PhotoBioModulation Overview

The utilization of monochromatic visible far-red to near-infrared (NIR) light for reducing pain, inflammation and edema, promoting healing of wounds, deeper tissues and nerves, has been extensively researched for more than 30 years.

Photobiomodulation (PBM) is the use of monochromatic light to influence biological systems. The low-energy photon irradiation using low energy lasers or light-emitting-diode (LED) arrays, has been applied clinically in the treatment soft tissue injuries and acceleration of wound healing.

In 1993 research sponsored by NASA had begun to define the light characteristics of cellular photon absorbion, and energy transformation utilizing LEDs (Light Emitting Diodes). These studies demonstrated that monochromatic light at the appropriate doses and wavelengths of light are therapeutically beneficial in tissue repair and pain control.

LED (SLD) near-infrared technology was found to be a new tool capable of delivering an effective wavelengths of light that are biologically beneficial, is non-invasive, non-medicating, and with no ill side-effects. The SLD (Super Luminous Diode) technology produces negligible heat, and clinically been tested to be safe, and therefore has the FDA non-significant risk (NSR) status. The advent of these high power SLDs (Super Luminous Diodes) makes effective treatment of larger areas possible at a much lower cost.

The success of the early studies prompted NASA (National Aeronautics and Space Administration) and DARPA (Defense Advanced Research Projects Agency) to award the University of Wisconsin and other leading research institutions several research contracts to investigate the effectiveness of LED’s (Light Emitting Diodes) for medical applications eliminating the need for lasers.

The research has demonstrated numerous biologic effects including:

- increased growth of skin and muscle cells in culture by 150-200%
- increased lymphatic flow
- increased formation of new capillaries
- support of nerve healing
- marked increase in DNA synthesis
- up-regulation of tissue regenerating genes
- growth factor synthesis
- release of growth factors from cells
- increased collagen production
- increase in stem cell proliferation
- increased fibroblastic and osteoblastic activity
- bactericidal effects on some bacteria
It has been clinically shown:
  • reduction in wound healing time by 50%
  • improvement in musculoskeletal training injuries by greater than 40%
  • improvement in OA pain in the cervical spine and knee
  • decrease in swelling in ankle sprains
  • improved repair of bone defects with bone graft
  • supports healing spinal cord injury
  • accelerated healing of wounds in diabetic mice

The resultant clinical benefits include pain relief in conditions such as:
  • bedsores
  • burns
  • carpal tunnel syndrome (CTS)
  • bursitis, tendonitis, and arthritis
  • ankle sprain
  • temporomandibular joint (TMJ) dysfunction
  • shoulder and neck pain
  • post-herpetic neuralgia
  • tissue repair in cases of diabetic ulcer
  • venous ulcer
  • mouth ulcer
  • fractures
  • tendon rupture
  • ligamentous tear
  • torn cartilage
  • nerve injury
  • alternative to Non-Steroid Anti-Inflammatory Drugs (NSAIDS)

Many therapeutic effects of photobiomodulation (PBM) are thought to be expressed by intracellular signaling mechanisms initiated by the interaction of photons with the mitochondrial photoacceptor molecule cytochrome oxidase which result in improved mitochondrial metabolism, increased synthesis of cytoprotective factors and cell survival.

The depth of near-infrared light penetration into human tissue has been measured spectroscopically (Chance, et al 1988). Spectra taken from the wrist flexor muscles in the forearm and muscles in the calf of the leg demonstrate that most of the light photons at wavelengths between 630-800 nm travel 23 cm through the surface tissue and muscle between input and exit at the photon detector. (Ref. (Chance, et al 1988) citation “The NASA Light-Emitting Diode Medical Program - Progress in Space Flight and Terrestrial Application”)

The FDA has deemed LED light therapy as a nonsignificant risk and has approved one of these devices as an alternative to Non-Steroid Anti-Inflammatory Drugs (NSAIDS) for the treatment of pain.
References:


HT Whelan, EV Buchmann, A Dhokalia, MP Kane, NT .. Effect of NASA Light-Emitting Diode Irradiation on Molecular Changes for Wound Healing in Diabetic .. Journal of Clinical Laser Medicine & Surgery, 2003 -

HT Whelan, MT Wong-Riley, JT Eells, JN VerHoeve, R .. DARPA Soldier Self Care: Rapid Healing of Laser Eye Injuries with Light Emitting Diode Technology RTO-MP-HFM-109 - 2004