

Laser Therapy (LLLT)

Overview

Laser therapy is used to increase the speed, quality and tensile strength of tissue repair, resolve inflammation, and give pain relief. It is a valuable modality due to the prospect of shorter recovery times. The therapeutic use of low power laser light in animals has become known as Low Level Laser Therapy, or LLLT; also sometimes called “Cold Laser Therapy”.

Laser Therapy works on the principle of inducing a biological response through energy transfer, in that the photonic energy delivered into the tissue by the laser modulates the biological processes within that tissue, and those within the biological system of which that tissue is a part.

LLLT is a form of photo (light) therapy which involves the use of red and near infrared laser light over injuries to improve wound and soft tissue healing, and to give relief for both acute and chronic pain.

LLLT can have both a biostimulative effect and a bioinhibitive effect within the irradiated tissue. LLLT is not a heat therapy. Treatment with LLLT is based on the chemical and biological effects of laser light in cells and tissues.

Electrotherapy and low-level laser are used in physiotherapy to assist in the attenuation of pain and to stimulate tissue repair. The dosage delivered by the practitioner during a laser treatment is determined by the condition being treated, and the desired therapeutic effect.

Treatment will be effected by application of the laser probe to points along tendons and ligaments, and at the origins and insertions of muscles. Larger muscles can be treated by application of the laser in a grid pattern to a series of points across the body of the muscle, or by scanning or painting the laser head across the affected area.

Joint conditions, such as osteoarthritis, can be treated by applying the laser probe to a series of points along the joint line, aiming the probe tip at the articular surface where possible, and to the origins and insertions of muscles around the joint.

Open wound healing can be accelerated through laser therapy, by the application of 1-to-4 Joules/cm² to a series of points in a 1cm square grid pattern across the surface of the wound, or by scanning or painting the wound surface with the laser.

As a general rule, optimal biostimulation is affected by the application of smaller dosages-per-point to more points at the treatment site.

Optimal bioinhibition is achieved through applying higher dosages-per-point, but to fewer treatment points.

When treating open wounds, the probe should be held slightly away from the tissue surface, whilst still maintaining a 90° angle.

In treating musculoskeletal conditions, laser therapy should be carried out following cryotherapy as the vasoconstriction caused by cooling the tissue will increase the penetration depth of the laser irradiation. Laser therapy helps to relax muscles, and so manipulations should be carried out following laser irradiation. Heat therapies and various creams and lotions can be applied after laser therapy.

Laser treatments can be carried out by irradiating daily for the first week, then gradually increasing the interval between treatments over successive weeks, according to the progression of the condition being treated. The total dosage should not exceed 100-200 J in any single treatment session. Laser dosage is cumulative, and so over treatment causing a degradation of LLLT effectiveness can come from overly-high dosages in one treatment session, or too many treatment sessions in close succession. Individual practitioner discretion is to be used to determine the appropriate maximum session dosage, and the frequency of treatment, for each particular patient.

When treating acute musculoskeletal injuries, the initial desired outcome of laser therapy is the reduction of pain and inflammation.

Ideally treatment will begin as soon as possible after the injury occurs, with relatively high, inhibitory dosages being used to attenuate the pain and reduce the initial inflammatory response. A treatment frequency of 1-2 sessions per day may be used for the first 2-4 days post-injury.

As the time post-injury progresses, dosages and treatment frequency may be reduced. In the period 5-10 days post-injury, mid-range dosages may be useful in promoting the rate of the inflammatory process and in clearing its products from the injury site, thus allowing healing to begin sooner.

Moving into the healing phase, dosages are lowered and treatment frequency is reduced further. Throughout the healing and rehabilitation phase of an injury, biostimulatory dosages are used to promote tissue repair and reduce scarring and adhesions. Higher doses may be used as required to alleviate any pain that results from over-working the injured body part during rehabilitation.

When treating chronic injuries or pain, it is best to start with lower doses and then work up to the most effective dose for that particular patient, as a high initial dose may cause an unpleasant exacerbation of symptomatic pain.

Summary:

- LLLT, by definition, has no appreciable thermal effect in irradiated tissue; it works by modulating the biological processes within the tissue through application of photonic energy at specific wavelengths;
- Therapeutic effects of laser are both wavelength and dosage dependent;

- Low dosages stimulate, high dosages inhibit (ref: Arndt-Schultz Law of Biomodulation) - both have therapeutic applications;
- Optimal Biostimulation: lower dosages per point - more treatment points;
- Optimal Bioinhibition: higher dosages per point - less treatment points;
- Infra-red wavelengths (~760-1260 nanometers) - deeper penetration - deeper tissue treatment, eg. musculoskeletal injuries, sports therapy, deeper APs and myofascial TPs, also wound healing, etc;
- The main reported benefit of using LLLT is reduction of rehabilitation time following an injury.

LLLT is used for:

- **Wound Management** – open wounds, ulcers, pressure sores
- **Soft Tissue Injuries** – sprains, strains, tendonitis, hematomas
- **Joint Conditions** – capsulitis, bursitis, joint strains
- **Arthritis** – Osteoarthritis (OA) and Rheumatoid (RA)
- **Chronic Pain** – reduction and management
- **Dermatological Conditions**
- **Reduction of Inflammation**

How LLLT works in the above cases:

- **Rapid Cell Growth** – accelerates cellular reproduction and growth
- **Faster Wound Healing** – stimulates fibroblast development in damaged tissue
- **Increased Metabolic Activity** – higher outputs of specific enzymes, greater oxygen and food particle loads on blood cells, more effective immune responses
- **Reduced Fibrous Tissue Formation** – reduces the formation of scar tissue following tissue damage
- **Anti-Inflammatory Action** – reduces swelling caused by bruising or inflammation of joints to give improved joint mobility
- **Increased Vascular Activity** – stimulates lymph and blood circulation, to allow the affected tissue to have the best possible circulation
- **Stimulated Nerve Function** – slow recovery of nerve function in damaged tissue can result in “dead” limbs or numb areas. LLLT speeds the process of nerve cell reconnection to bring the numb area back to life. LLLT also increases the amplitude of action potential to optimize muscle action.

Contraindications:

- **Carcinoma** Do not use the laser over any known primary or secondary lesions.
- **Thyroid** Laser should not be used over the thyroid gland.
- **Hemorrhage** It is conceivable that laser-mediated vasodilatation may worsen the hemorrhage.
- **Steroid Injections** Patients may suffer an exacerbation of symptoms after laser therapy in conjunction with a recent steroid injection. For this reason laser should be used with caution following a steroid injection on or near the same site. We

- recommend one or two treatment points only at the minimum recommended dosage for that probe.
- **Anti-Coagulants** It is possible that probe pressure may cause slight bruising after treatment.

General Treatment Guide

Wounds – it is important to treat the periphery of the wound, as well as the wound surface, to optimize the repair process. Prior to treating the wound directly, you should also irradiate the proximal lymph nodes (i.e., those between the wound and the core of the animal).

Tendon Injuries – LLLT is most effective when applied to acute injuries, so it is recommended to begin treatment of bowed tendons and strained ligaments as soon as the injury occurs. Laser therapy will help reduce the pain and swelling associated with the injury, and will enhance the healing process.

Muscle Injuries – often undiagnosed and untreated, muscle strains and tears are very common. LLLT is very successful in treating all muscle injuries and, as in tendon injuries, should be applied as soon as possible after the injury occurs. Once the damaged muscle has been identified, treatment should include the entire muscle, including the origins and insertions of the muscle, and to any supportive tissues. Any points in the muscle that are painful upon palpation (trigger points) should also be treated.

Joints – LLLT is used to reduce the inflammation and pain associated with degenerative joint disease, such as arthritis. By treating the afflicted joints once or twice a week, you can safely extend the life of the animal and improve its quality of life.

Adjunctive Treatments – LLLT should be carried out following cryotherapy, as the vasoconstriction caused by cooling the tissue will improve the penetration of the laser irradiation. Heat therapies and manipulative therapies should be applied after laser treatment.

Definitions & Parameters

Energy (Radiant Energy) – The capacity for doing work. Calculated by multiplying Power (Watts) by Time (Seconds), and stated in Joules (J).

Energy Density (Radiant Exposure) – A measure of the amount of energy being delivered to a particular area on a surface, stated in Joules per Square Centimeter (J/cm^2)

Power – The rate at which energy is emitted, transferred or received. The Standard International Unit of Power is the Watt. Radiant Power, or Radiant Flux, is power emitted, transferred or received in the form of radiation.

Power Density (Irradiance) – A measure of the amount of radiation being delivered to a particular area on a surface, stated in Watts per Square Centimeter (W/cm^2).

Wavelength – The distance, in meters, between two successive points on a periodic wave which are in the same phase. Due to the very short wavelengths of light and infrared radiation, it is often expressed in ‘nanometers’. One nanometer is one billionth of a meter ($1 \times 10^{-9}\text{m}$)

Frequency – actually the amount of time measured in pulse per second

- ACUTE Conditions or wounds – use a lower frequency
- CHRONIC conditions or wounds and PAIN – use a higher frequency.

Dosage (J) – the output power of the laser device multiplied by the length of time the laser beam is acting upon the tissue. The most important factor in determining the effect in the tissue.

- Low doses (1-4J) stimulate, whereas higher doses (5+ J) inhibit. Depending upon the condition being treated, and the stage of healing progression, either a stimulatory or inhibitory dose is indicated.
- Throughout a course of treatment, for example, one may start with higher doses in order to inhibit pain and swelling associated with acute injuries, and then gradually decrease the dose as the required effect becomes that of stimulating healing.
- The frequency of the treatment must also be adjusted according to the stage of the healing process: laser treatments can be given once or twice daily during the first few days after an injury, but then should be extended to once every two or three days as the injury begins to heal.
- This, along with decreasing the dosage per treatment session, ensures that the healing process is not inhibited through overdosing the animal.

Cumulative Dose – LLLT treatment is cumulative (the dose from one treatment lasts some time, and what remains of the dose is added to the dose at the next treatment). It is vital to space treatment intervals such that the cumulative dose does not get so high that it reaches the bio-suppressive range (this will not result in tissue damage, but healing will take longer).

- Minor acute problems can be treated daily until resolved (usually 4-5 treatments).
- Chronic conditions are best treated with more widely-spaced treatments.
- For more severe acute conditions, treat daily for the first week or two and then gradually increase the interval between treatments over the following weeks until the injury is completely healed.

Modulating Frequency – The SpectraVet laser is equipped with 11 modulation frequencies from 250Hz – 5000Hz, and a continuous wave (CW) setting. These frequencies refer to the number of times the laser beam is switched on and off each second. Research has shown that modulating, or pulsing, the laser beam in this way can lead to improved outcomes. However, **for most conditions and injuries, the continuous wave (CW) setting is the best option.**

- Acute injuries, such as wounds, swelling, pain and muscle injuries, low frequencies (CW or 250Hz) can be used. This creates an immediate analgesic and anti-inflammatory effect.
- Chronic conditions, such as arthritis, non-healing wounds, and recurrent muscle injuries, high frequencies (3000-5000Hz) can be used to restimulate the healing process.

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