Low-Level Light Therapy:

Navigating the Science and Applications of Photobiomodulation in Eye Care

Joseph J. Allen, OD, FAAO, Dipl ABO

Doctor Eye Health

The Doctor Eye Health Podcast

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All Relevant Relationships Have Been Mitigated

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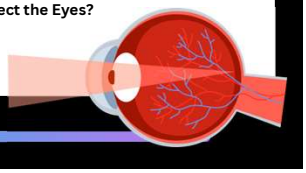
What is Red Light Therapy and Photobiomodulation Therapy (PBMT)

Laser Vs LED?

How does LLLT / PBMT Work?
- **Understanding Protocols**

How Does Red Light Therapy Affect the Eyes?
- **Retinal Disease**
- **Ocular Surface Disease**
- **Myopia**



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Why Are We Talking About This??

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Valeda (LumiThera)

Approved by FDA on November 4, 2024

Eyerising Myopia Management Device
Eyerising International

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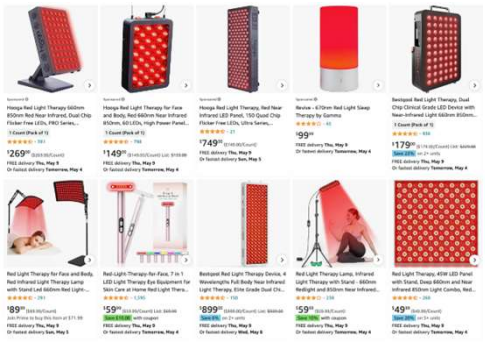

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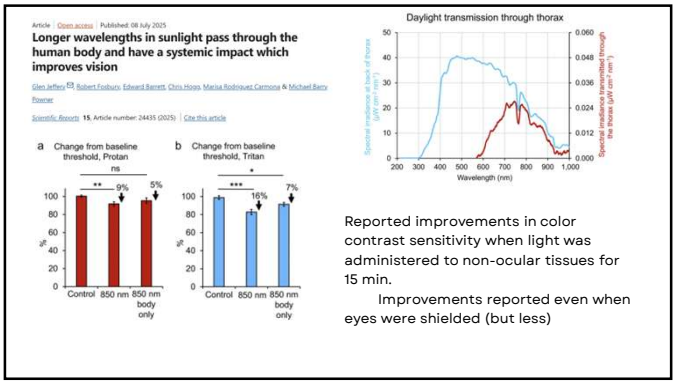

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Simple definition

"Red light therapy" is a treatment that uses low wavelength light to help improve

- tissue health
- reduce inflammation
- treat pain
- promote healing

Common names

Red Light Therapy
Low-Level Light Therapy (LLLT)
Low-Power Laser Therapy
Low-Level Laser Therapy
Non-Thermal LED Light
Soft Laser Therapy
Cold Laser Therapy
Photobiomodulation Therapy (PBMT)

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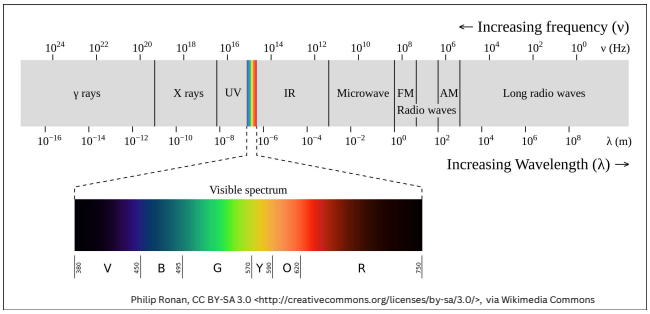

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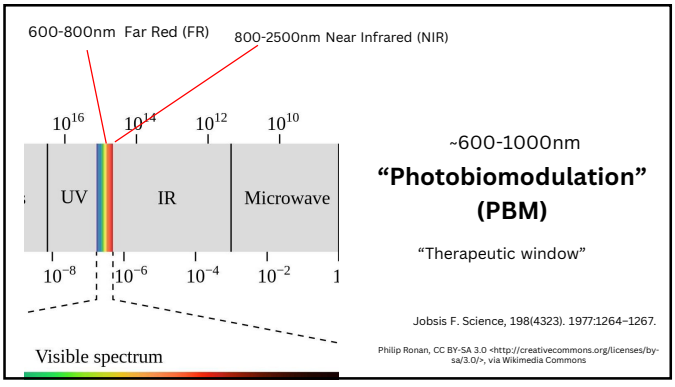

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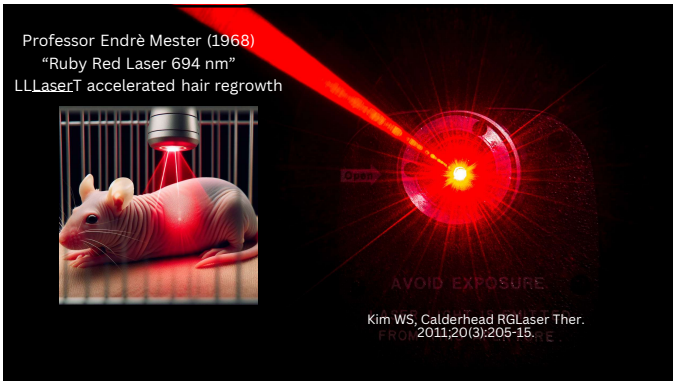

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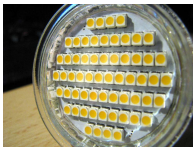
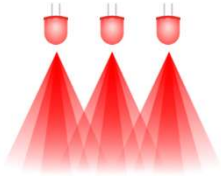
NASA LED

- less divergent
- higher power
- greater stability
- quasimonochromaticit





Whelan HT, Houle JM, Whelan NT, et al. (2000):. Space Tech. & App. Int'l. Forum. Space Tech. & App. Int'l. Forum: 37–43

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LED vs LASER

PROS
- Cheaper
- Safer
- Compact and wide treatment area

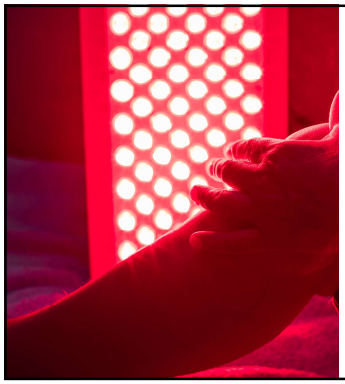
Cons
- Tissue penetration?
  - debated
- less precise targeting

PROS
- Deeper tissue penetration
- More precise treatment
- Historically more studied in early research

Cons
- higher cost
- safety risks (beam intensity)
- less suitable for large treatment areas
  - (small spot size)

Hamblin MR. Photochem Photobiol. 2018 Mar;94(2):199-212.

14



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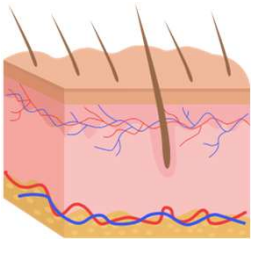
Below 600nm = hemoglobin will absorb

Above 950nm = water will absorb
(limits penetration and creates Heat)



Ash C, et al. Lasers Med Sci. 2017 Nov;32(8):1909-1918. Epub 2017 Sep 12.
Opel DR, et al. J Clin Aesthet Dermatol. 2015 Jun;8(6):36-44

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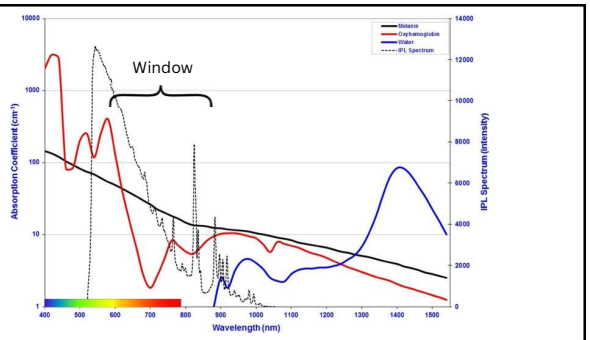

Ash C, et al. Lasers Med Sci. 2017 Nov;32(8):1909-1918. Epub 2017 Sep 12.

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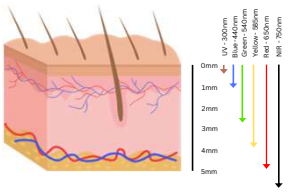

Blue LEDs
- (activate light-gated calcium channels)
- destruction of bacteria via the formation of oxygen free radicals and cytokine production

Yellow LEDs
- alters ATP production, gene expression, and fibroblast activity

Red LEDs
- activate fibroblast growth factor, increase type 1 pro-collagen, and decrease MMP-1

Combination Therapy
- Exposure to combination of LED wavelengths is **often more effective than monotherapy**

Opel DR, et al. J Clin Aesthet Dermatol. 2015 Jun;8(6):36-44
Zein R,. J Biomed Opt. 2018 Dec;23(12):1-17.
Ash C, et al. Lasers Med Sci. 2017 Nov;32(8):1909-1918.

18

• Medicine (Baltimore). 2025 Feb 14;104(7):e41596. doi: 10.1097/MD.0000000000041596

Clinical study to evaluate the efficacy and safety of home-used LED and IRED mask for crow's feet: A multi-center, randomized, double-blind, sham-controlled study

Sang Hyun Park [a], Seong Oh Park [b], Jae-A Jung [c,*]

19

• Medicine (Baltimore). 2025 Feb 14;104(7):e41596. doi: 10.1097/MD.0000000000041596

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20

• J Cosmet Dermatol. 2024 Sep 25;24(1):e16599. doi: 10.1111/jocd.16599

Efficacy and Safety of a Home-Use Light-Emitting Diode Neck Device for Improvement in Neck Wrinkles: A Multicenter, Randomized, Double-Blind, Sham Device, Superiority Verification, Confirmatory Clinical Trial

Seong Oh Park [1,2†], Jiwoo Jang [1], Sang Hyun Park [2], Jae-A Jung [2], Chihwan Cha [3], Ro Hyun Lee [2], Jung Kwon An [2]

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Variables?

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Key Parameters in LLLT / PBMT

- wavelength
- power
- irradiation time
- beam area (at the skin or culture surface)
- pulse parameters (frequency)
- anatomical location (skin color, target location, i.e. depth below skin, mitochondrial density)
- number of treatments
- interval between treatments

Jenkins PA, Carroll JD. Photomed Laser Surg. 2011 Dec;29(12):785-7.

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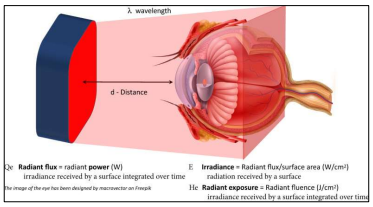


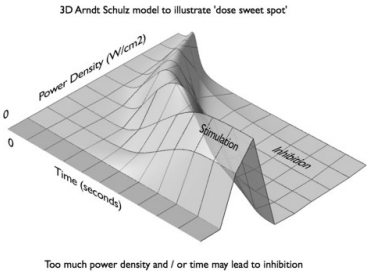
Photo credit Valter K (2024)

irradiance (W/cm2) **X** exposure (seconds) = [radiant exposure] (J/cm2)

Valter K, et al. Front Ophthalmol (Lausanne). 2024 Aug 15;4:1388602.

24

Biphasic Dose-Response Curve



Too much power density and / or time may lead to inhibition

Huang YY, et al. Dose Response. 2011;9(4):602-18.
Valter K, et al. Front Ophthalmol (Lausanne). 2024 Aug 15;4:1388602.

25

Ideal settings???

26

Ideal settings???

27

Ideal settings???

Research is ongoing

Tissue dependent

Huang YY, et al. Dose Response. 2011;9(4):602-18.
Valter K, et al. Front Ophthalmol (Lausanne). 2024 Aug 15;4:1388602.

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Acne	Crescentic glomerulonephritis	Liver regeneration	Periodontitis
Achilles tendinitis	Delayed hypersensitivity	Lung fibrosis	Peritonitis
Acute pain	Dentin regeneration	Lung hemorrhage	Pleurisy
Acute respiratory distress syndrome	Depression	Lung inflammation	Pressure ulcer
Adipose tissue inflammation	Dermal abrasions	Lung injury	Radiation injury
Age-related macular degeneration	Diabetic kidney	Lymphedema	Restenosis
Allergic asthma	Diabetic eyes	Mastitis	Retinitis pigmentosa
Allergic contact dermatitis	Diaphragm muscle dysfunction	Methanol toxicity of retina	Rheumatoid arthritis
Allergic rhinitis	Eardrum perforation	Morphine withdrawal	Sarcopenia
Allodynia	Endophthalmitis	Multiple sclerosis	Sciatica
Alzheimer's disease	Exercise performance	Muscle injury	Spinal cord injury
Amyotrophic lateral sclerosis	Haemarthrosis	Myocardial infarct	Stroke
Aneurysm	Hair loss	Myonecrosis	Submandibular gland inflammation
Arthritis	Heart failure	Myopathy	Surgical wound infection
Atherosclerosis	Hearing loss	Nerve injury	Teeth re-implantation
Atrophic gastritis	Hyperalgesia	Neuropathic pain	Tendinopathy
Auditory neuropathy	Hypertension	Oral mucositis	Thrombocytopenia
Bone fracture	Kidney fibrosis	Oral ulcer by formocresol	Tinnitus
Bone grafts	Kidney injury	Osteoarthritis	TMJ inflammation
Burn injury	Laryngitis	Osteomyelitis	Tracheal incision healing
Cancer	Ligament injury	Osteoporosis	Traumatic brain injury
Colitis	Listeria infection	Parkinson's disease	Wound healing
COPD	Liver cirrhosis	Paw edema	

Heiskanen V, et al. Photochem Photobiol Sci. 2018 Aug 8;17(8):1003-1017

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But how does it work?

- **Alters Inflammatory Response**
- **Enhances Tissue Repair**
- **Pain Modulation**

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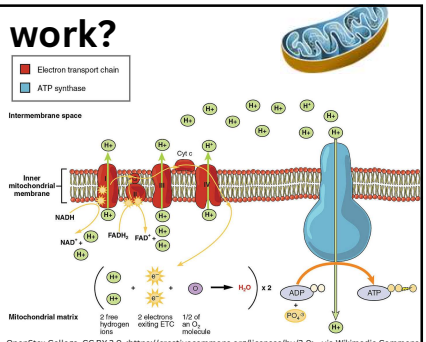
How Does It work?

~660nm & ~800nm directly activates & absorbed by **cytochrome c oxidase (Complex IV)** within mitochondrial membrane

- Increases **ATP** and **cAMP**
- nitric oxide (**NO**)

NO - increases
- anti-apoptotic pathways
- cellular metabolism



OpenStax College, CC BY 3.0 <https://creativecommons.org/licenses/by/3.0>, via Wikimedia Commons

de Freitas LF, et al. IEEE J Sel Top Quantum Electron. 2016 May-Jun;22(3):7000417

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How Does It work?

- **Retrograde signaling**
  - (Alters Gene Expression within nucleus)
- Activation of light sensitive ion channels
- Activation of transcription factors
- May have direct cell-free light-mediated effects on molecules

Karu TI, Et al. Photochem. Photobiol. 2008;84(5):1091–1099
de Freitas LF, et al. IEEE J Sel Top Quantum Electron. 2016 May-Jun;22(3):7000417

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Reduction in inflammation
- inhibiting prostaglandin E2, COX-1 and COX-2
- modifications on histones
- influence the expression of cytokines and chemokines

Cytoprotection
- can delay or inhibit methanol and cyanide toxicity
- can reduce amyloid-β-peptide in Alzheimer's disease

Lim W, et al. Photochem. Photobiol. 2013;89(1):199–207.
Chen C, et al. Mediators Inflamm. 2014;1–13. 2014.
Eells JT, et al. Proc. Natl. Acad. Sci. U. S. A. 2003;100(6):3439–3444.
Zhang H, et al. Cell. Signal. 2012;24(1):224–232

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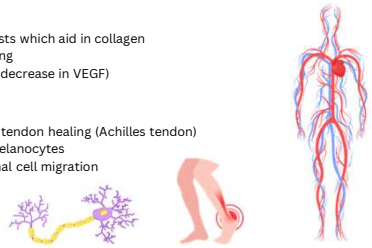
Proliferation
- keratinocytes and fibroblasts which aid in collagen synthesis and wound healing
- vascular endothelial cells (decrease in VEGF)
- osteoblasts

Migration
- migration of tenocytes for tendon healing (Achilles tendon)
- migration and vitality of melanocytes
- fiber sprouting and neuronal cell migration



Sperandio FF, et al. J. Biophotonics. 2014;
Szymanska J, et al. *J. Physiol. Pharmacol.* 2013;64(3):387–391.
Amid R, et al. J Lasers Med Sci:163–170.
AlGhamdi KM, et al. Lasers Med. Sci. 2015;30(5):1541–1551.
Raj V, et al. Biophys Rev (Melville). 2021 Jun 17;2(2):021303
Zhang, P, et al. Graefes Arch Clin Exp Ophthalmol 261, 2535–2545 (2023)

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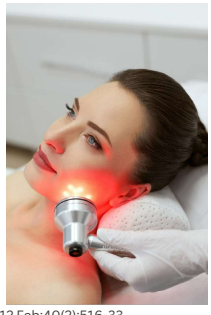
REVIEW

PBMT
- Reduces oxidative stress
- Reduces inflammation
- Supporting mitochondrial function
- Stimulates cellular repair (through transcription & protein synthesis)
- Enhancing fibroblast activity and collagen synthesis
- Improves circulation and oxygenation of tissues
- Reduces pain by modulating nociceptors and lowering inflammation.



Chung H, et al. Ann Biomed Eng. 2012 Feb;40(2):516-33.
Zein R, et al. J Biomed Opt. 2018 Dec;23(12):1-17.
Hamblin MR. et al. Photochem Photobiol. 2018 Mar;94(2):199-212.

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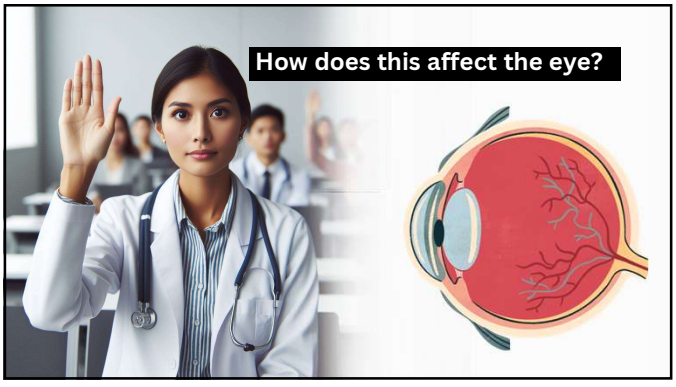

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Retinal Disease
- Age Related Macular Degeneration
- Diabetic Eye Disease

Ocular Surface Disease
- Dry Eye Disease
- Chalazion

Myopia

Published research also on (not covered in this talk)
- Central Serous Retinopathy
- Glaucoma
- Neuropathic Corneal Pain
- LHON
- Stargardt's disease
- Amblyopia
- spaceflight associated neuro-ocular syndrome (SANS)

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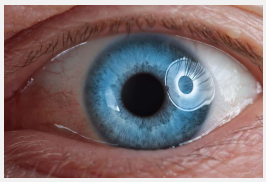
WHY THE EYE?

- Dense concentration of mitochondria
- Vulnerability to oxidative damage and inflammation.



- Eyelid skin is extremely thin and translucent
- This allows minimal scattering or absorption.

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Light transmission through the human eyelid: *in vivo* measurement

M.J. Moseley

Department of Ophthalmology, University of Leicester, Clinical Sciences Building, Leicester Royal Infirmary, PO Box 65, Leicester LE2 7LX

S.C. Bayliss

Department of Physics, University of Leicester

A.R. Fielder

Department of Ophthalmology, University of Leicester

(Received 17 November 1987)

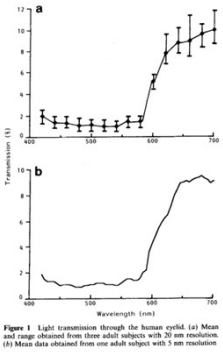

Figure 1 Light transmission through the human eyelid. (a) Mean and range obtained from three adult subjects with 20 nm resolution. (b) Mean data obtained from one adult subject with 5 nm resolution

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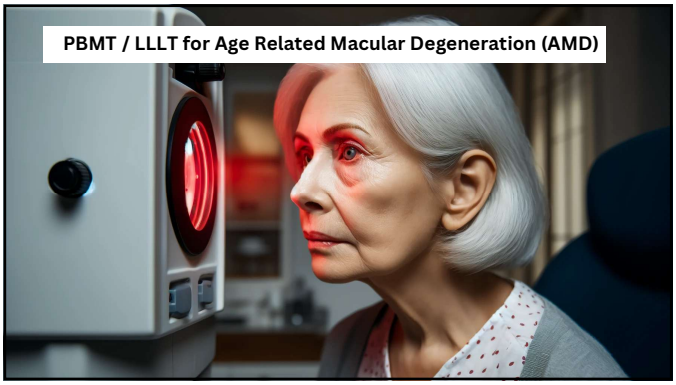

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PBMT for Age Related Macular Degeneration (AMD)

LIGHTSITE I pilot study 2018
- PBMT vs Sham (30 patients with dry AMD - BCVA 20/40-20/200)
- nine sessions delivered over three weeks
  - average gain of four letters in BCVA immediately at months 1 and 7.
  - ~50% with PBT had improvement of 5+ letters vs 13.6 in sham group at 1 month
  - Statistically significant improvements were observed in **contrast sensitivity, central drusen volume, central drusen thickness, and quality of life** ($p < 0.05$)

Markowitz SN, et al. Retina. 2020 Aug;40(8):1471-1482.
Merry GF, et al. Acta Ophthalmol. 2017;95(4):e270–e277

41

PBT for Age Related Macular Degeneration (AMD)

(590 nm, 660 nm, and 850 nm)

Siqueira RC. Photobiomodulation Using Light-Emitting Diode (LED) for Treatment of Retinal Diseases. Clin Ophthalmol. 2024 Jan 22;18:215-225.

42

PBT for Age Related Macular Degeneration (AMD)

(590 nm, 660 nm, and 850 nm)

Parameter	Specifications
Light sources	Light-emitting diodes
Light emission (maximal)	590-nm output: 5 mW/cm^2 660-nm output: 65 mW/cm^2 850-nm output: 8 mW/cm^2
Beam diameter	30 mm (nominal) at treatment plane
Treatment exposure time	A total of 250 seconds (4 minutes 10 seconds). There are 4 phases: 1: 35 seconds, patient's eyes open [pulsed yellow and NIR wavelengths] 2: 90 seconds, patient's eyes closed [continuous red wavelength] 3: 35 seconds, patient's eyes open [pulsed yellow and NIR wavelengths] 4: 90 seconds, patient's eyes closed [continuous red wavelength]

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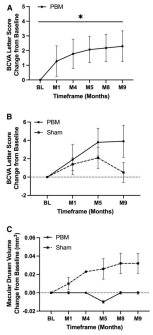
PBT for Age Related Macular Degeneration (AMD)

LIGHTSITE II study 2021

- PBM vs Sham (44 patients with intermediate dry AMD)
- nine treatments over a 3- to 5-week period w/ retreatment at 4 & 8 months
  - statistically significant improvement in BCVA with a 4-letter gain in the PBM-treated group versus 0.5-letter gain with sham ($p < 0.1$)
  - 35.3% of PBM-treated eyes showed ≥ 5-letter improvement at 9 months
  - No increase in Drusen volume with PBT vs increase in sham
  - **20% less GA growth** in the PBM group over 10 months



Burton B, et al. Ophthalmol Ther. 2023 Apr;12(2):953-968

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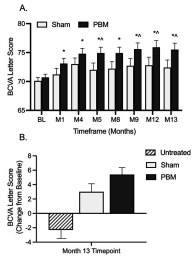
PBT for Age Related Macular Degeneration (AMD)

LIGHTSITE III study 2021

- PBM vs Sham (100 patients with intermediate dry AMD)
- nine sessions over 3 to 5 weeks every four months over 24 months
  - 55% of PBM-treated eyes showed ≥ 5 letter gain (mean 9.7 ± 3.7)
  - 26.4% showed ≥10 letter gain (mean 12.8 ± 2.7)
  - 5.5% showed ≥ 15 letter gain.
- favorable safety profile
- GA advanced in 9.8% of Sham-treated eyes
  - **1.1% of PBM-treated eyes**



Boyer D, et al. Retina. 2024 Mar 1;44(3):487-497.
Marion Ronit Munk,et al. Invest. Ophthalmol. Vis. Sci. 2023;64(8):5059.

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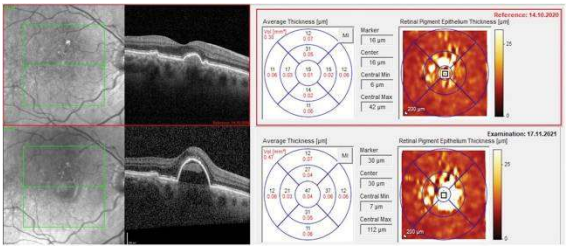
Macular Drusen with sham



Boyer D, et al. Retina. 2024 Mar 1;44(3):487-497.

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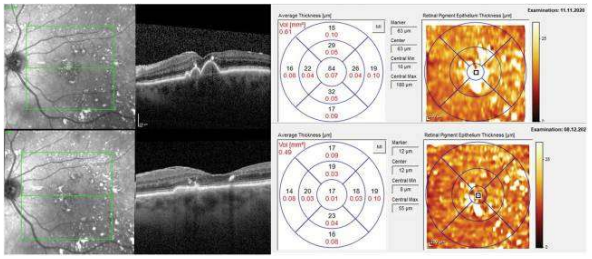
Macular Drusen with PBT



Boyer D, et al. Retina. 2024 Mar 1;44(3):487-497.

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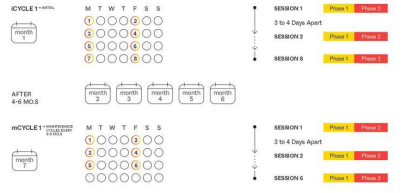
PBT for Age Related Macular Degeneration (AMD)

Ophthalmol Ther. 2024 Sep 13;13(11):2855–2868. doi: 10.1007/s40123-024-01030-w

Safety, Tolerability, and Short-Term Efficacy of Low-Level Light Therapy for Dry Age-Related Macular Degeneration

EYE-LIGHT® device

590 nm (yellow) and 630 nm (red), in both continuous and pulsed modes



Borrelli E, et al. Ophthalmol Ther. 2024 Nov;13(11):2855-2868.

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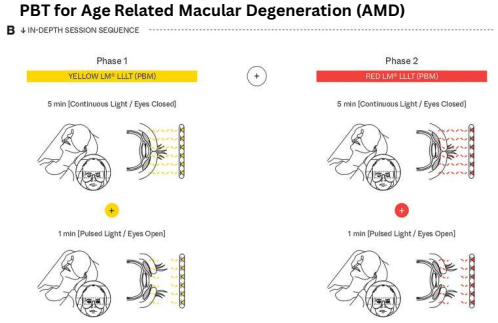
PBT for Age Related Macular Degeneration (AMD)



Borrelli E, et al. Ophthalmol Ther. 2024 Nov;13(11):2855-2868.

49

• Ophthalmol Ther. 2024 Sep 13;13(11):2855-2868. doi: 10.1007/s40123-024-01030-w

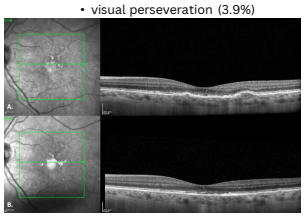
Safety, Tolerability, and Short-Term Efficacy of Low-Level Light Therapy for Dry Age-Related Macular Degeneration

Results at 4 months (n=76)

- gain of five or more letters post-treatment vs sham (20.3% vs. 8.9%) respectively; p = 0.043)
- statistically significant disparity in mean drusen volume changes from baseline

Safety & Tolerability

- No signs of retinal phototoxicity
- warmth (10.5%)
- dry eye like symptoms (7.9%)
- visual perseveration (3.9%)



Borrelli E, et al. Ophthalmol Ther. 2024 Nov;13(11):2855-2868.

50

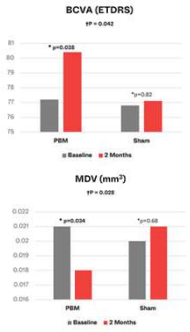
PBT for Age Related Macular Degeneration (AMD)

Article | Published: 19 April 2025

Photobiomodulation-induced choriocapillaris perfusion enhancement and outer retinal remodelling in intermediate age-related macular degeneration: a promising therapeutic approach with short-term results

n=60 8 sessions over 4 weeks

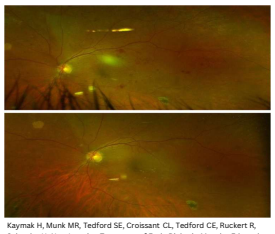
- significant improvements in BCVA (Δ +3.2 ± 1.4 letters, p = 0.042)
- reduction in drusen volume (Δ −0.003 ± 0.001 mm³, p = 0.028)
- decrease in choriocapillaris Flow Deficit % (Δ −3.1 ± 1.4%, p = 0.024)



Viggiano, P., et al. Eye (2025).

51

PBT/ LLLT for Diabetic Macular Edema (DME)



Kaymak H, Munk MR, Tedford SE, Croissant CL, Tedford CE, Ruckert R, Schwahn H. Non-Invasive Treatment of Early Diabetic Macular Edema by Multiwavelength Photobiomodulation with the Valeda Light Delivery System. Clin Ophthalmol. 2023 Nov 22;17:

- Significant reduction in retinal microvascular leakage
  - inner plexiform layer
  - inner nuclear layer
  - outer plexiform layer

Eells et al tested anti-VEGF alone VS anti-VEGF plus PBT. Using 670 nm-light treatment for three consecutive days per week for 8 weeks

- central retinal thickness (CRT) of **−24±5 microns and improvement of 6±5 letters** in the **PBT group**
- anti-VEGF alone =CRT +120 ± 97 microns gain and −3 ± 4 letters

Shen W, et al. Diabetologia. 2020;63(9):1900–1915.
Cheng Y, et al. Diabetes. 2018;67(2):291–298.
Eells J, et al. Poster presented at: 2017 ARVO Annual Meeting; May 7-11, 2017; Baltimore, MD.,

52

Ophthalmol Retina. Author manuscript; available in PMC 2023 Apr 1.
Published in final edited form as:
Ophthalmol Retina. 2022 Apr; 6(4): 298–307.
Published online 2021 Oct 8. doi: 10.1016/j.oret.2021.10.003
PMCID: PMC9011341
NIHMSID: NIHMS1778118
PMID: 34628066

A Randomized Trial of Photobiomodulation Therapy for Center-Involved Diabetic Macular Edema with Good Visual Acuity (Protocol AE)

Judy E. Kim, MD,[1] Adam R. Glassman, MS,[2] Kristin Josic, PhD,[2] Michele Melia, ScM,[2] Lloyd P. Aiello, MD,[3] Carl Baker, MD,[4] Janis T. Eells, PhD,[5] Lee M. Jampol, MD,[6] Timothy S. Kern, PhD,[7] Dennis Marcus, MD,[8] Hani Salehi-Had, MD,[9] Sandeep N. Shah, MD,[10] Daniel F. Martin, MD,[11] Cynthia R. Stockdale, MSPH,[2] and Jennifer K. Sun, MD, MPH[3]

- Participants had CI-DME and visual acuity (VA) 20/25 or better
- 670 nm at a dose of 4.5 J/cm2 - applied for 90 seconds twice daily for 4 months.

safe and well-tolerated, was not found to be effective

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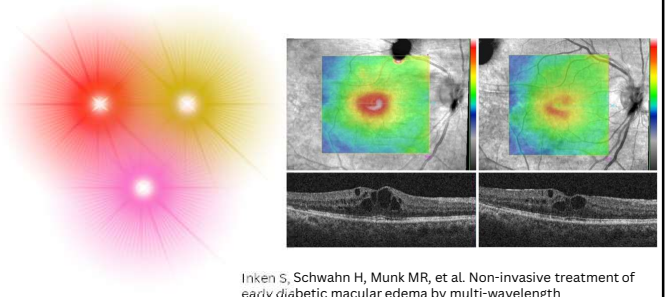


Inken S, Schwahn H, Munk MR, et al. Non-invasive treatment of early diabetic macular edema by multi-wavelength photobiomodulation with the Valeda light delivery system. Invest. Ophthal Vis Sci. 2021;62(8):1066.

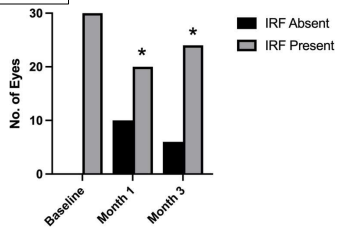
54

Clin Ophthalmol. 2023; 17: 3549–3559.
Published online 2023 Nov 22. doi: 10.2147/OPTH.S415883
PMCID: PMC10676639
PMID: 38026594

Non-Invasive Treatment of Early Diabetic Macular Edema by Multiwavelength Photobiomodulation with the Valeda Light Delivery System

Hakan Kaymak, [1,2] Marion R Munk, [3,4,5] Stephanie E Tedford, [6] Cindy L Croissant, [6] Clark E Tedford, [6] Rene Rucker, [4,*] and Hartmut Schwahn [1]

- Mean CRT at Baseline was 293.6 ± 50.3 µm and significantly reduced at Month 1 to 284.1 ± 39.4 µm
  - IRF was completely resolved in 10/30 eyes (33.3%) following PBM treatment at Month 1 ($p < 0.0001$;
  - At Month 3, 24/30 eyes (80.0%) showed IRF ($p < 0.0001$
  - No phototoxicity at 16 months.



Inken S, Schwahn H, Munk MR, et al. Invest. Ophthal Vis Sci. 2021;62(8):1066.

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PBT/ LLLT for Ocular Surface Disease

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Intense Pulsed Light (IPL) VS PBMT / LLLT

- high-intensity (500nm-1200nm), **polychromatic** light
- obliteration of atypical erythematous blood vessels
- decrease in Demodex & bacterial load
- heating of the meibomian glands and liquefaction of the meibum
- Promotes cell proliferation, enhancing collagen synthesis, increasing local blood flow, and activating immunologic cells, reducing pro-inflammatory cytokines

- low-power, high-fluence, and **quasimonochromatic** light
- promotes cellular repair, tissue regeneration, reduction of pain, inflammation, and prevention of tissue damage
- May decrease neutrophils and inflammatory cytokines leading to an increase in basal tear secretion
  - May improve corneal surface healing (in mice)

Castro C, et al. Cureus. 2023 Jul 5;15(7):e41386.
Goo H, et al. Med Lasers. 2019;8:50–58.

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PMBT / LLLT FOR DRY EYE
STAND ALONE

Ophthalmic Physiol Opt. 2024 Nov;44(7):1464-1471. doi: 10.1111/opo.13371. Epub 2024 Aug 2.

Effect of low-level light therapy in individuals with dry eye disease

Antoinette Anhut [1], Alexander W Schill [1], Rachel Redfern [1], Eric R Ritchey [1]

Methods: 30 Participants with mild to moderate dry eye were recruited. 3 visits were 7 (±3) days apart and all participants received 633 nm LLLT (eye-light®) for 15 min at each visit.

- Non-invasive Keratographic Break-Up Time (NIKBUT) – ($p < 0.05$).
- Tear Meniscus Height (TMH) – $p < 0.05$
- Tear film lipid layer thickness – increased by 12.9 nm $p < 0.05$
- Eyelid temperature – increased by 7.0°C for both upper and lower eyelids $p < 0.05$
- OSDI decreased by 10.2 points $p < 0.05$
- Meibum quality score – showed significant improvement ($p < 0.05$).

633nm
103 mW/cm2
total fluence of 110 j/cm2 is applied

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LLLT FOR DRY EYE
Pre/Post Cataract Surgery

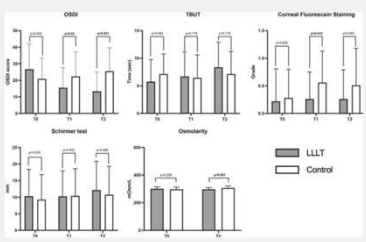
633nm
103 mW/cm2
total fluence of 110 j/cm2 is applied

Ophthalmol Ther. 2025 Aug 24;14(10):2557-2569. doi: 10.1007/s40123-025-01228-6

Effect of Low-Level Light Therapy on Ocular Surface Parameters in Patients Undergoing Cataract Surgery: A Prospective Double-Masked Randomized Controlled Clinical Trial

Mihaela-Madalina Timofte-Zorila [1,2], Filippo Lisi [3], Nicoleta Vlas [1,2], Mario Troisi [4], Gamze Ozkan [5], Mariana Pavel-Tanasa [6], Simiana Istrate [7], Cristina Preda [8], Giulia Coco [9], Assem Namradbeyova [10], Giuseppe Giannaccare [1,2], Daniel-Constantin Branisteanu [1,2]

Methods: 98 patients randomized to LLLT (50 patients) or sham treatment (48 patients)
- 15 min tx 1 week b4 surgery & 1 week post



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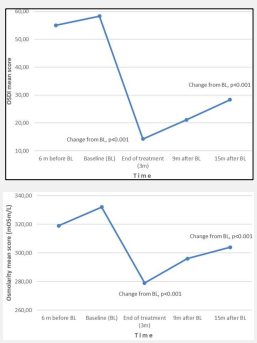
PMBT / LLLT FOR DRY EYE
PMBT/LLLT & IPL

N= 156:
Treatment:
IPL - Used Eye-light® device.
- 4 sessions over 3 months
  - (weeks 0, 1, 4 and 12)

LLLT (completed immediately after IPL)
- 633 ± 10 nm, 103 mW/cm2.
- 15 minutes of treatment,
- total fluence of 110 j/cm2

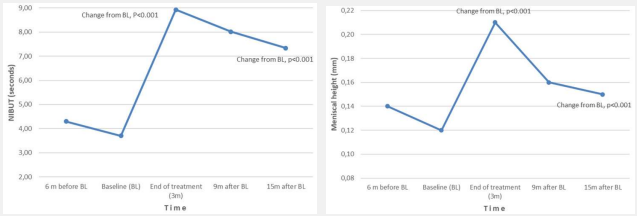


Pérez-Silguero MA, et al. Clin Ophthalmol. 2021 May 21;15:2133-2140

60

PMBT / LLLT FOR DRY EYE

PMBT/LLL & IPL



Pérez-Silguero MA, et al. Clin Ophthalmol. 2021 May 21;15:2133-2140

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PMBT / LLLT FOR DRY EYE

PMBT/LLLT **VS** IPL

N=40 patients with MGD
randomized to receive either LLLT or IPL

Randomized Controlled Trial > Cornea. 2023 Feb 1;42(2):141-144.
doi: 10.1097/ICO.0000000000002997. Epub 2022 Feb 2.

Low-Level Light Therapy Versus Intense Pulsed Light for the Treatment of Meibomian Gland Dysfunction: Preliminary Results From a Prospective Randomized Comparative Study

Giuseppe Giannaccare [1], Marco Pellegrini [2 3 4], Giovanna Carnovale Scalzo [1], Massimiliano Borselli [1], Domenico Ceravolo [1], Vincenzo Scorcia [1]

Summary

- IPL alone is effective at improving symptoms (OSDI), and reduces corneal staining.
- IPL + LLLT leads to greater and **more sustained improvement**, especially in
  - lipid layer thickness
  - basal tear flow
  - symptom scores over six months.
- LLLT may provide added benefits by **directly stimulating the lacrimal gland** and eyelid tissues, possibly explaining the longer-lasting effects.

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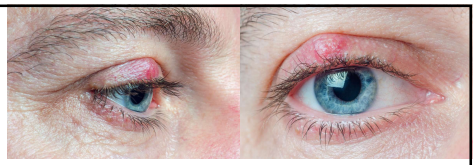
PBT for Chalazion



Epi-C mask used on 26 eyes with recalcitrant chalazion

Single 15 minute LLLT treatment = resolution in 46% of eyes within 1 month (with 100mg oral doxy coverage)

Resolution in 92% of eyes with 2 treatments

Stonecipher K, Potvin R. Low level light therapy for the treatment of recalcitrant chalazia: a sample case summary. Clin Ophthalmol. 2019 Sep 5;13:1727-1733.

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Where Does Red Light/ LLLT fit in?

- Safe for all skin types
- Prolonged benefits for OSD
- More affordable
  - ~100-150 USD/tx
    - vs ~400USD/tx with IPL
- Comfortable/Relaxing (no zap/pian)
- Easily operated by clinical staff
- Benefits for ocular adnexa
  - Chalazia
    - Hordeolum?
  - Fine lines/wrinkles?
- Benefits pre/post Sx tx

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MYOPIA

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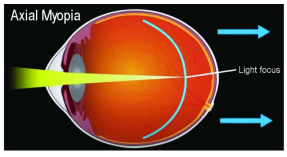
RLRL for Myopia

Repeated low-level red light (RLRL) treatment might improve blood flow and metabolism of the fundus
Reducing scleral hypoxia and restoration of scleral collagen levels

Red light treatment might signal
retinal > choroid > scleral communication

via **molecular signaling** of

- dopamine
- acetylcholine
- nitric oxide



Xiong R, et al. Ophthalmology. 2023;130(3):286–296.
Nickla DL, et al. Prog Retin Eye Res. 2010 Mar;29(2):144-68. Epub 2009 Dec 29.

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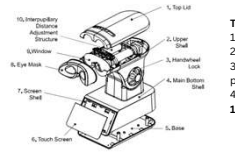

The main technical indicators of the device are as follows:
1. Input power ≤ 100 VA; input voltage: AC10 V-240 V, 50 Hz/60 Hz;
2. Wavelength: **650 nm ± 10 nm;**
3. **Laser** spot diameter: 7 mm ± 3 mm, laser spot diameter at the observation port: 10 mm ± 2 mm;
4. Output power: **2.0 mW ± 0.5 mW, output power at a distance of 100 mm: 1.07 - 1.42mW.**

Photo credit: Eyerising International

Considering light attenuation between the LEDs and the eye, as well as pupillary diameter, this device is expected to provide light at a power of 0.28 + 0.10 mW at the pupil,

Jiang Y, Zhu Z, Tan X, Kong X, Zhong H, Zhang J, Xiong R, Yuan Y, Zeng J, Morgan IG, He M. Effect of Repeated Low-Level Red-Light Therapy for Myopia Control in Children: A Multicenter Randomized Controlled Trial. Ophthalmology. 2022 May;129(5):509-519

67

Randomized Controlled Trial > Ophthalmology. 2022 May;129(5):509-519.
doi: 10.1016/j.ophtha.2021.11.023. Epub 2021 Dec 1.

Effect of Repeated Low-Level Red-Light Therapy for Myopia Control in Children: A Multicenter Randomized Controlled Trial

Yu Jiang [1], Zhuoting Zhu [1], Xingping Tan [2], Xiangbin Kong [3], Hui Zhong [4], Jian Zhang [1], Ruilin Xiong [1], Yixiong Yuan [1], Junwen Zeng [5], Ian G Morgan [6], Mingguang He [7]

- 264 children, ages 8 to 13 years with myopia
- cycloplegic spherical equivalent refraction (SER)
  - of -1.00 to -5.00 diopters (D)
  - astigmatism of 2.50 D or less
  - anisometropia of 1.50 D or less

Jiang Y, Zhu Z, Tan X, Kong X, Zhong H, Zhang J, Xiong R, Yuan Y, Zeng J, Morgan IG, He M. Effect of Repeated Low-Level Red-Light Therapy for Myopia Control in Children: A Multicenter Randomized Controlled Trial. Ophthalmology. 2022 May;129(5):509-519.

68

Randomized Controlled Trial > Ophthalmology. 2022 May;129(5):509-519.
doi: 10.1016/j.ophtha.2021.11.023. Epub 2021 Dec 1.

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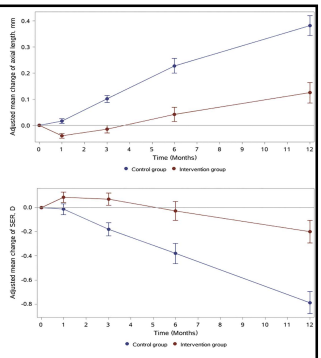


- **69.4% reduction in axial length** progression
- **76.6% reduction in myopia progression**

VS wearing spectacles only for 12 months

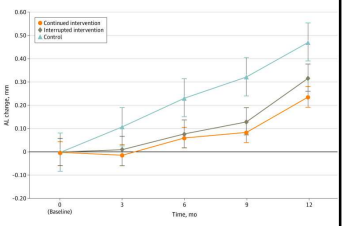
Jiang Y, et al. Ophthalmology. 2022 May;129(5):509-519.

69

Randomized Controlled Trial > JAMA Netw Open. 2023 Apr 3;6(4):e239612.
doi: 10.1001/jamanetworkopen.2023.9612.

Effect of Repeated Low-level Red Light on Myopia Prevention Among Children in China With Premyopia: A Randomized Clinical Trial

Xiangui He [1,2], Jingjing Wang [1], Zhuoting Zhu [3,4,5], Kaidi Xiang [2], Xinzi Zhang [2], Bo Zhang [1], Jun Chen [1], Jinluxing Yang [1], Linlin Du [1], Chunjin Niu [6], Mei Leng [7], Jiannan Huang [1], Kun Liu [2], Haidong Zou [1,2], Mingguang He [4,8,9], Xun Xu [1,2]



278 children with **premyopia**
- (defined as cycloplegic spherical equivalence refraction [SER] of −0.50 to 0.50 diopter [D])

RLRL therapy BID, 3 min sessions, 5 days per week

54.1% reduction in incident myopia within 12 months among children with premyopia

He X, Wang J, Zhu Z, et al. Effect of Repeated Low-level Red Light on Myopia Prevention Among Children in China With Premyopia: A Randomized Clinical Trial. JAMA Netw Open. 2023;6(4):e239612.

70

BMC Ophthalmol. 2024; 24: 78.
Published online 2024 Feb 20. doi: 10.1186/s12886-024-03337-5
PMCID: PMC10877869
PMID: 38378527

Efficacy of Repeated Low-Level Red Light (RLRL) therapy on myopia outcomes in children: a systematic review and meta-analysis

Mohamed Ashraf Youssef, Ahmed Ragab Shehata, Ahmed Moataz Adly, Mohamed Ragab Ahmed, Hoda Fahmy Abo-Bakr, Rehab Mahmoud Fawzy, and Ahmed Taha Gouda

5 RCTs with 833 patients total

650 nm RLRL for myopia control in the short term of 3, 6, and 12 months follow up

3 months	6 months	12 months
AL : MD -0.16mm	AL : MD -0.21mm	AL : MD **-0.31mm**
SER : MD 0.33D	SER : MD 0.46D	SER : MD **0.63D**
MCT: MD 34.65μm	MCT: MD 34.75μm	

Youssef MA, et al.. BMC Ophthalmol. 2024 Feb 20;24(1):78.

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But is it Safe?

72

> Ophthalmic Physiol Opt. 2024 Mar;44(2):241-248. doi: 10.1111/opo.13272. Epub 2024 Jan 5.

Red light instruments for myopia exceed safety limits

Lisa A Ostrin [1], Alexander W Schill [1]

- Two devices shown to approach or exceed the maximum permissible exposure, depending on pupil size.
- The three-minute protocol may put the retina at risk for photochemical and thermal damage.
- Clinicians should be cautious with the use of low level red light therapy for myopia control in children until safety standards can be confirmed.

Sky-n1201a
Future Vision

Tang J, et al. Am J Ophthalmol. 2023 Aug;252:153-163.
Eyerising International refutes 'inaccurate claims' in University of Houston red light myopia study
https://www.insightnews.com.au/eyerising-international-refutes-inaccurate-claims-in-university-of-houston-red-light-myopia-study/

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> JAMA Ophthalmol. 2023 Jul 1;141(7):693-695. doi: 10.1001/jamaophthalmol.2023.1548.

Retinal Damage After Repeated Low-level Red-Light Laser Exposure

Huanyu Liu [1], Yuan Yang [1], Jingli Guo [1], Jie Peng [1], Peiquan Zhao [1]

bilateral vision loss lasting 2 weeks
after 5-month application of RLRL (Eyerising)

OCT identified bilateral foveal ellipsoid zone disruption and interdigitation zone discontinuity

Symptoms:
complaint of abnormally bright light and prolonged afterimages
Reduced vision to 20/30 OU
Improved to 20/25 OU after 3 months

Liu H, Yang Y, Guo J, Peng J, Zhao P. Retinal Damage After Repeated Low-level Red-Light Laser Exposure. JAMA Ophthalmol. 2023 Jul 1;141(7):693-695.

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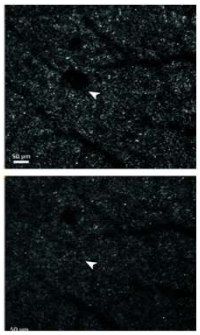


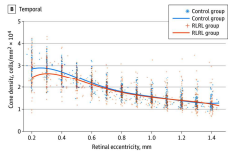
> JAMA Ophthalmol. 2025 Apr 24:e250835. Online ahead of print. doi: 10.1001/jamaophthalmol.2025.0835

Cone Density Changes After Repeated Low-Level Red Light Treatment in Children With Myopia

Xinyi Liao [1,2,3], Jifeng Yu [4], Yuzhuo Fan [1,2,3,5], Yiyuan Zhang [1,2,3], Yao Li [1,2,3,5], Xuewei Li [1,2,3,5], Honexin Song [6,7,8], Kai Wang [1,2,3,5,6]

99 children with myopia

- RLRL users showed decreased cone density within 0.5-mm eccentricity from the foveal center



Liao X, Yu J, Fan Y, Zhang Y, Li Y, Li X, Song H, Wang K. Cone Density Changes After Repeated Low-Level Red Light Treatment in Children With Myopia. JAMA Ophthalmol. 2025 Apr 24:e250835.

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In office VS **OTC devices**

76

In office VS **OTC devices**

- Quality Manufacturing
  - Accurate power/wavelength
- Based on Clinical Studies?
- Safety / Efficiency

- Questionable manufacturing
- No clinical studies / minimal reports
- Safe?
- Efficient?

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Ideatherapy Hotselling Portable TL09-A5 630nm 710nm 850nm 900nm 5 Spectrum High Power Rechargeable Battery Led Red Torch Light

1 - 99 pieces	100 - 499 pieces	>= 500 pieces
$32.00	$30.00	$28.00

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- Red Light Therapy / LLLT is very promising for eye health
  - Macular Degeneration
  - Dry Eye
- BUT…
  - Concerns about safety
    - especially with some devices
- Full understanding of tissue specific light dosages are not established
  - For now – stick to published protocols set by manufacturers
- Be weary of OTC devices not made for the eyes
  - Follow manufacturer guidelines & protocols

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Thank You!!

DOCTOR EYE HEALTH

www.DoctorEyeHealth.com

Hello@DoctorEyeHealth.com

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