

Wound Care

SPRING 2015
VOL. 13 NO. 1



C A N A D A

THE OFFICIAL PUBLICATION OF THE CANADIAN ASSOCIATION OF WOUND CARE

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Kick-start Stalled Wounds with Laser Therapy

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Despite many advances in conventional wound care, the treatment of complex, persistent lesions continues to be problematic with regard to effective healing. Whether they are aggravated by chronic illnesses, compliance issues or inappropriate wound care practices, many patients continue to suffer from recalcitrant wounds.

What is laser therapy?

Laser therapy—also known as cold laser, low-level laser therapy or photobiomodulation—is an emerging therapeutic approach in which cells or tissues are exposed to low-intensity red and near-infrared light emitted from lasers or light-emitting diodes (LEDs). Laser therapy is a non-invasive, non-toxic approach without documented adverse effects or interactions with pharmaceuticals. It has been approved by Health Canada for a range of musculoskeletal conditions and wounds.

When the light source is

placed against the tissue involved, photon particles of light penetrate several centimetres into the area and are absorbed by chromophores in the electron transport chain of the mitochondria. This process results in improved cellular metabolism through increased production of adenosine tri-phosphate (ATP).¹ This primary mechanism of action initiates a cascade of secondary physiological effects, including stimulation of inflammatory mediators and proliferation of key cell types involved in the remodeling process.

Safety and Contraindications

Lasers are classified by wavelength and maximum power output into four classes. Most therapeutic laser devices are in the red to infrared range and are classified as Class 3b (5–500 mW), which means that both the patient and the clinician need to wear protective goggles while treatment is being administered. This power output range does not thermally heat the tissue.

Laser therapy can be safely administered in patients who have epilepsy, pacemakers, pros-

theses, metal plates or implants. While no adverse events have been noted in published clinical research, there are some contraindications according to guidelines recently published in *Physiotherapy Canada* on the use of electrophysical agents by the Canadian Physiotherapy Association². These include directly treating the eyes, the low back or abdomen of pregnant women, regions of known or suspected malignancy and persons with untreated haemorrhagic disorder.

Effects on Wound Healing Phases

Research in the field of laser therapy has shown that it can positively enhance and accelerate the inflammatory, proliferative and remodeling phases of wound healing.^{3,4} Laser therapy can modulate prostaglandin levels, enhance the action of macrophages and promote fibroblast proliferation.³ It has also been shown to enhance the quality and texture of the dermis.⁵

Laser therapy is associated with the regeneration of rich networks of small blood vessels, in close proximity to the epithelial layer (i.e., angiogenesis)⁶ thereby improving microcirculation that enhances the oxygenation levels in the wound and surrounding tissue. Chronic ulcers are able to transition to an acute inflammatory state and permit the resolution of the ulcer through re-epithelialization of the wound (see case profile on this page).

A Case of Pre-gangrenous Ulcer Secondary to Diabetes Mellitus

Medical History: The patient is a 50-year-old female who developed gangrene after several months of conventional wound care, including antibiotics and topical ointments. The patient also received 30 hyperbaric-chamber treatments, but there was minimal improvement in the ulcer.



An infectious disease specialist prescribed eight weeks of IV ertapenem 1000 mg. As no substantial improvement was seen in the ulcer, amputation of the right toe was recommended by an orthopedic surgeon.

Physical Examination: Gangrene was noted over the distal phalanx of the right first toe. Edema, cyanosis and tenderness were noted to be affecting all the toes. The entire foot was cold and the joints immobile. There was no tactile sensation in the toes. Pain was present 24/7 and was described as excruciating and intolerable.

Discussion: A course of 40 laser therapy treatments was administered over 10 months. The patient was reassessed every three to four treatments with respect to wound dimensions, temperature of the extremity, tactile sensation and pain level. Complete healing of the forefoot pathology was achieved and amputation of the lower extremity was avoided. Colour, temperature and the range of motion of all joints were returned to normal. The dependent rubor, which was present on the initial visit, was no longer evident, and the patient experienced normal sensation in the foot. Pain levels were completely eliminated over the course of treatment. She continues to do well four years post therapy.



Clinical Research

While most research has been conducted in animal models, there have been a number of clinical studies in humans that have demonstrated improved wound contraction and accelerated healing without adverse effects noted. A few of these studies are highlighted here.

Hopkins et al.⁷ showed that in healthy subjects (n = 22), wounds treated with laser therapy contracted at a faster rate than those treated with a sham laser.

Kajagar et al.⁸ examined a group of patients with chronic diabetic ulcers (n = 68) and found that after 15 days of treatment the group treated with laser therapy combined with conventional therapy showed an ulcer reduction of $40.24 \pm 6.30\%$ compared to the group treated with conventional therapy, which showed a reduction of $11.87 \pm 4.28\%$.

Minatel et al.⁹ measured wound closure rates in a group of patients with chronic diabetic leg ulcers (n = 14) over a 90-day period of treatment. They found that the laser-treated group achieved 56% more granulation and 79.2% faster healing by day 30 as compared to the placebo group. By day 90, 58.3% of the

laser-treated group showed complete healing, and 75% had achieved 90-100% healing. In contrast, only one placebo-treated ulcer had healed fully and no other ulcer attained > 90% healing.

While there is a growing body of clinical research to support the use of laser therapy for chronic wounds, there is a need for larger clinical trials to confirm efficacy and establish optimal parameters for wavelength, dose and frequency of treatment.

The Extent and Cost of Chronic Wound Care


The Canadian Association of Wound Care (CAWC) estimates the cost of treating a chronic wound at \$10,376.¹⁰ This includes the cost of dressings, medications and hospital or community care visits. At a wound clinic in Toronto that regularly performs laser therapy, the cost of treatment ranges from \$50 – \$100 per visit depending on the extent of the wound and the time needed to treat the area. Chronic wounds can take from 10 to 40 treatments over one to 10 months for complete closure, resulting in an estimated cost of \$500 to \$4000, a savings of 60 – 95%.

Who can administer laser therapy?

While laser therapy can be administered by a number of different health-care practitioners, wound applications should be administered by physicians, nurses or physiotherapists who have had advanced training in wound care.

Training is required on the safe administration of Class 3b lasers. Some manufacturers offer additional training for wound applications focused on the parameters and treatment approach using a particular device.

Conclusion

Laser therapy is a therapeutic technology that not only expedites the inflammatory process but also enhances tissue healing, even with the most challenging lesions. Wounds that are enlarging or unresponsive to prolonged periods of conventional wound care can significantly benefit from laser therapy in terms of neovascularization, epithelialization, granulation and collagen formation at an accelerated rate. 

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Interested in learning more?

THE SCIENCE BEHIND LASER THERAPY:

- Enwemeka CS et al. The efficacy of low-power laser in tissue repair and pain control: A meta-analysis study. *Photomed Laser Surg.* 2004;22(4):323–329.
- Prindeze NJ, Moffatt LT, Shupp JW. Mechanisms of action for light therapy: A review of molecular interactions. *Exp Biol Med (Maywood).* 2012;237:1241–1248.