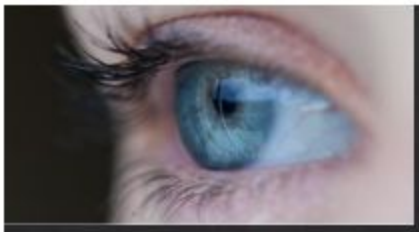

PhotoBioModulation - PBM
What is it?

Nicholas Lee
Consultant Ophthalmologist specialising in Medical Retina
Western Eye Hospital
Clementine Churchill Hospital and Bishops Wood Hospital
Tortola Vision – British Virgin Islands

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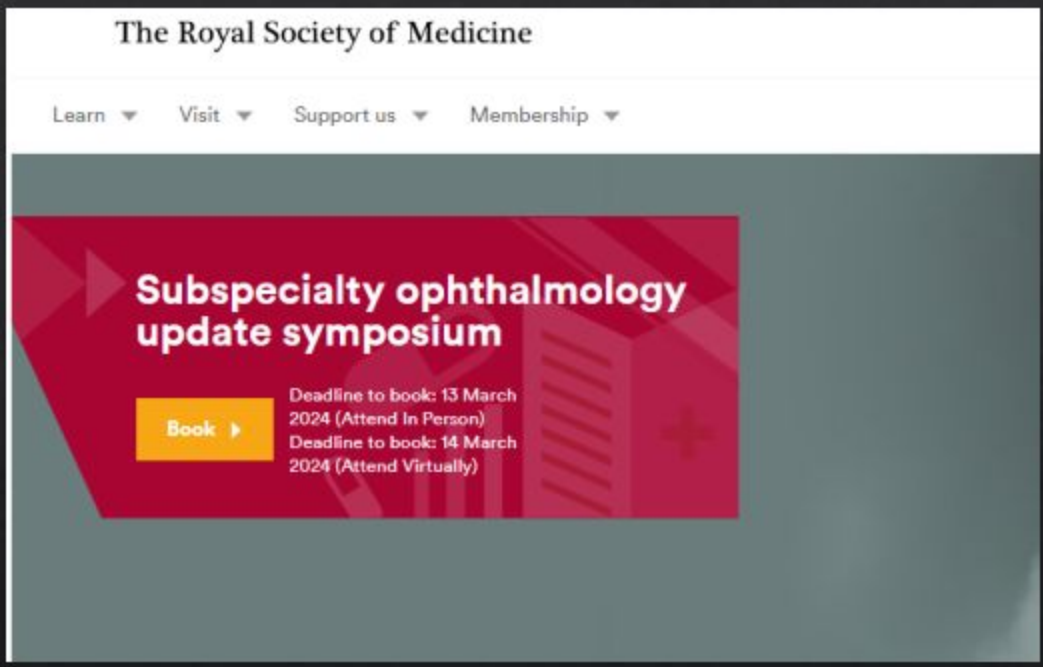


2

OVERVIEW

General PBM

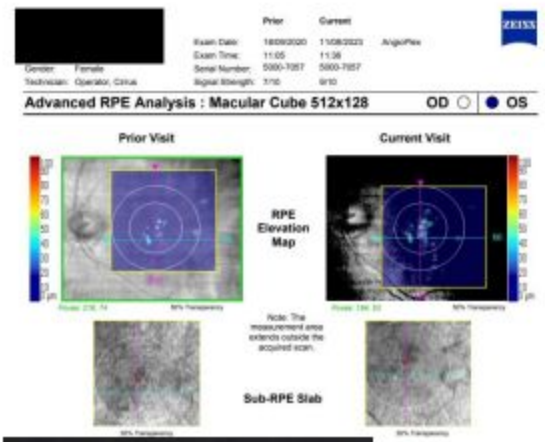
- Definition and basic concept of PBM/LLLT
- Brief history and evolution of the technology
- Applications in General Medicine

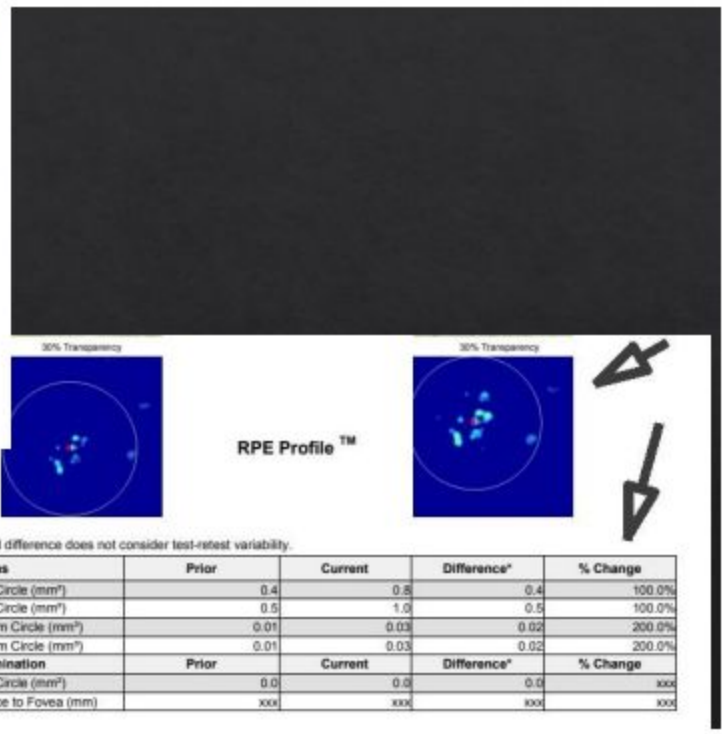
LLLT
Cold Laser Therapy

Ophthalmic Applications

- Brief overview of dry macular degeneration (AMD)
- Definition, prevalence, and impact on vision
- Introduction to PhotoBioModulation (PBM) for the eye
- Clinical LIGHTSITE I, II, III Trials
- Valeda PBM treatment

3

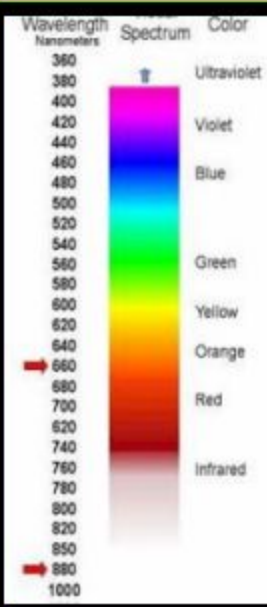




*The calculated difference does not consider test-retest variability.

RPE Elevations	Prior	Current	Difference*	% Change
Area in 3 mm Circle (mm²)	0.4	0.8	0.4	100.0%
Area in 5 mm Circle (mm²)	0.5	1.0	0.5	100.0%
Volume in 3 mm Circle (mm³)	0.01	0.03	0.02	200.0%
Volume in 5 mm Circle (mm³)	0.01	0.03	0.02	200.0%
Sub-RPE Illumination	**Prior**	**Current**	**Difference***	**% Change**
Area in 5 mm Circle (mm²)	0.0	0.0	0.0	xxx
Closest distance to Fovea (mm)	xxx	xxx	xxx	xxx

4



What is Red Light Therapy?

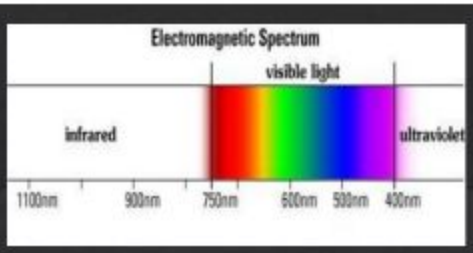
Red Light Therapy delivers light from the biologically active wavelengths of 660 nm and 850 nm.

These two **biologically active peaks of red light** occur within the Red and Near Infrared light spectrum.

While red light therapy may get a tiny bit warm,
Red Light, and most especially the NIR, is not hot (thermal).

By contrast, Far Infrared light gets hot. *It can even cause burns!*

5



Neils Ryberg Finsen

Rickets UV Treatment (1925)

John Harvey Kellogg
(1852-1943)

6

TECHNOLO

LOW-POWER lasers may help wounds to heal quicker and reduce pain by stimulating various biological processes. A pilot study just completed at the Anatomy Department in Guy's Hospital, London, showed that wounds in mice healed more rapidly when treated with light from an infrared laser.

Mary Dyson, the zoologist who led the study, says she began the work with scepticism, examine what appeared to be exaggerated claims made by some laser manufacturers. But now she believes that more studies are needed to turn "laser magic" into real science.

The study used three groups of mice. The controls received mock laser irradiation, and she treated the others with laser light at 3-4 joules per square centimetre—one at a frequency of 700 hertz and the other at 1200 hertz. In the group submitted to 700 hertz, the healing process speeded up considerably.

The laser light seemed to stimulate both cellular activity and the development of a new blood supply in the damaged tissue.

Endre Mester, a surgeon at the Semmelweis University of Medicine in Budapest, Hungary, discovered the biological effects of low power lasers some 20 years ago. Mester investigated the possible carcinogenic properties of the light from low-powered helium-neon lasers by submitting mice to regular doses on patches of skin where their fur had been removed. There were no malignant effects, but the fur grew back on irradiated areas faster than on those not treated.

Judith Perera

US. Adam Mester uses low-power lasers to treat otherwise incurable ulcers. He takes patients referred by other specialists who can do no more for them. Of the 1300 treated so far, he has achieved complete healing in 80 per cent and partial healing in 15 per cent.

He uses three different types of laser: one argon ion laser supplied by Spectraphysics, of Britain, which is good for large relatively superficial wounds; two Hungarian-made helium-neon lasers that can penetrate more deeply, and an infrared gallium aluminium arsenide diode laser, made by Omega, in London, which penetrates even further.

Mester says his treatment is especially valuable for patients who have failed to respond to antibiotics or are allergic to them.

Laser manufacturers have long claimed that low-powered lasers have a wide range of medical applications, but until recently there has been little scientific evidence to support these claims. Apart from wound healing, they are proposed for pain reduction, quick healing of sports injuries and treatment of arthritis. Now, several studies have appeared which suggest they should be looked at again.

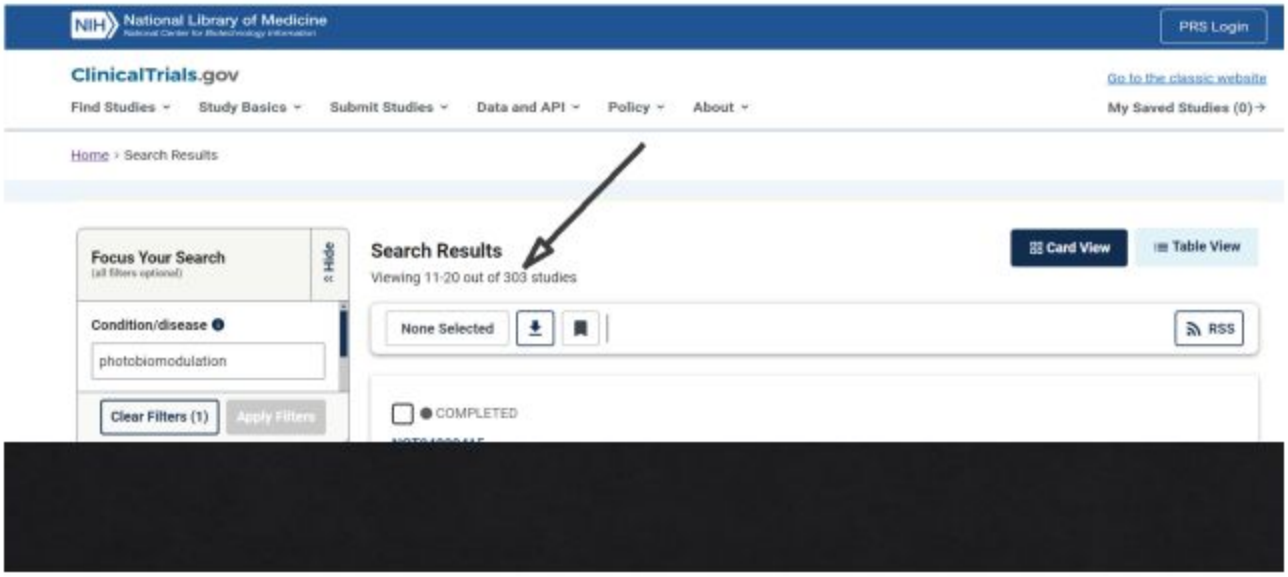
A double-blind study by Judith Walker at the Pain Institute in Los Angeles showed that chronic pain eased after treatment with low-powered lasers. Those who

7

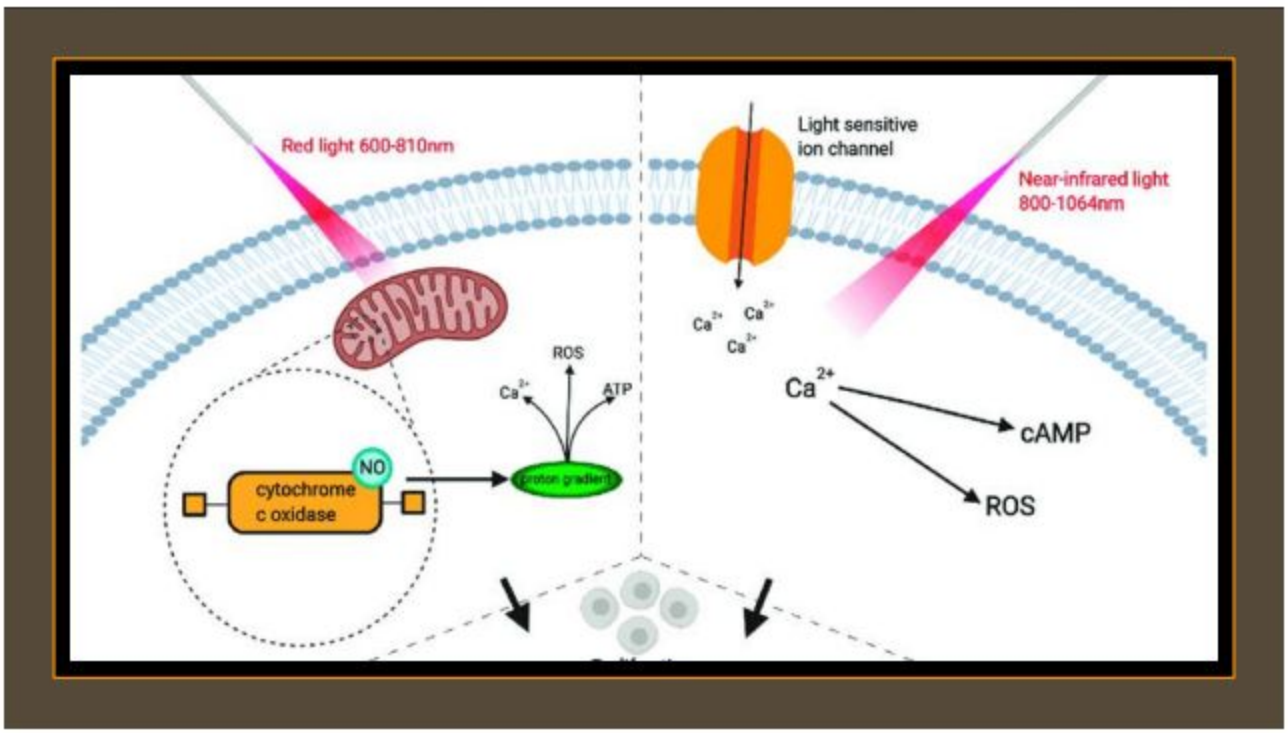
Low Level Laser Therapy (LLLT)
Published in the worlds top scientific journals
Over 200 (RCT) clinical trials
Over 2000 laboratory studies

- Einstein first proposed the phenomenon of stimulated emission
- Theodore "Ted" Maiman built the first working laser
- Prof. Mester - Budapest - discovers laser biostimulation
- UK Physios first use low power laser for sports injuries treatment
- James Carroll raised £ for laser research at Guys Hospital London
- THOR formed
- NASA conducted LED therapy wound healing study for space
- US Military nerve regeneration research with THOR lasers
- First FDA clearance for THOR
- Spinal cord regeneration
- LLLT published in Nature and Pain
- WHO Bone & Joint Task Force recommend on neck pain (Spine)
- Lancet review neck pain
- APTA recommends LLLT for Achilles Tendinopathies
- BMJ "strong evidence" for LLLT on frozen shoulder
- Intl Assoc for the Study of Pain, "strong evidence" Chronic Myofascia
- ???

8


National Library of Medicine
PRS Login
ClinicalTrials.gov
Go to the classic website
Find Studies
Study Basics
Submit Studies
Data and API
Policy
About
My Saved Studies (0)
Home › Search Results
Focus Your Search
(all filters optional)
Hide
Condition/disease
photobiomodulation
Clear Filters (1)
Apply Filters
Search Results
Viewing 11-20 out of 303 studies
Card View
Table View
None Selected
RSS
COMPLETED

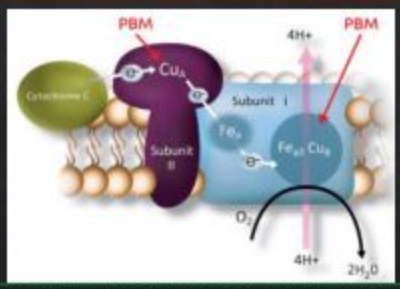
9


Red light 600-810nm
Light sensitive
ion channel
Near-infrared light
800-1064nm
ROS
ATP
NO
cytochrome
c oxidase
proton gradient
cAMP
ROS

10

Photobiomodulation (PBM) Approach

PBM uses low-level light to stimulate cellular function leading to beneficial clinical effects



- Photons are absorbed by photoacceptors in the targeted tissue mitochondrial protein, cytochrome C oxidase (CCO)
- Secondary cellular effects include increases in energy production, improved blood flow and reduced inflammation with changes in signaling modalities
- Cellular changes occur through activation of transcription factors

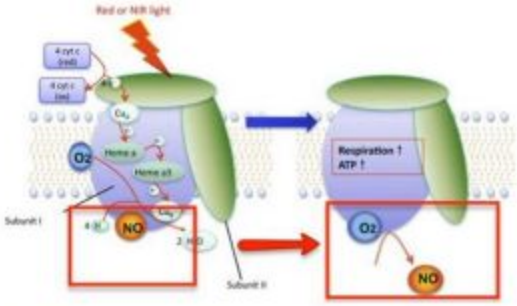
Valeda Wavelengths (nm)	Cellular Targets
590	Stimulates CCO activity, increases nitric oxide (NO) synthesis, inhibits VEGF expression
660	Promotes O_2 binding (Cu_B) to CCO and stimulates metabolic activity (ATP), inhibits inflammation and cellular death
850	Drives electron transfer (CuA) to CCO and stimulates metabolic activity (ATP), inhibits inflammation and cellular death

Valeda wavelengths were selected based on their cellular targets and importance in AMD

Wong-Riley MTT, et al. J Biol Chem. 2005; 280: 4761-71; Ball KA, et al. J Photochem Photobiol B Biol, 2012; 102: 182-91.

11

How does Red and Near Infrared Light work?



Science generally accepts that Red Light Therapy is triggered by light absorption by the Cytochrome C Oxidase (CCO) inside the mitochondria or cell membrane.

Red Light Therapy causes the Nitric Oxide (NO) to pop off of CCO and ATP production to resumes.

Nitric oxide can bind to cytochrome c oxidase in the mitochondria, the site of cellular respiration. This interaction can modulate mitochondrial respiration and thus affect the production of cellular energy (ATP). This aspect of NO's function is important in cellular energy balance and metabolism

Increase in NO in inflammation, or cell injury cause Mitochondrial respiration to decrease

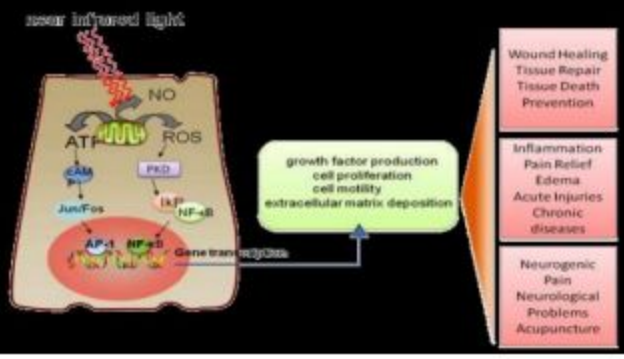
PBM displaces the NO allowing mitochondrial respiration to increase.

12

PHOTOBIOSTIMULATION BENEFITS[8]

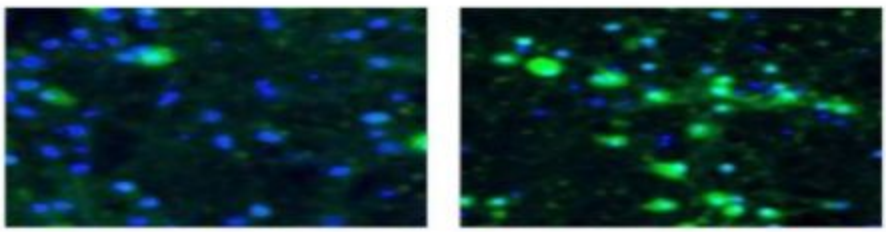
1. Increases ATP synthesis
2. Stimulates cell growth
3. Increases cell metabolism
4. Improves cell regeneration
5. Invokes an anti-inflammatory response
6. Promotes edema reduction
7. Reduces fibrous tissue formation
8. Stimulates nerve function
9. Reduces the production of substance P

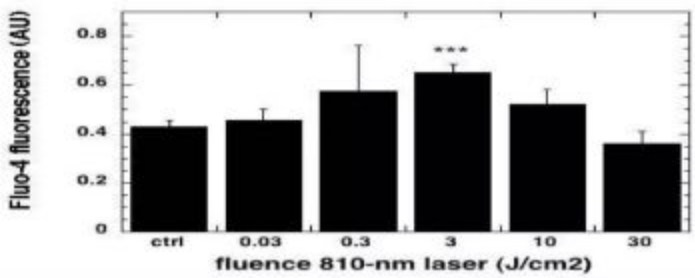
7. Stimulates long term production of NO
8. Decreases the formation of bradikynin, histamine, and acetylcholine
9. Stimulates production of endorphins



13

Intracellular calcium post 810-nm laser
Biphasic dose response

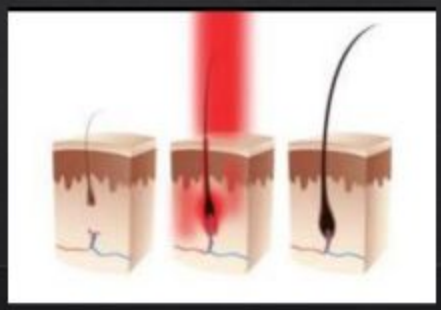




cAMP

14

2. **1967 Experiments with mice**
   a) Could laser be used to treat cancerous tumors?
   b) Used low power ruby laser (694 nm)
   b) Laser treatments did NOT kill tumor cells
   c) Laser treatments DID enhance healing of incisions and hair growth
   d) First to observe photobiostimulation

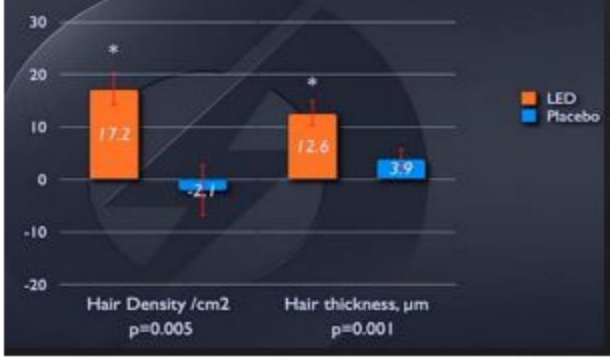


PubMed Search

- Phototherapy = 37,785 studies
- Photobiomodulation = 510 studies
- Photostimulation = 1,067 studies
- Lllt = 5,139 studies
- Low-level laser therapy = 5,910 studies
- Near-infrared light = 8,431 studies

15

Androgenetic Alopecia
(Male Pattern Baldness)



Bauman Medical Group

16

Early application of low-level laser may reduce the incidence of postherpetic neuralgia (PHN)

Yu-Tsung Chen [1], Hsiao-Han Wang [2], Tsung-Jen Wang [3], Yu-Chuan Li [2], Ting-Jui Chen [4]

Affiliations + expand

PMID: 27543213 DOI: 10.1016/j.jaad.2016.03.050

Postherpetic Neuralgia

(Crossover Trial)

20 patients (11 male , 9 female)
Mean age of 69 years (55 – 82)
Mean duration of PHN of 2.5 years (6 months – 8 years)
1 x week PBM treatments

lind Crossover Trial or Low Level Laser Therapy in the treatment of Postherpetic Neuralgia
Hira, N., Kumar, P.S., Jayakumar, C.S., and Ohshiro, T
py Pilot Edition 1:0 Pilot Issue 2 Pages 61-64

17

What is PBM Therapy?

Application of monochromatic light

- Tissue Repair
- Inflammation
- Oedema
- Pain
- Health / Wellness
- Strength
- Endurance
- Recovery
- Renal disease
- Degenerative disk
- OA
- TBI
- Tendinopathies
- Osteoarthritis
- Neck Pain
- Low Back Pain
- Neuropathic pain
- Wound Healing
- Lymphoedema
- Fibromyalgia
- Oral Mucositis
- Post surgical pain
- TMD
- Dentine Hypersensitivity

THOR

18

https://www.thorlaser.com/ - Amersham UK

HOW TO ADMINISTER LASER

1. Locate Treatment Area
   - Tender Points
   - Use of Pain-Relieving Guide
2. Turn on TQ Solo
3. Select Frequency (5 Hz, 50 Hz, or Variable Frequency)
4. Press "Start" and place laser device over treatment area
5. Treatment Duration: 5 minutes

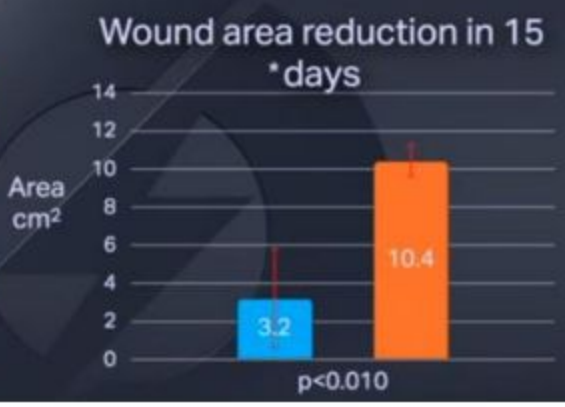
Modes of Operation

Program / Mode	1	2	3
Pulse Frequency	5 Hz	50 Hz	1000 to 3000 Hz
Time	5 Minutes	5 Minutes	5 Minutes
Systemic Effect	Tissue Repair / Healing	Anti-inflammatory	Acute Pain Treatment
Depth Of Penetration	Deepest	Medium	Superficial

19

Efficacy of PBM on Wound Healing in Patients with Chronic Diabetic Foot Ulcers

RCT
64 Patients
Ulcer age 4-5 weeks
Daily for 15 days



20