

LED Light Therapy: An Effective Alternative Treatment Option



The world of new treatment options and modalities can sometimes be overwhelming for clinicians and therapists. New technologies and modalities have to be evidence based and scientifically proven to be incorporated in a patient's treatment plan.

Although light therapy was documented in medical literature as early as 1500BC, it was the Danish physician Nils Finzen, believed as the father of light therapy, who received the Nobel Prize for his work in 1903. Since then, numerous authors and scientists have advocated light therapy treatment (or the generic term is phototherapy) for many conditions such as; wound healing, rheumatoid arthritis, joint and soft tissue injuries and pain relief.

The bio stimulus is dependent on the wavelength used and for an effective therapy to take place, the light needs to be absorbed by the body. Receptors identified for absorption of the wavelength energy lies inside the cell. This will be explained later.

Therapists are mostly familiar with devices termed as low level laser therapy or laser based light therapy. Lasers, however, have some inherent characteristics that make their use in a clinical setting problematic; mainly limitations in beam width, heat generation, high cost, and fragility. The size of wounds and areas that can be treated is limited because of time constraint; heat production from the laser light itself can damage tissue, and the pinpoint beam of laser light can damage the eye (protective eyewear has to be used by the patient and the therapist).

The modern LED based light therapy devices offer an effective alternative to lasers. These diodes can be configured to produce multiple wavelengths, which produce a more diffuse light so that larger areas can be treated at a time. The diodes are very robust, light-weight and produce virtually no heat. It is also of importance to note that LED light therapy has been deemed a no significant risk by the FDA; thus, FDA approval for the use of LEDs in humans for light therapy has been obtained¹.

How does it work?

Light therapy (laser and LED based) stimulates the basic energy processes in



Fig 1. Hamstring injury with hematoma



Fig 2. 3 Treatments over 5 Days



Fig 3. Lymphoedema



Fig 4. 3 treatments over 5 days



Fig 5. Venous Ulcer (3 years old)



Fig 6. After 10 Treatments, twice weekly (Note the regaining of pigmentation)

the mitochondria (energy compartments) of each cell, particularly when near-infrared light is used to activate the wavelength sensitive constituents inside (chromophores, cytochrome systems). Optimal light wavelengths (proven in prior studies of laser and LED light)^{3, 4, 5} to speed wound healing rate lie in the range between 610 and 880 nm. These wavelengths can be

macrophage stimulation, lymphocyte stimulation, and greater rate of extracellular matrix production have been reported with light treatment.

Light therapy can also be regarded as a complementary/extra treatment modality that will greatly enhance the effectiveness of conventional treatment modalities used in practice. The major advantage of LED

joint disease, RA, Gout, Spinal Column Pathology and Osteoporosis.

- Callus formation: fractures, stress fractures
- Nerve regeneration: Peripheral nerve injuries, Bell's Palsy, Neuropathy (in diabetic patients), Postherpetic Neuralgia, Herpes Zoster infections, etc.

Respiratory Conditions

- Upper respiratory: Sinusitis, Rhinopathy, Croup, etc.
- Lower respiratory: Bronchospasm, Pneumonia, Pleuritis, consolidation, Asthma, Inflammatory Lung Tissue, etc.

Dermatological Conditions

- Acne
- Psoriasis
- Eczema
- Keloid scars
- Herpes simplex infections (cold sores)
- Cellulites

Vascular and Lymphatic Conditions

- Venous and arterial deficiencies
- Vascular regeneration
- Lymph drainage, lymph nodes

Wounds

- Acute and chronic wounds
- Prevention of scar tissue formation (early treatment essential)
- Pressure points (prevention) and sores

Practical Considerations in choosing a Light Therapy Device for your Practice

Clinicians and therapists working with a diverse range of patient needs are not phototherapy specialists and have great difficulty in calculating, or choosing doses for effective treatments. This could be a contributing factor in why this amazing modality has been under utilised for so long.

There is, a "Therapeutic Window" of dosing, viz. 0.1 J/cm² to 10J/cm², that has proven bio-stimulatory effects in tissues. The treatment dose is the most important parameter in successful treatment of pathological conditions. It is also proven that the wavelength is the factor that causes the biological response in a cell, and not the way of delivering that wavelength, such as laser versus LED.

Pulsed emission affects the output power and thus the average output power must be taken into consideration. When all or part of a photonic emission protocol is in the form of pulsed emission, it

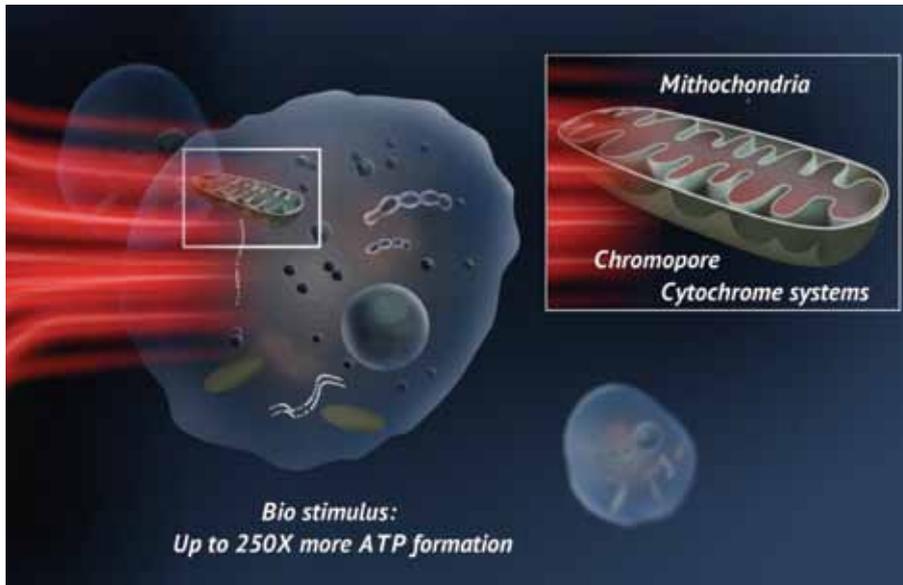


Fig 7. A simple graphic to show light absorption by the cell

The depth of near-infrared light penetration into human tissue has been measured spectroscopically. Spectra taken from the wrist flexor muscles in the forearm and muscles in the calf of the leg demonstrate that most of the photons at wavelengths of 630 to 800 nm travel between 2 cm and 20 cm through the skin surface and muscle.

Light therapy provides low-energy stimulation of tissues by lasers or LED-based light therapy devices², which results in increased cellular activity during wound healing in such tissues^{2,3}. These activities include collagen production and angiogenesis. Wound healing has three phases: first, a substrate is laid down, second, cells proliferate, and third, there is remodeling of tissue. Studies published so far suggest that light bio stimulation produces its primary effect during the cell proliferation phase of the wound healing process. It has also been demonstrated that the mitochondria are receptive to near-infrared light and that light increases respiratory metabolism of certain cells⁵. Processes such as fibroblast proliferation, attachment and synthesis of collagen and pro-collagen, growth factor production (including keratinocyte growth factor [KGF]), transforming growth factor [TGF], and platelet-derived growth factor [PDGF],

Light Therapy is that it is practical, easy to use, lightweight and portable (hospital/home visits), effective, affordable and durable.

The mechanism on which light therapy works complements traditional treatment plans in acute and chronic conditions due to the following effects seen in patients:

1. ATP stimulation
2. Stimulation/regulation of DNA and RNA production
3. Stimulation/regulation of the immune system
4. Analgesic effect (acute and chronic)
5. Strong anti-inflammatory effect
6. Reduced scar formation
7. Cell repair if treated within 4-6 hours of injury.
8. Regeneration of nerve, muscle, venous and bone cells
9. Reduced muscle spasms
10. Increased blood supply
11. Increased lymph vessel diameter

Therefore, light Therapy treatment for the following pathologies will be highly effective:

Orthopedics

- Soft tissue pathologies: muscle, tendon, fascia, ligament, menisci, etc.
- Arthritic Conditions: degenerative

results in longer treatment time (compared to continuous photonic emission) in order to administer the desired dose. Numerous studies have shown there are different effects when pulsing light, as opposed to continuously emitting light²⁵⁻²⁹

Before investing in a light therapy device for your practice, a physical therapist needs to consider the following:

- For devices where the treatment settings need to be programmed, make sure you know the dosage (J/cm^2) formula by heart e.g. $time (s) = dose \times cover\ area (cm^2) / average\ output\ power (W)$
Remember:
 - Treatment with LED based devices: + 20% higher dose
 - Most devices' output power is given in mW. $1W = 1000mW$
 - WALT (World Association of Laser Therapy) has published guidelines and recommended dosages (therapeutic window) for certain wavelengths.
- Devices with pre-programmed dosages are available which may be a better option for therapists with little knowledge in the field of light therapy. Using a pre-programmed device emitting dosages within the 'therapeutic window' ensures an effective treatment dosage.
- When all the dose parameters are equal, laser based devices can be slightly more effective for deeper conditions (speckle formation). For superficial conditions, LEDs are equally effective.
- LED based devices are in most cases more practical, mainly because:
 - Wider aperture of the probes – can treat large body areas, like back, neck, etc.
 - No need to wear eyewear (spreading beam and no risk of eye injuries).
 - Average of 50,000 hours diode lifetime. There is no need to measure output power before treatments, as there is no lowering of output power with time (laser diodes' output power lowers with usage).
 - They are more robust, lightweight/portable and much cheaper than laser based devices.
 - Diodes are not heat sensitive.
- It is safe to prescribe LED based devices for home (ongoing) treatment.

A device that is designed with a pre-programmed effective dose is simple for the patient to apply without supervision (the same as a patient taking a prescribed dose of medication).

- With LED based devices, there is no risk of harmful excessive heat formation in tissues
- It is a brilliant complementary treatment modality, enhancing treatment objectives
- Great patient tolerance, especially in animal patients.

A few practical tips:

- Always treat deep areas through the shortest route to the area.
- Diagnose the condition, and identify the anatomical structure that needs to be treated.
- If structure is deep lying, treat anterior, lateral, and posterior to the area, to ensure light absorption in the desired structure.
- Keep in mind that light therapy has a systemic, immune-modulatory effect as well as a local effect.
- Treat over lung areas, where Bronchospasm and inflammation or consolidation is present.
- Light therapy can be safely used over growth plates, metal implants, and on patients receiving anti-clotting medication.
- Excellent results in treating most conditions such as: Sinusitis (penetrates bone, restores mucus membranes, relieves pain and congestion, stimulates drainage), TMJ, Bell's Palsy (nerve regeneration, immune stimulation, anti-inflammatory), Neuropathy (especially in diabetic patients - restores sensation, with added value in balance, proprioception, etc.), sport injuries, over-use syndromes, etc.
- An alternative for needles in acupuncture points
- Use light therapy before manipulation, to relieve muscle spasms, pain, and to gain better effect.
- Also treat earache, sore throats and teething in pediatric patients. These are usually associated problems when treating upper respiratory conditions.
- Treat proximal lymph nodes to assist in reduction of swelling and local infections.
- Blood irradiation: treat over major blood and lymph nodes, such as armpit, groin, posterior knee, etc. This will enhance general pain relief (endorphin secretion), relaxation (serotonin

secretion), immune response, and general wellbeing.

- When treating acne, tinnitus, or sinusitis, also treat over the mastoid processes.
- Treat fractured or cracked ribs and pleuritis. It will relieve pain and encourage deep inspiration, and effective coughing.
- When treating the anterior neck area, place a spoon or other light impermeable object over the Thyroid. When treating sinusitis, use a teaspoon to protect the eyes from the intense light.
- Treatment with light therapy before invasive procedures (directly pre-operatively or before painful/uncomfortable procedures), will result in optimum cell/tissue condition, and faster healing, less swelling, less pain and increased immune response.
- Treat acute conditions daily, for best results. Chronic conditions (RA, chronic pain conditions, psoriasis, and other maintenance treatments) can be treated 2-3 times weekly for 1 month, skip 1 month, repeat 2-3 times weekly.
- Warts, nail fungi and other longstanding viral and fungal infestations: treat daily or at least 3 times a week, for at least 15-20 treatments, to stimulate the immune response and assists in clearing the infections.
- Treat cold sores within 6 hours of symptoms developing. This will ensure an optimum immune response. Also treat areas where cold sores commonly appear for at least 8 treatments. This will ensure less frequent attacks.
- Treat the cause of conditions where possible, e.g. in venous ulcers, treat the whole extremity, and proximal lymph nodes, for an extended period. Light therapy stimulates regeneration of blood vessels, nerve and lymphatic vessels. Prevention is better than cure!

Summary

New research is ongoing, other new advances and exciting research pave the way for a vast range of conditions effectively treatable by LED Light therapy. From Alzheimer and Dementia sufferers, eye pathologies, oral mucositis to traumatic brain injuries, the list is almost unending. LED Light therapy devices offer a great complementary, effective treatment option. Scientifically proven, non-invasive, safe and practical; Light therapy is one of the most effective treatment options for a vast array of pathologies. From newborns to geriatrics, from humans to animals: Any living cell can be treated with spectacular results.

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