Part I: What is Low-Level Laser Therapy?

High-powered, intense-heat laser therapy has been used surgically to ablate tissue since the mid-20th century. While laser has been used in the Soviet Union and Europe since the 1970s, it wasn’t until the early 1990s that laser therapy entered North America. In 2002 the first laser-therapy device was cleared by the FDA. Today, low-level laser therapy (LLLT) is an emerging clinical tool used by naturopathic doctors, medical doctors, and rehabilitation specialists that is rapidly gaining momentum because of its non-invasive nature, its widespread usability, and its efficacy in stimulating tissue repair. LLLT is used to treat a wide variety of conditions including pain, degenerative diseases, and skin conditions.

This four-part series will focus on what LLLT is and how it is used. Part I will focus on describing LLLT and how it works, while subsequent sections will describe its usefulness in various conditions including acute and chronic pain, such as injury, low-back pain, and fibromyalgia.

Low-level laser therapy (LLLT) refers to the use of lasers or light-emitting diodes (LEDs) to project low-frequency energy to targeted cells or tissues for therapeutic benefit. It can be emitted in a continuous wave or pulsed mode. While laser apparatuses come in many shapes and forms, and emit light of various wavelengths, specific red light and near-infrared light wavelengths have been found to offer an optimum range for maximal tissue penetration and therapeutic benefit on pain and tissue repair. Outside of these wavelengths, much energy is lost to either absorption by other cells or molecules inside the body, or to scatter. LLLT is also known as low-intensity laser, low-power laser, cold or soft laser, biostimulation, photobiomodulation, irradiation, low-energy photon therapy, or low-output laser.
Is it safe?

LLLT does not generate destructive heat or ionizing radiation. LLLT is non-invasive, and depending on the apparatus used, can be applied safely in clinic settings or at home. There is a need however to protect against potential eye damage, depending on the specific class of laser device used and the wavelength of light emitted.\[^4\] Safety glasses are therefore required for class 3B and 4 lasers in order to eliminate this risk.\[^2, 4\] With this precaution taken, incidence of adverse effects is low, and was not different from placebo in the randomized, double-blind trials investigating this therapy,\[^4, 8\] with subjects reporting little to no discomfort with use.

Subsequent segments in this series will discuss how laser acts on the body tissues to relieve pain and promote healing, as well as the application of LLLT in the treatment of chronic pain, with rates of efficacy based on current research findings.

References


Low-Intensity Laser Therapy — A non-invasive option for treatment

Part II: Relief of Pain and Tissue Repair: How does LLLT work?

By: Christine Nguyen, BPHE, ND
Ottawa Integrative Health Centre
1129 Carling Ave
Ottawa, ON. K1Y 4G6
www.oihc.ca

As with acupuncture, although there is widespread recognition of its efficacy, people often have difficulty grasping how it is that this therapy works. In this section, we discuss the mechanisms by which LLLT relieves pain and promotes tissue healing.
The therapeutic effects of LLLT come from the emission of photons contained in the laser beam. When this penetrates the targeted body tissues, the photons electrically stimulate specific receptors present in those cells. When these receptors are stimulated, it begins a cascade of events, triggering specific biological processes at the cellular level.¹ Depending on the types of receptors stimulated, specific biological responses are elicited from the cells.

Over 50 randomized controlled trials investigating the use of LLLT have been published in the last 15 years, in peer-reviewed medical journals, documenting the biological effects of laser therapy, and fuelling renewed interest in this treatment.

In 2004, a meta-analysis of 43 peer-reviewed trials investigated the use of LLLT on tissue repair and pain control was published.² Not only did the analysis find a positive treatment effect, but it identified several effects of laser on the tissues. These included: improved collagen formation, which is a crucial structural protein in connective tissues; increased rate of healing; improved tissue strength; and increased wound closure.²,³ Researchers also found that all three phases of tissue repair were positively affected by laser treatment: inflammation, cell proliferation, and tissue maturation. In essence, then, laser therapy promotes injury or wound healing by:

a) Accelerating collagen (connective tissue protein) synthesis;³
b) Speeding up the inflammatory process, which is required for clearing away debris and promoting healing; and

c) Improving tissue strength during and after healing.²

Another way in which LLLT promotes healing is by providing more energy to the cells, for use in the healing process. Following any type of injury or trauma, there is impairment of the muscle cells’ ability to produce ATP;¹⁰ ATP is the molecule that acts as the “energy currency” of the cell. A practical analogy might be to imagine a car following a car accident. The accident has caused the gas pipe to stop pumping the fuel necessary to operate the vehicle, and so the engine subsequently slows down in function and power. Enter LLLT, which effectively increases ATP production (“gas” in the car analogy), thereby re-activating the processes needed to get the engine running again, and allowing tissue recovery to take place.

Finally, it is also important to note how LLLT does NOT work. LLLT does not produce significant tissue temperature changes in targeted tissues, so any therapeutic effects appear to be non-thermal.⁴ Also, energy in this region of the electromagnetic spectrum is non-ionizing (meaning it is different than radiation for example); therefore, it does not pose any of the dangers associated with UV light, such as DNA mutations or cancer.⁵ For these reasons, laser therapy is safe, non-invasive, painless, and can be administered in clinic settings.⁶
Low-Intensity Laser Therapy — A non-invasive option for treatment

Part III: Low Intensity Laser Therapy for Fibromyalgia

By: Christine Nguyen, BPHE, ND
Ottawa Integrative Health Centre
1129 Carling Ave
Ottawa, ON. K1Y 4G6
www.oihc.ca

Now that we have an understanding of how laser has its effects (part II), we can discuss in more detail the therapeutic effects it has been shown to have in patients with chronic pain. Chronic pain, lasting more than six months, is predicted to reach epidemic proportions in developed countries over the next three decades due to the aging population.[1] Patients resist over-medication of pain with pharmaceutical drugs due to risk of dependence, as well as risks associated with long-term use of these drugs.

Low-level laser therapy (LLLT) has been used in pain management for over two decades.[2, 3] Early clinical findings demonstrated a reduction in the tenderness of trigger

References
points within 15 minutes of LLLT application.[4] LLLT can help effectively manage pain while minimizing dependence on “pain-killers.”

Fibromyalgia (FMS) is a complex pain syndrome, with multiple causative factors and diffuse pain locations in the body. A placebo-controlled study was conducted to evaluate the efficacy of LLLT in 40 female patients with FMS; in this case, FMS was defined as having widespread pain for at least three months duration, and the presence of at least 11 tender point sites as measured with a digital pressure device.[3] The treatment group received daily LLLT for 3 minutes at each tender point for two weeks, while the placebo group received sham laser (no laser beam was emitted). Significant improvements were noted in both groups, but the laser treatment group demonstrated remarkably greater benefits post treatment in terms of pain, muscle spasm, morning stiffness, and tender point number. No side effects were reported, suggesting that LLLT is a safe, effective and non-invasive treatment option for patients with FMS, who often find themselves suffering from chronic pain with limited options.

Another study found that LLLT was able to improve pain and upper-body flexibility, compared to sham laser, in women with FMS.[6] Laser therapy was administered twice a week for four weeks, during which sessions seven tender points located across the neck, shoulders, and back were treated. In addition to pain improvements, patients reported a decrease in the impact of FMS on their life.

How does LLLT moderate pain? Some of the proposed mechanisms for pain reduction include reduction of inflammation,[2] reduction in oxidative stress and muscle fatigue,[6] inhibition of pain signals at the nerves,[4, 7] and increased levels of serotonin (the “feel good hormone”) leading to increased feelings of well-being.[1]

Thus, these recent findings suggest that LLLT can be a viable, cost-effective, and effective treatment option for pain conditions, comparable to pharmaceutical drugs but without the side-effect profile, and with more long-term benefit than pharmaceutical inventions. In part IV we discuss low-back pain.

References
In industrialized societies low-back pain (LBP) is one of the most common reasons for seeking medical care,[1] and is estimated that LBP affects 80% of the population at some point in their lives.[2] Non-pharmacological treatment options include exercise therapy, education, physical modalities, acupuncture, manipulation, and massage, to name a few. Exercise therapy is widely used for LBP, and large reviews have supported its beneficial role in chronic LBP.[3] In addition, laser therapy is a promising non-drug treatment for LBP.

Two investigations involving a total of 136 patients suffering from LBP for between 12 weeks and 12 months compared the effect of LLLT versus exercise therapy versus both for chronic LBP.[1, 2] In both studies, LLLT was determined to be an effective method in reducing pain and functional disability from chronic LBP. In Gur’s 2003 investigation, treatment was administered five times a week for four weeks. The pain reduction was greatest using the laser plus exercise combination and laser alone, more so than exercise alone.[2] In the 2007 study, laser treatment twice a week for six weeks resulted in similar short-term benefits at six weeks across all three treatment groups.[1] However, in the long term (measured at 12 weeks), the combination exercise plus laser group demonstrated greater reductions in pain and disability, and improvement in range of motion compared to the group that received only exercise therapy.[1] Both investigations lend support for the additional benefit of using LLLT in conjunction with exercise or other therapies in the treatment of chronic LBP.
Laser therapy is also beneficial for other types of musculoskeletal pain, including chronic neck pain. In a thorough meta-analysis of the existing scientific literature published in The Lancet, 16 randomized controlled trials involving 820 patients with acute and chronic neck pain were assessed.[4] Fourteen of those trials involved chronic neck pain sufferers with average pain duration of 90 months! LLLT was applied to an average of 11 trigger or tender points or acupuncture points in the neck for a course of 10 treatments administered either daily or twice a week. This review found that not only was there clinically significant pain relief from using LLLT, but this relief was equally effective as the use of non-steroidal anti-inflammatory drugs (NSAIDs), such as aspirin or Advil, at managing pain.[4] Even more remarkable was the finding that the benefits of LLLT occurred both immediately as well as in the long term: reductions in neck pain lasted up to three months post-treatment for acute neck pain, and up to 22 weeks post-treatment in chronic neck pain.[4, 5]

In summary, through this four-part series we see that low-level laser therapy (LLLT) is a safe and effective strategy to help manage chronic pain including fibromyalgia, low-back pain, and neck pain. LLLT helps relieve pain, promote healing, and may decrease dependence on pharmaceutical pain medications.

References