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Light Therapy (How and Why it works)

Monochromatic light with wavelengths ranging from 600nm(red) to 1000nm(infrared) have been found to have therapeutic effects on mammalian cells. Coherent (laser) light has been found to be more effective, but any essentially monochromatic light source will work.

Dosage is critical, and should be adjusted during the course of treatment based on results. Treatment guidelines should only be used as a starting point. It is better to treat with too little energy than too much.
Under treatment will result in an increase in the number of treatments necessary, but over treatment can result in complete suppression of beneficial effects. Typical dosages range from $1J/cm^2$ to $10J/cm^2$
A Joule (J) is equal to 1 Watt/Second

Thermal Effects (there is no such thing as "cold" infrared light)

"Cold Laser" is an often misunderstood term. When light of any wavelength (especially infrared light) is absorbed by tissue, heat will be generated. The term cold laser was coined to distinguish therapeutic lasers from surgical lasers used to cut and burn tissue. Although many light therapy devices have power outputs low enough that the patient will not notice any temperature increase. There will still be small thermal effects, most notably an increase in local circulation.

Non-Thermal Effects

We tend to think of plants, bacteria, algae, etc. as the only organisms that can utilize the energy from light. But in reality many chemicals present in human cells, particularly cytochromes, porphyrins and flavins, react to light. Generically these compounds are referred to as chromophores.

Stimulation of these chromophores by light of the right wavelengths results in a cascade of reactions within the cells.

Increased ATP production.
ATP is the fuel that powers most reactions within the cell.

Increased DNA and RNA synthesis.
Resulting in increased cell proliferation and replacement of damaged tissue.

Increased permeability of cell membranes. (many active transport mechanisms require ATP, an increase in ATP production will result in increased transport across cell membranes)

Increased expression (upregulation) of various genes, Including those responsible for cell proliferation and tissue regeneration.

Downregulation of genes coding for proteins associated with apoptosis(programmed cell death)

Increased synthesis of serotonin and endorphins.

Increased synthesis of membrane components.

In short, exposure to monochromatic light in the range from 600nm to 1000nm results in a local increase in cellular metabolism and cell replication. New cells are made to replace damaged tissues, existing cells in injured areas are strengthened, and local increases in endorphin production and changes in nerve conductivity result in decreased pain sensation.

Misconceptions

Superluminous diodes are not laser diodes, a superluminous diode is just a very bright LED. The light emitted by an LED is not coherent, nor is it generated via stimulated emission (the common definitions of a laser) LED's also do not actually emit light of a single wavelength. To the naked eye an LED appears to be monochromatic, but LED's and SLD's emit light over a narrow band of wavelengths typically 30 to 80 nm wide at one half maximum intensity. This is still narrow enough to be effective as a light therapy modality.

Diode lasers are lasers in the sense that most of their light is generated via stimulated emission, but unlike chemical lasers they do not emit purely monochromatic light, and the coherence length is shorter than a chemical laser such as a CO_2 or HeNe laser. Diode lasers also have a highly divergent beam when used without collimating optics.

References:
Jan Tunér and Lars Hode "Laser Therapy: Clinical Practice and Scientific Background". Prima Books, Grängesberg Sweden, 2002

Harry T. Whelan, MD, Ellen V. Buchmann, B.S. Apsara Dhokalia, Ph.D. et al. Effect of Light-Emitting Diode Irrariation on Molecular Changes for Wound Healing in Diabetic Mice. Journal of Clinical and Laser Medicine and Surgery. 21:67-74, 2003

Margaret T.T. Wong-Riley, Xuetao Bai, Ellen Buchmann and Harry T. Whelan. Light –emitting diode treatment reverses the effect of TTX on cytochromes oxidase in neurons. NEUROCHEMISTRY 12:3033-3037 October 2001

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