation of rats with the spared nerve injury (SNI) pain model was conducted. A 270 mW/cm² dose was delivered trancutaneously to the DRG and sciatic nerve in SNI rats. The higher irradiance was found to block the pain transmission.

The authors propose a combination therapy with initial high irradiance/fluence rates for fast pain relief, followed by low irradiance/fluence rates for prolonged pain relief by altering chronic inflammation.

Published:

Read the Full Study:
https://www.ncbi.nlm.nih.gov/pubmed/28075022
Characterization of Macrophage/Microglial Activation and Effect of Photobiomodulation in the Spared Nerve Injury Model of Neuropathic Pain

Ann Kobiela Ketz, PhD1, Kimberly R. Byrnes, PhD2, Neil E. Grunberg, PhD3, Christine E. Kasper, PhD4, Lisa Osborne, PhD4, Brian Pryor, PhD5, Nicholas L. Tosini6, Xingjia Wu, BS7, Juanita J. Anders, PhD7

1Center for Nursing Science and Clinical Inquiry, Landstuhl Regional Medical Center, Landstuhl, Germany
2Department of Neuroscience, Uniformed Services University of the Health Sciences, Bethesda, MD
3Department of Neuroscience, Military & Emergency Medicine, and Medical & Clinical Psychology, Uniformed Services University of the Health Sciences, Bethesda, MD
4Department of Nursing, Uniformed Services University of the Health Sciences, Bethesda, MD
5LiteCure, LLC, Newark, Delaware, USA
6St. Mary’s College of Maryland, St. Mary’s City, MD
7Department of Anatomy, Physiology & Genetics, Uniformed Services University of the Health Sciences, Bethesda, MD

Objective: Neuropathic pain is common and debilitating with limited effective treatments. Macrophage/microglial activation along ascending somatosensory pathways following peripheral nerve injury facilitates neuropathic pain. However, polarization of macrophages/microglia in neuropathic pain is not well understood. Photobiomodulation treatment has been used to decrease neuropathic pain, has anti-inflammatory effects in spinal injury and wound healing models, and modulates microglial polarization in vitro. Our aim was to characterize macrophage/microglia response after peripheral nerve injury and modulate the response with photobiomodulation.

Methods: Adult male Sprague-Dawley rats were randomly assigned to sham (N = 13), spared nerve injury (N = 13), or injury + photobiomodulation treatment groups (N = 7). Mechanical hypersensitivity was assessed with electronic von Frey. Photobiomodulation (980 nm) was applied to affected hind paw (output power 1 W, 20 s, 41 cm above skin, power density 43.25 mW/cm², dose 20 J), dorsal root ganglia (output power 4.5 W, 19 s, in skin contact, power density 43.25 mW/cm², dose 85.5 J), and spinal cord regions (output power 1.5 W, 19 s, in skin contact, power density 43.25 mW/cm², dose 28.5 J) every other day from day 7-30 post-operatively. Immunohistochemistry characterized macrophage/microglial activation.

Results: Injured groups demonstrated mechanical hypersensitivity 1-30 days post-operatively. Photobiomodulation-treated animals began to recover after two treatments; at day 26, mechanical sensitivity reached baseline. Peripheral nerve injury caused region-specific macrophages/microglia activation along spinothalamic and dorsal-column medullar lemniscal pathways. A pro-inflammatory microglial marker was expressed in the spinal cord of injured rats compared to photobiomodulation-treated and sham group. Photobiomodulation-treated dorsal root ganglion macrophages expressed anti-inflammatory markers.

Conclusion: Photobiomodulation effectively reduced mechanical hypersensitivity, potentially through modulating macrophage/microglial activation to an anti-inflammatory phenotype.

Key words: Inflammation; Macrophage; Microglia; Neuropathic Pain; Photobiomodulation; Spared Nerve Injury
BACKGROUND: Class IV laser therapy is a recent modality that is used to treat pain and promote healing of muscular tissue. The procedure is minimally invasive and easily performed. Laser therapy was added to conventional chiropractic treatment of spinal manipulation and an exercise program for treating patients with back pain. The objective of this investigation was to assess efficacy and safety of the combination and generate preliminary results for a randomized controlled trial.

METHODS: Between 9/2009 and 2/2010, a total of 55 patients with non-surgical lower back pain (sciatica) presented to my office and gave consent for treatment. Twenty-four patients with back pain received spinal Class IV laser therapy in addition to manipulation for back pain. Twenty-one patients (historical controls) received spinal manipulation without Class IV laser therapy. All patients completed VAS scales before treatment (VAS0), at one week (VAS1), and at four weeks (VAS4). Regardless of treatment group, all patients received a personalized regimen of spinal manipulation, manual therapy, and exercise, under the direction of the principal investigator (LDM). Percent difference between VAS0 and VAS4 was compared between groups.

RESULTS: Demographics were similar for both groups (Table 1). Patients in the manipulation + laser group reported pain relief after 2-3 sessions of laser therapy (clinical observation). No adverse events were noted following laser therapy.

Table 1 – Patient demographics and dependent variables

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Age</th>
<th>VAS 0</th>
<th>VAS 4</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser + Manipulation</td>
<td>24</td>
<td>54.2 ± 11.1</td>
<td>6.5 ± 1.9</td>
<td>1.75 ± 1.6</td>
<td>71.7 ± 22.0</td>
</tr>
<tr>
<td>Manipulation Only</td>
<td>21</td>
<td>51.0 ± 12.7</td>
<td>5.5 ± 1.4</td>
<td>3.5 ± 2.1</td>
<td>50.5 ± 28.4</td>
</tr>
</tbody>
</table>

A positive-valued percent differences of VAS between pretreatment and 4wk points; indicate that a quantitative reduction in pain by both treatment groups. Statistical comparison of the groups using an unpaired t-test indicated that the manipulation + laser offers greater pain reduction when compared to manipulation only (p=0.007). Interval estimates indicate a 21.18 larger reduction in VAS (95% Confidence Interval: 6.00, 36.35) in the manipulation + laser group.

CONCLUSIONS: These results indicate that both treatments successfully reduced the VAS by the fourth week of treatment, and that a higher reduction in VAS occurred in the group treated by manipulation + laser at week four.

In summary, Class IV laser therapy is a safe and effective modality for treating low back pain when added to conventional treatment of manipulation and exercise. Further study is indicated to support these initial findings.
Chambersburg Animal Hospital
Osteoarthritis, Labrador Retriever

**Author:** Chambersburg Animal Hospital, Chambersburg, PA

**Signalment:** 11 year old, F/S Labrador Retriever, “Willow”

**History:** Chronic history of right forelimb lameness and difficulty “getting up and down” but owner presented dog for acute left forelimb lameness

**Ortho Exam:** Grade 4/5 lameness left forelimb; left elbow joint capsule palpated thickened; decreased ROM and evidence of osteoarthritis in multiple joints

**Initial Diagnostics:** Radiographs showed evidence of severe OA in left elbow joint

**Laser Therapy:** All between 8-12 W CW
2000 Total Joules to each elbow
2000 Total Joules to left shoulder
2800 Total Joules to each stifle, hip(s)
2800 Total Joules to lumbar spine

**Treatment Frequency:** Twice weekly for 6 weeks

**Other Treatments:** Adequan injectable; Tramadol. *Patient had previously been treated with Rimadyl but resulted in no improvement per owner, since patient was taking Temaril-P chronically for allergies, no NSAID was prescribed.

**Watch the Case Video:**
http://www.litecure.com/blog/studies/chambersburg-animal-hospital-osteoarthritis-labrador-retriever/
Case study in pain management
Unraveling the mystery of the anorexic dog.

By Jennifer F. Johnson, VMD, CVPP
For Veterinary Practice News

Introduction
In small animal general practice, veterinarians are often presented with baffling cases, incomplete histories and patients who aren’t willing to open up about their problems. This pain management case demonstrates the importance of evaluating pain in all patients regardless of the presenting complaint. Highlighting the use of thermal imaging for diagnosis and high-powered laser therapy for treatment, this case illustrates the great benefit laser therapy provides when integrated into a pain management program.

Initial Presentation
Tommie, an 11-year-old male neutered miniature poodle, presented to the clinic with a three-day history of not eating. Although a senior citizen, Tommie has been an agility dog his whole life and normally exhibits a robust appetite and has a high-energy life, with a regular exercise schedule. His body condition is excellent and he continues to have good muscle strength.

Tommie’s initial examination revealed a different dog. Although clinically appearing well-hydrated, he was depressed, lethargic and reluctant to move. On palpation, mild to moderate mid-thoracolumbar back pain was appreciated and Tommie was given a pain scale number of 4 out of 10.

Because of previous issues with bladder stones, a urinary tract ultrasound was performed and revealed no urinary tract stones or disease. Comprehensive blood work—CBC, serum chemistries, Lyme/Ehrlichia/Anaplasma tick diseases—revealed no abnormalities. Survey radiographs of the thoracolumbar spine and hips were taken and revealed no obvious abnormalities.

The owners declined referral to a specialty center for an MRI. A tentative diagnosis of midback pain was made and laser therapy was initiated. A Companion Therapy Laser, with its deep tissue applicator to treat on-contact, was used for the deep tissue treatments. The thoracolumbar spine and epaxial muscles were treated with 2,160 total joules (9 J/cm² target dose) and oral administration of Tramadol 50 mg q 6 hrs was prescribed. Because of previous GI intolerance to multiple types of NSAIDs, an anti-inflammatory was not prescribed.

Re-Examination
The laser therapy was repeated 24 hours later and the owner reported that Tommie seemed a little brighter but still was not eating. The following afternoon a physiologic examination was performed using a digital thermal imaging (DTI) camera (Image 1). Images showed significant increases within the thermal gradients along the entire dorsal spine, with the most increase around the neck and lumbar area. Digital palpation was repeated with significant painful response to palpation of the cervical spine, especially at the first and second cervical vertebrae. Pain was noted to be seven out of 10 when the neck was manipulated.

Laser therapy was continued every other day for four treatments, now including the cervical spine with a dose of 2,100 joules (10 J/cm² target dose); thoracolumbar spine, 2,160 joules; and lumbosacral spine, 2,300 joules (10 J/cm² target dose). Oral Gabapentin, 100 mg twice a day, was added in an attempt to reduce any neuropathic pain component from possible cervical disc disease.

Follow-Up
Tommie was re-examined one week later after the sixth laser treatment. The owner reported that his appetite was completely normal and that he was much more active in the home. Repeated thermal images showed an obvious change in the thermal gradients in just one week, which correlated with palpation (Image 2). Pain scale assessment was three out of 10 when manipulating the cervical spine and one out of 10 for the rest of the body. The owners reported that they had decreased the Tramadol to 50 mg at bedtime, and he continued to take the Gabapentin (100 mg) twice a day.

Case Discussion
This is an interesting case where laser therapy played a key role in achieving good patient health outcome after an acute onset of pain. This type of case is not unusual in general small animal practice, where it is often difficult to determine the cause of symptoms as well as the source of pain. The use of hospital-standard pain assessment techniques, such as palpation and the use of both owner and clinician objective pain scales, help to quantify the response to treatment.

Certainly, the addition of digital thermal imaging helped to pinpoint the focus of our pain assessment, and repeated images demonstrated the positive response to our laser therapy. In this particular case, deep tissue laser therapy performs as a primary pain management tool, greatly surpassing the role of pharmacologic intervention, because of this patient’s particular intolerance to NSAIDs. Veterinarians can expect similar positive effects if they start to employ the power of laser therapy as a first-line treatment for patient pain.

Dr. Johnson, a certified veterinary pain practitioner, became the sole owner of Stoney Creek Veterinary Hospital in Morton, Pa., in 2007. The AAHA-certified hospital employs four veterinarians and 28 team members. Her special interests include general and orthopedic surgery of all pets, pet bird and small exotic pet medicine, and diagnostic ultrasound.

This Education Center article was underwritten by Companion Animal Health of Newark, Del.
Severe Bursitis and Osteoarthritis
American Quarter Horse Gelding

**Author:** Lisa Miller, DVM, CCRT

**Signalment:** 26 year old American Quarter Horse Gelding, “Rio”

**Patient Symptoms:** Severe bursitis and osteoarthritis of the elbow

**Medical History:** 2 IA injections of steroid + Hyaluronic Acid, systemic NSAID’s and chiropractic, joint support supplement in feed - No improvement noted (All treatments tried over a period of 8-12 weeks)

**Laser Treatment:** 7,500 Joules each applied to left elbow and left shoulder (15,000 Total Joules). (Palpated secondary soreness and swelling d/t weight shifting from lameness), beginning three times weekly, then weaning frequency as patient improved.

**Patient Updates:** After June 2013 Rio received maintenance laser treatments once weekly to his elbow 4-8 weeks for the following year and then only on an “as needed” basis. He is not on any systemic medications, just a chondroprotectant supplement in his feed daily.

Watch the Case Video:
Baton Rouge Veterinary Specialists
Chronic Scar Tissue & Lymphatic Obstruction
Labrador Retriever

**Author**: Baton Rouge Veterinary Specialists, Baton Rouge, LA

**Signalment**: 2 year old, F/S, Labrador Retriever, “Jade”

**Presentation**: 6 month history of 3-legged lameness with any activity. Failure of medical therapy; presented to surgeon for amputation. Treatments applied before laser therapy included: Rimadyl, Tramadol, Clindamycin, Baytril, Pentoxiphylline, Prednisone and Adequan. These treatments had been given in extended time frames over 5-6 months and patient was still 3-legged lame. Radiographs, Cytology and culture of scar tissue in area of right hock were obtained and patient was diagnosed with chronic inflammation and probable lymphatic obstruction.

**Treatment Details**: 1100 total Joules delivered to tarsus at 7W, CW (total area = 125 cm²; energy density of 8.8 J/cm²). Patient received 10 total treatments over 20 days.

**Treatment Results**: Before video taken on initial presentation – patient is non-weight bearing on affected leg. Post video is taken after 10 treatment sessions. Patient is completely weight bearing and pain free.

Watch the Case Video:
http://www.litecure.com/blog/studies/baton-rouge-veterinary-specialists-chronic-scar-tissue-lymphatic-obstructiono/
I am a big proponent of rescue groups. There are many “discarded” dogs and cats, most of which are absolutely wonderful pets. I have worked with Peppertree Rescue for many years and really appreciate their dedication to dogs with medical needs. Peppertree will find out about them and screen them, and then have them transported to the Albany area where they can be attended to. This was the case with Glinda, a sweet, 8-ish year old Golden Retriever cross.

Upon physical exam, I found some areas of concern. While Glinda weighed in at a reasonable 74 pounds, her body condition score was abnormal. She had poor muscle mass in her back legs and was carrying more fat than she should. I also noted that she had decreased extension in both of her hip joints and was uncomfortable when I manipulated them. As I palpated her knees, I found chronic thickening in both the left and right knee with discomfort and mild instability. These findings are consistent with arthritic change in both the knees and hips.

Often times the hip arthritis is a consequence of hip dysplasia, while the arthritis and instability in her knees was consistent with chronic damage to her cruciate ligaments. I discussed this with the owners and we started with a conservative management program. I prescribed a course of therapy for her in the Rehabilitation Program’s Underwater Treadmill and an Adequan injection series for her. The buoyancy the underwater treadmill provides would allow Glinda to exercise and lose weight, while the Adequan injection series would be twice a week for 4 weeks, then one injection a month thereafter. This would help to improve her joint fluid in all of her joints, as well as reduce the damage to her cartilage.

Over the next 3 months, Glinda worked in the underwater treadmill twice a week, gradually increasing her time and distance with each session. Her comfort level improved and she lost 9 pounds. While she was moving well, I noted further instability in both of her knees. It was time for a sedated orthopedic exam and radiographs. Peppertree Rescue agreed to help with her costs and a short while later we had our answers.

Glinda had partially torn the cruciate ligament (ACL) in both of her knees. The right was not as stable as the left, and both had moderate arthritic change. She also had hip dysplasia,
characterized by poor coverage of her femoral heads, and consequently had developed arthritis in her hips as well. The right knee needed stability. With hip arthritis in both legs and arthritis in both of her knees, the instability in the right needed surgical correction. My plan was to correct that with a procedure called a TPLO: Tibial Plateau Leveling Osteotomy. This would eliminate the need for the cruciate ligament and allow stability in the knee that would allow her to walk on the leg appropriately and slow the progression of arthritis forming in that knee. I was unsure if her left knee would need the same correction down the road.

Surgery was a success for Glinda. The TPLO gave her right knee the stability her body needed. She did very well in her post-operative rehab program, going through laser therapy treatments and underwater treadmill sessions. During her therapy she was always a smiling, happy patient. After 12 weeks of restricted activity, her tibia healed and I started to increase her overall activity. We would manage the arthritis in her knees and hips as an ongoing condition.

She has become an avid hiker with her owners. She goes for 30-45 minute walks every day and enjoys being outside. While her arthritis has progressed, her multimodal pain management regimen has kept her from having any further surgeries at this time.
Textbook
*Laser Therapy in Veterinary Medicine: Photobiomodulation*

Laser Therapy in Veterinary Medicine: Photobiomodulation is a complete guide to using therapeutic lasers to treat veterinary patients, focusing on practical information.

- Offers a comprehensive resource for incorporating therapeutic lasers in veterinary practice
- Focuses on practical information tailored for the veterinary clinic
- Written by 37 leading experts in veterinary laser therapy
- Provides a thorough foundation on this standard-of-care modality
- Emphasizes clinical applications with a real-world approach

Get the Book at:
https://aimla.org/laser-therapy-in-veterinary-medicine-photobiomodulation-textbook

Resources

- International Veterinary Academy of Pain Management
  https://ivapm.org/

- 2015 AAHA/AAFP Pain Management Guidelines for Dogs and Cats
  https://www.aaha.org/professional/resources/pain_management.aspx
If you are thinking of adding Class IV laser therapy to your practice there are a few questions you should ask before you make a purchase. You should be purchasing more than a laser for pet pain – but a total solution for your practice. Here are 5 questions you should ask a your sales representative before you buy:

1. **Implementation**: Many companies say they provide implementation solutions for your practice, but take the time to dig deeper to understand the details of the support materials they provide. Does the implementation program help educate the staff and clients alike? What components are really included in the program? Some companies offer comprehensive marketing toolkits that include both staff and patient education tools. The more comprehensive toolkits should include client education videos, presentations, ads, banners, training videos, promotional materials for the office, website resources and marketing tips. Also ask if they have a marketing consultant too – this added service can be a huge asset to your practice.

2. **Downtime**: When adding any type of capital equipment to your practice there is always the possibility that the unit will require repair or maintenance. Ask your sales representative what happens if your laser therapy equipment experiences a failure. Will they send you a loaner unit? How long will it take to repair your unit? The answer you should get is that the company will deliver a loaner system to you overnight to ensure you don’t go a day without your therapy laser.

3. **On-Going Laser Therapy Education**: Ask about what kind of educational opportunities are available after you purchase your laser therapy equipment. Some companies offer on-going seminars, webinars, users’ conferences, and special CE events. Also ask if the company you plan to work with is engaged in scientific studies – is the company continuing to educate itself too? The strong companies are constantly striving to learn and teach.

4. **Clinical Support**: If a patient comes in and you are not sure how to approach their condition is there someone at the laser therapy company you can talk to? Clinical support is a must-have. Ask about who the clinical experts are on staff that will answer your questions – what are their credentials?

5. **Customer Care**: Is there a dedicated customer care department? How long does it take for them to get back to you? When you are having a problem the last thing you want to do is wait. Go with a company who prides itself on outstanding customer care after the sale.

Class IV laser therapy can have a real impact on your patients and your practice. Be sure you are selecting a company who will be your laser therapy partner for the long-term.

---

**Did You Know?**

**Companion Therapy Lasers** are manufactured in the USA?
Why Choose Companion®?

Evidence.

Products based in evidence that provide superior clinical outcomes are Companion’s commitment. Protocols for all Companion products are based on a large body of clinical research coupled with an understanding of your real-world needs as a veterinarian.

Education.

When you invest in new technology, the learning process can seem daunting. How will I get outcomes? Will it work in my practice? Companion is founded on the cornerstone of education and provides appropriate learning opportunities for each step of your learning journey.

Partnership.

Through every stage of your purchase process and transition into the Companion family, our team is here to make sure the technology you are investing in is a fit for your clinic. Our team of sales, clinical, business, and customer support resources provides support for you - no matter what your needs are.
For more information about how a therapy laser can transform your clinic call 877-627-3858 to set up your in-office demonstration.