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Myopia And Light

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Disclaimers

- OPTOMETRIC PRACTICE
- NEUROLENS ADVISORY BOARD
- VT RETREAT SEMINARS
- AUTHOR OF *VISUAL SECRETS FOR SCHOOL SUCCESS*
- ONLINE COURSES FOR VISION
- VP OF THE COLLEGE OF SYNTONIC OPTOMETRY
- MEMBER AOA INFANTSEE COMMITTEE & OOA OPAC COMMITTEE

Epidemiology of Myopia

Today —— 22.9% Incidence Worldwide

Epidemiology of Myopia

By 2050

49.8% Incidence Worldwide

5 Billion People

1 Billion will have High Myopia

Epidemiology of Myopia

According to the International Commission on Illumination and the Comité International des Poids et Mesures,

"The lighting environment of modern society can be extremely unnatural: We may be suffering from the hazard of arrhythmic blue light but also from violet light deprivation."

Facts About Myopia

Risk Factor

Urban versus Rural Living
2.6 > chance of developing myopia

Facts About Myopia

Risk Factor

Genetics
Greatest chance if both parents are myopic

Facts About Myopia

Risk Factor

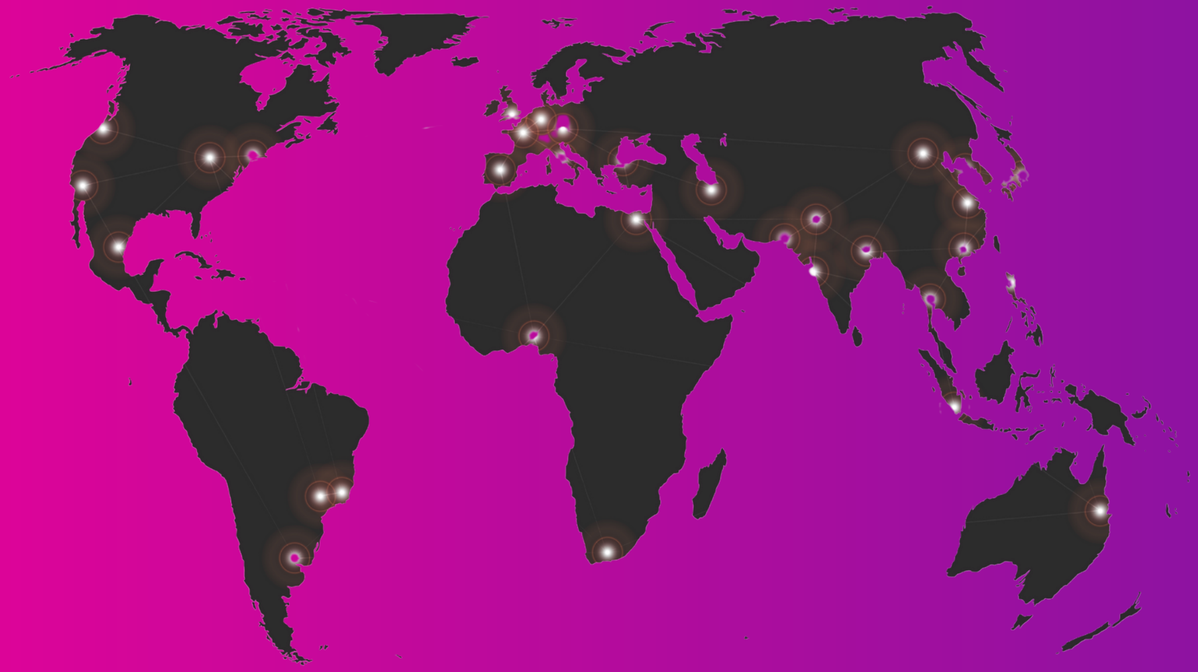
Less time outdoors. For every hour outside, progression recedes by 2%.

Facts About Myopia

Risk Factor

Duration of daily sunlight exposure

Facts About Myopia



Risk Factor

Asia has a higher incidence than Europe and North America.
Africa has the lowest rates.

Facts About Myopia

Risk Factor

Years of education correlate to greater % of myopia.

Facts About Myopia

Risk Factor

Duration of digital device use

Facts About Myopia

Risk Factor

Working Distance

Facts About Myopia

Risk Factor

Circadium Rythm Disruption

Facts About Myopia

Risk Factor

Time spent sleeping

Facts About Myopia

Risk Factor

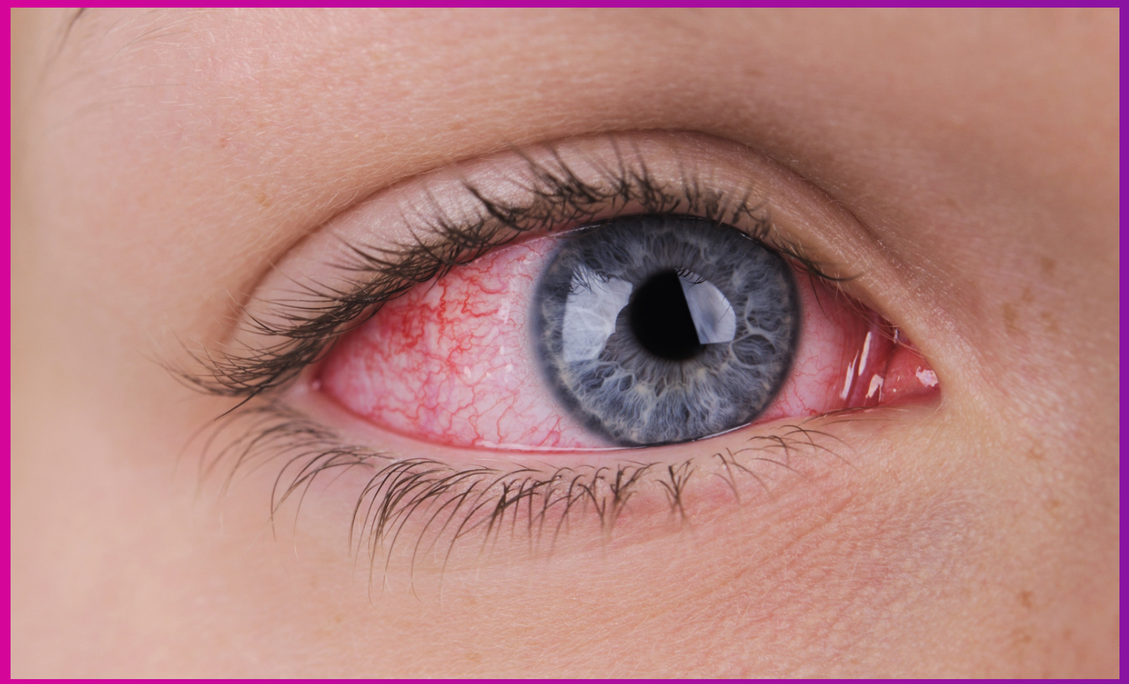
Club activity

Facts About Myopia

Risk Factor

IOP

Facts About Myopia



Risk Factor

Dry Eye

Randomized Trial

Effect of Repeated Low-Level Red-Light Therapy for Myopia Control in Children: A Prospective, randomized, double-masked, controlled clinical trial.

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

https://www.aaojournal.org/article/S0161-6420%2822%2900669-8/fulltext#back-bib10

Randomized Trial

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

Significantly slowed axial length progression by 70%.

70% of participants experienced .05mm axial length shortening.

Randomized Trial

Red Light wavelength 650nm

Commonly used in China for amblyopia treatment

Desktop light therapy device

Illumination level=1600 Lux

Randomized Trial

Red Light Study

3 minute session

2x / day with 4 hr. interval

5 days per week

Red Light Therapy

He, et. al., found...

Repeated low-level red light therapy (650 nm, 1600 lx) could effectively improve the progression of myopia in children aged 8–13 years.

Red Light Therapy

The hypothesis:

Red affects photobiomodulation of far red/near-infrared light, which includes the wavelength range of 630–1000 nm.

Red Light Therapy

Far red/near-infrared light uses:

Increasing cerebral blood flow
Augmenting brain energy metabolism
Improving the antioxidant capacity
Promoting cell growth
Improving the reparative ability of cells

Red Light Therapy

Far red/near-infrared light uses:

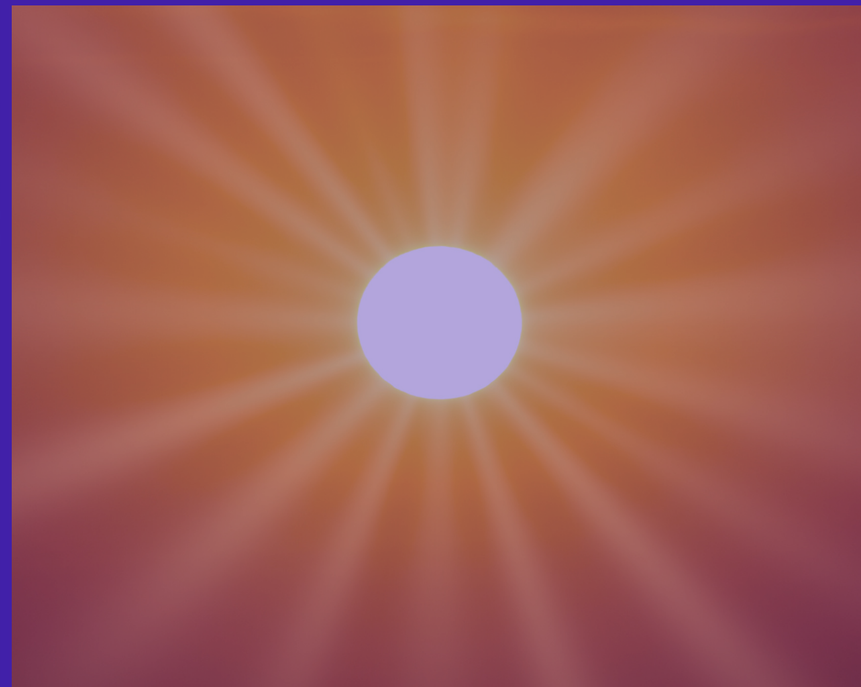
Red light therapy was effective at any age

https://www.karger.com/Article/FullText/529819

Light Influences Neurotransmitter

Light stimulates the release of dopamine in the retina.

Retinal dopamine is produced on a diurnal cycle. It tells the eye to switch from rod-based night vision to cone-based daytime vision.



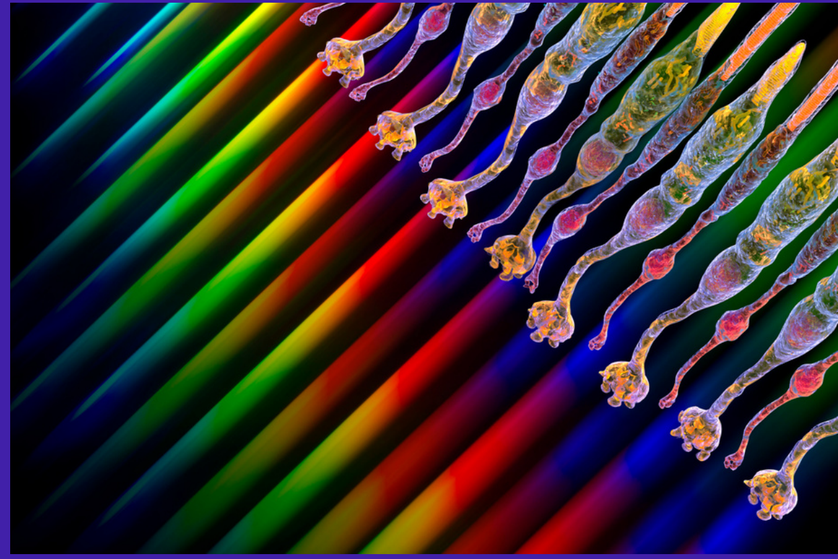
Indoor Lighting

DISRUPTS THE CIRCADIUM RHYTHM IMPORTANT FOR DOPAMINE RELEASE

Outdoor Lighting

STIMULATES THE CORRECT RELEASE OF DOPAMINE IMPORTANT FOR REDUCING RISK OF MYOPIA

6 OPSINS



LIGHT SENSITIVE PROTEINS
HTTPS://EN.WIKIPEDIA.ORG/WIKI/OPSIN

RHODOPSIN	L CONE	M CONE	S CONE	MELONOPSIN	NEUROPSIN
OPN2 (Rods)	OPN1LW	OPN1MW	OPN1SW	OPN 4	OPN 5
505 nm	557 nm	527 nm	420 nm	480 nm	380 nm
blue-green	yellow	green	violet	sky blue	ultraviolet

Violet Light has a protective effect on myopia development in mice, chicks, and humans.

Ultraviolet (UV)-protective coating on windows blocks all light below 400 nm, almost no VL is emitted by artificial light sources.
It is hypothesized that the lack of VL in modern society is one reason for the myopia increase.

Light And Myopia: Taking Action

Get Outside !!!

TIME OUTSIDE	LIGHT LEVEL	NEAR WORK
3 hours/day	10,000 LUX	< 18 min/day

Violet Light

Violet Light has a protective effect on myopia development in mice, chicks, and humans.

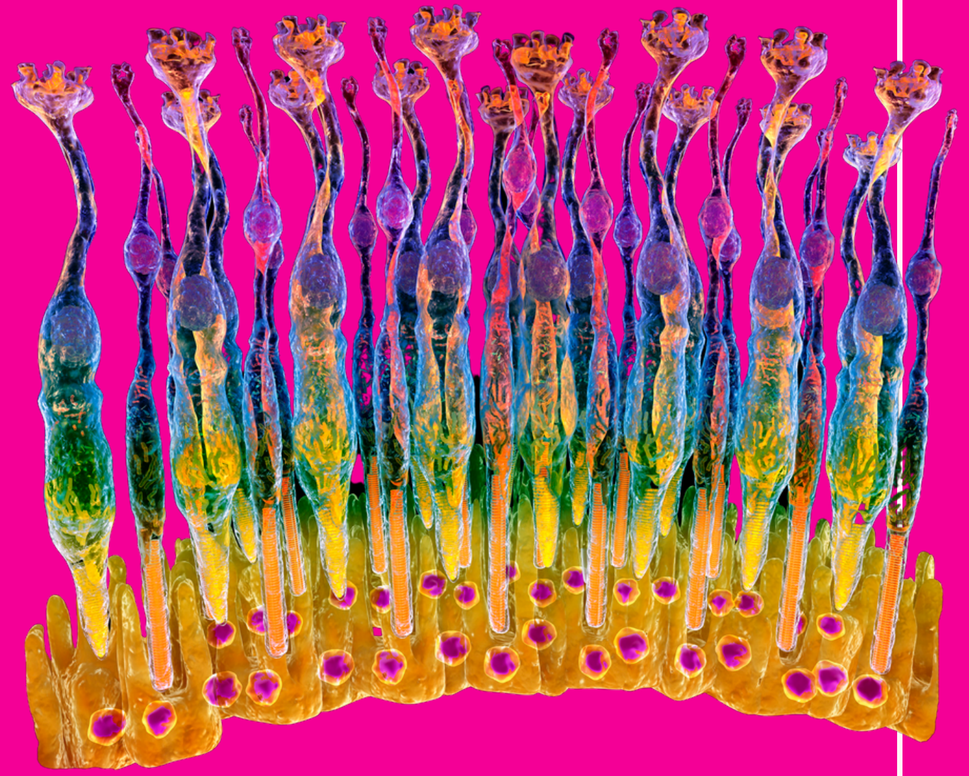
According to Commission Internationale de l’Eclairage (International Commission on Illumination)

Violet Light

- Violet light is abundant outdoors but mostly absent indoors
- It’s not emitted by artificial lights
- Ultraviolet protective coatings on windows and eyeglasses also filter out violet light wavelengths

Violet Light

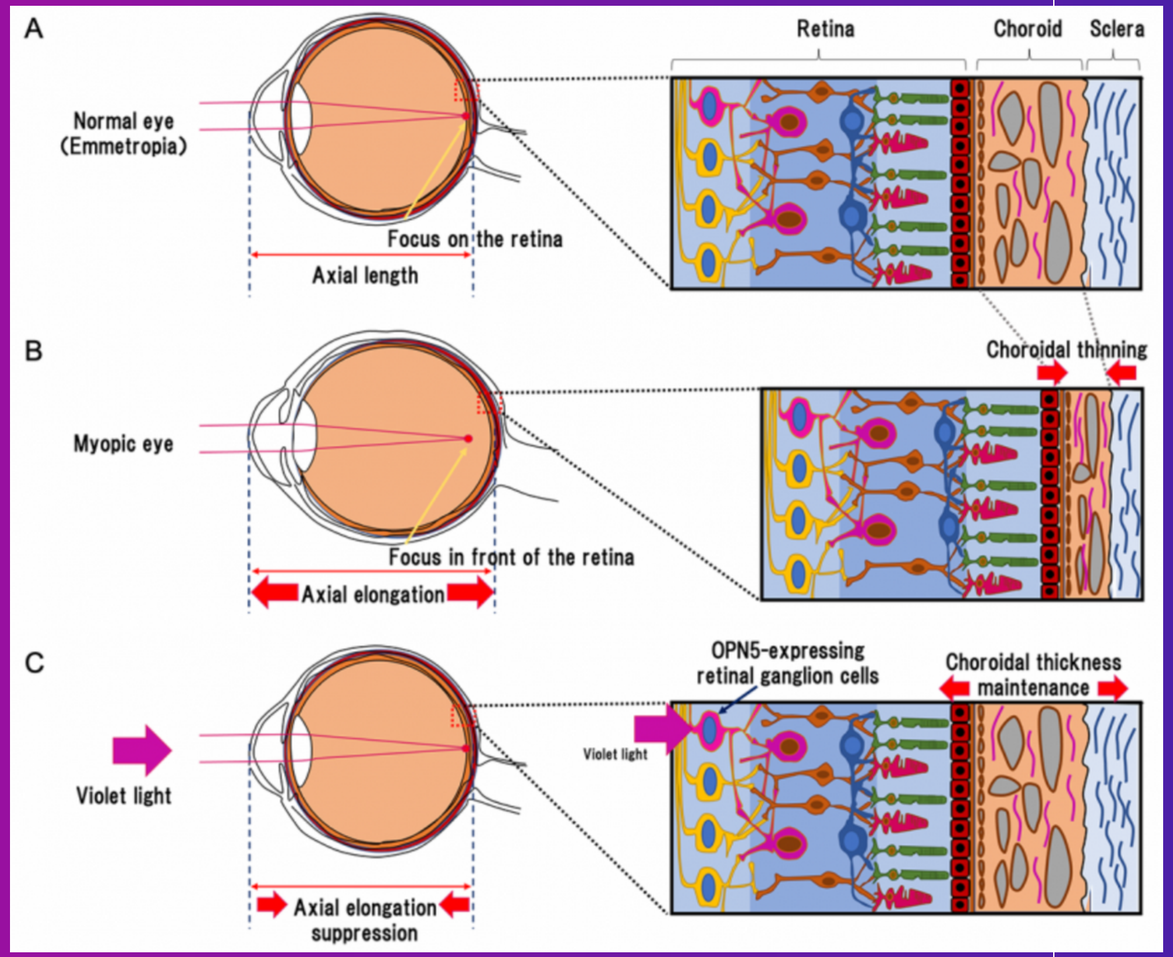
The protective effects of violet light depend on the **OPN5** photoreceptor called neuropsin.



Violet light interacts with the photoreceptor protein OPN5 to prevent progression of myopia.

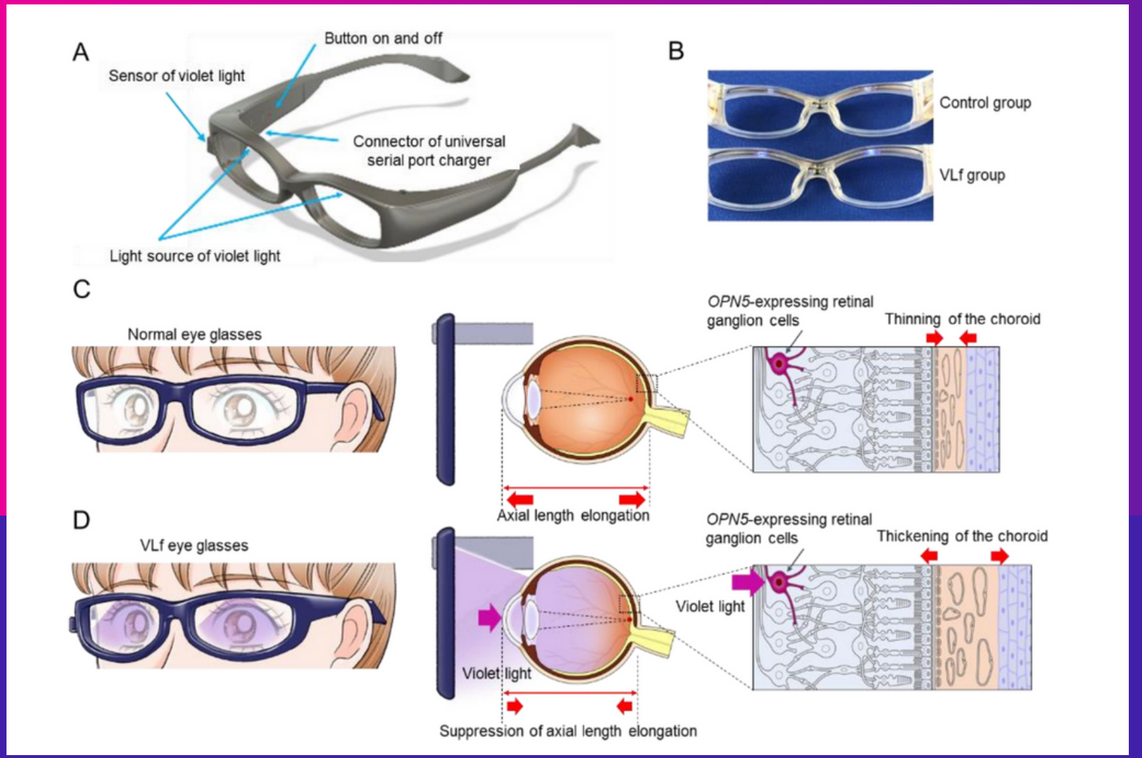
- A: Normal eye.
- B: Myopic eye with elongation between the cornea and the retina and thinning of the choroid.
- C: Violet suppressesing elongation and thinning of the choroid.

(Illustration: Toshihide Kurihara)



35 Subjects

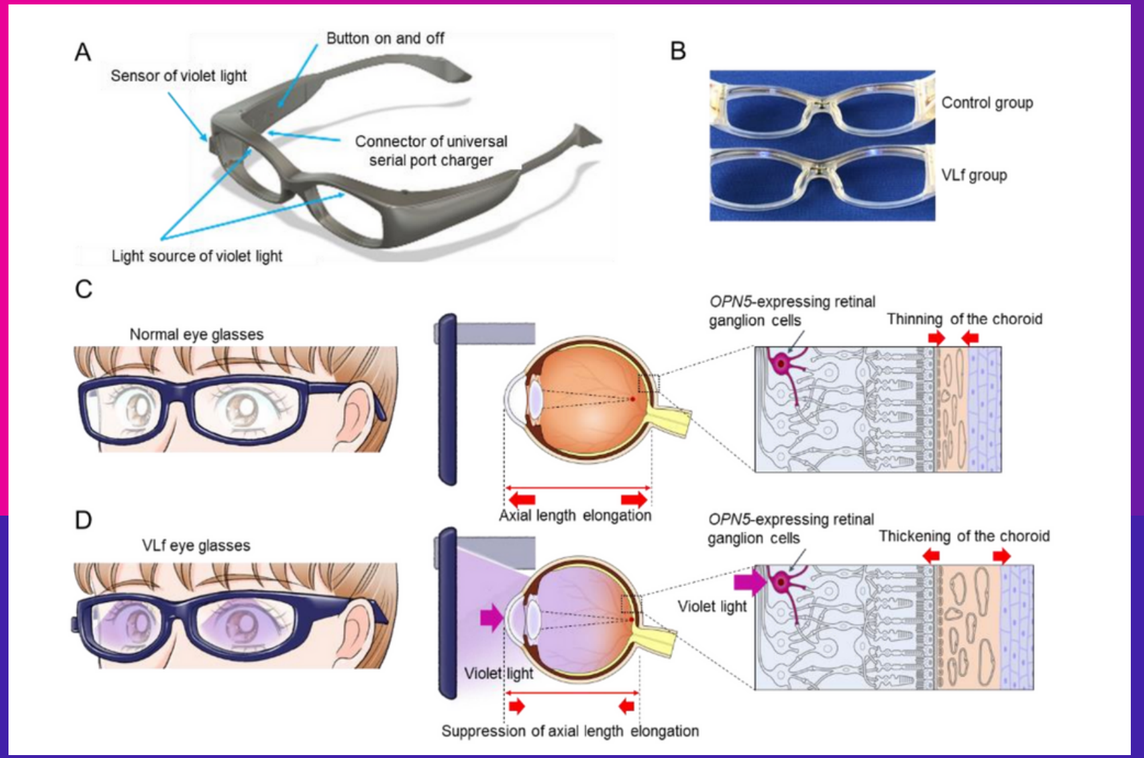
6-MONTH RANDOMIZED, DOUBLE-MASKED, PILOT CLINICAL TRIAL



- 310 nm
- 3 hours daily
- Axial length change noted at 6 months
- file:///Users/brendamontecalvo/Downloads/jcm-11-06000-v2.pdf

35 Subjects

SUPPRESSION RATES



- Axial elongation: 40.0%
- Myopia progression (cycloplegic subjective refraction): 72.9%
- Choroidal thickening: 80.0%

OPN5 Photoreceptor Protein

Prevents lens defocus

OPN5: Multiple Studies

GRANTS:

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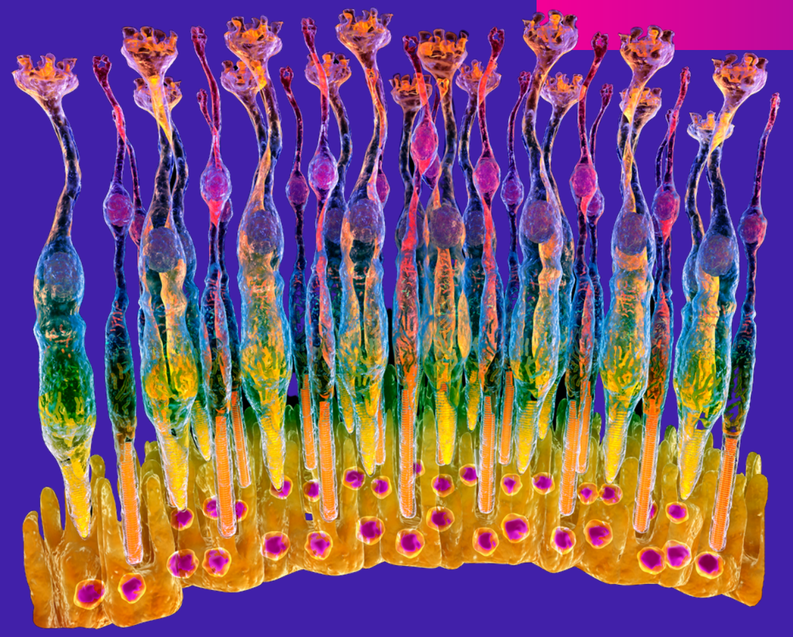
2. Tsubota Laboratory, Inc.; the United States National Eye Institute (grant Nos. EY016435, EY027077, EY027711
3. U.S. Department of Veterans Affairs (grant No. IK6 RX003134; and the Emma and Irving Goldman Scholar Endowed Chair at Cincinnati Children’s Hospital Medical Center.

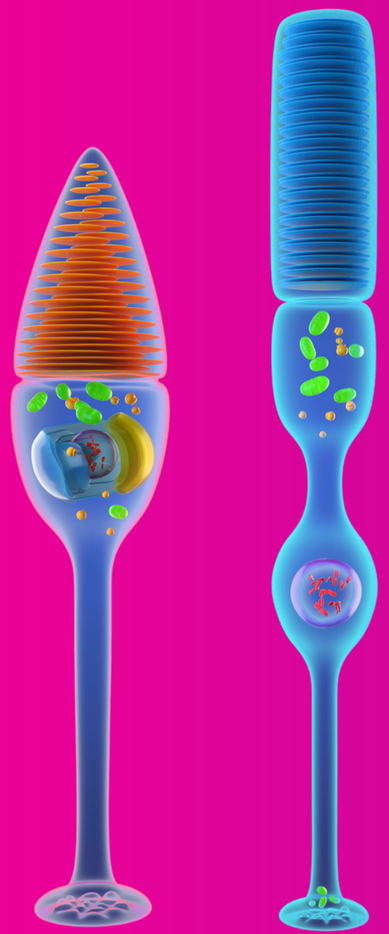
Violet Light Transmission is Related to Myopia Progression in Adult High Myopia,
Hidemasa Torii, Nature 06 November 2017



Violet Light has a protective effect on myopia development in mice, chicks, and humans.

- The absence of retinal OPN5 prevents thickening of the choroid.
- OPN5 retinal ganglion cell (RGC) plays a key role in emmetropization.
- Thus VL has a protective effect on myopia development.

Study Comparing Wavelength Specificity of Violet Light



- Blue (440 to 480 nm)
- Green (500 to 540 nm)
- Red (610 to 650 nm)

VL was shown to SUPPRESS MYOPIA PROGRESSION in both refraction and AXIAL LENGTH in mice.

- Neither red light nor green light produced significant suppression of refractive change or axial length.
- Blue light produced a modest suppression of refractive change and axial length.
- VL produced the most robust response and significantly suppressed refractive and AL change compared with other wavelengths.

VL was shown to suppress myopia progression in both refraction and AL in mice.

- The VL wavelength was very narrow and emitted almost no light that might stimulate ipRGCs.
- ipRCGs are unlikely to play an important role in VL–OPN5 pathway.

Rhesus Monkeys
Tree Shrews

Red light developed hyperopic responses

Effect of Violet Light-Transmitting Eyeglasses on Axial Elongation in Myopic Children: A Randomized Controlled Trial, Kiwako Mori, Hidemasa Torii, Yutaka Hara, Michiko Hara, Erisa Yotsukura Journal of Clinical medicine

Chickens, Mice,
Fish, Guinea Pigs

Violet light reduced axial length

Dim Light

DIM LIGHT EXPOSURE AND MYOPIA IN CHILDREN. INVEST OPHTHALMOL VIS SCI. 2018;59:4804–11. LANDIS EG,YANG V,BROWN DM,PARDUE MT,READ SA.

Dim light exposure may be another important strategy for preventing myopia by rod pathways other than cone cells, and that a broad range of light levels are essential in refractive development.

Dim Light

DIM LIGHT EXPOSURE AND MYOPIA IN CHILDREN. INVEST OPHTHALMOL VIS SCI. 2018;59:4804–11. LANDIS EG,YANG V,BROWN DM,PARDUE MT,READ SA.

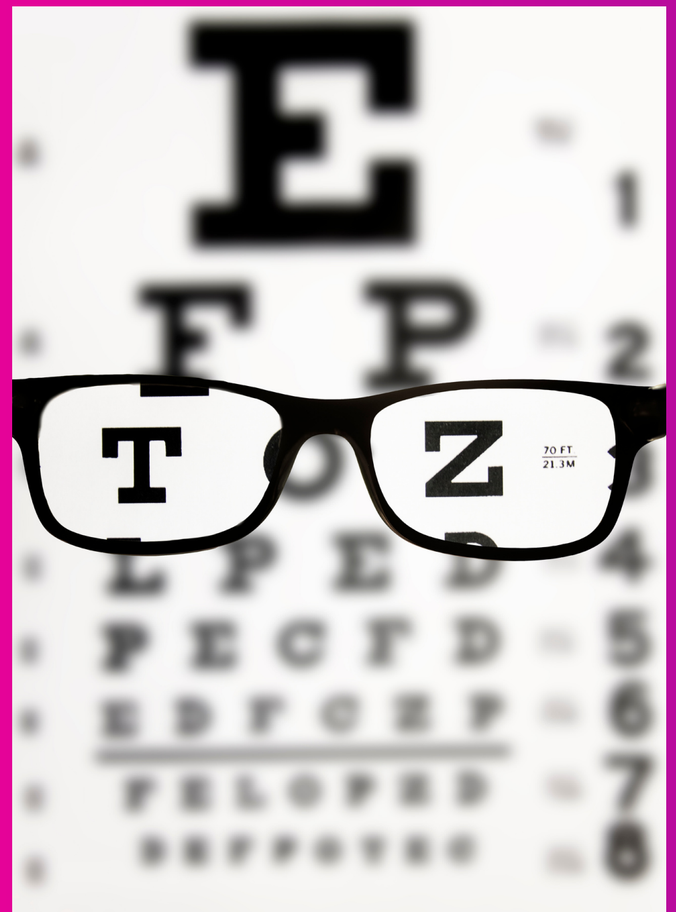
Light intensity, as a protective factor, is negatively correlated with the development of myopia.

Violet Light

DIM LIGHT EXPOSURE AND MYOPIA IN CHILDREN. INVEST OPHTHALMOL VIS SCI. 2018;59:4804-11. LANDIS EG,YANG V,BROWN DM,PARDUE MT,READ SA.

Extremely low frequency electromagnetic fields (a form of electromagnetic waves with a long wavelength), could inhibit the expression of type I collagen in human fetal scleral fibroblasts and play an important role in scleral remodeling, which may accelerate the development of myopia.

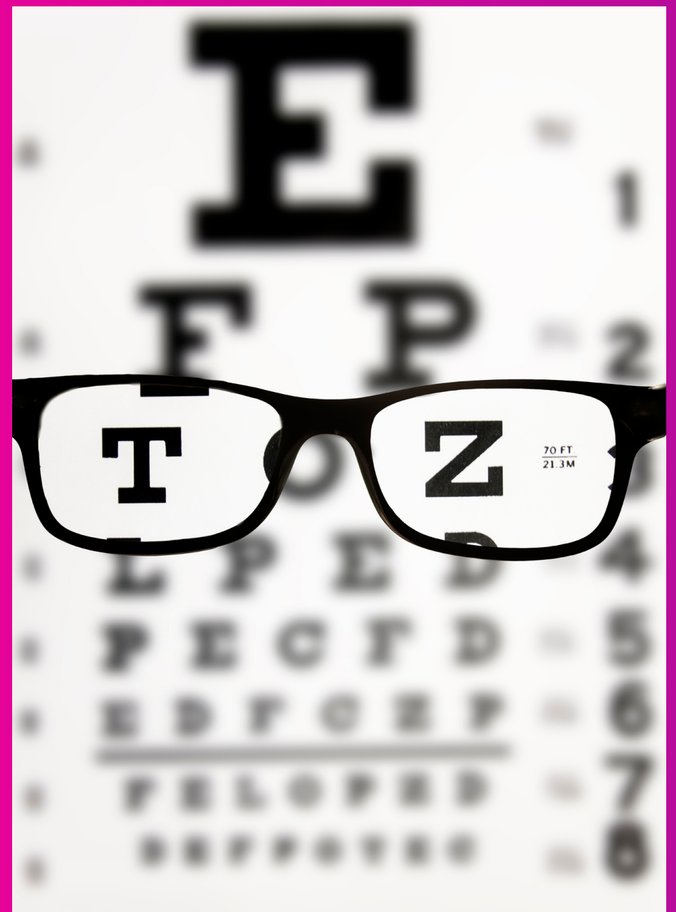
Case: Syntonogram
Vol. 18 No. 2 March-April 1955



17 yo needs 20/20 visual acuity to achieve a 4-year scholarship with the Naval Reserve Officer Corps.
R: 20/50
L: 20/30

Deadline was 4 months.

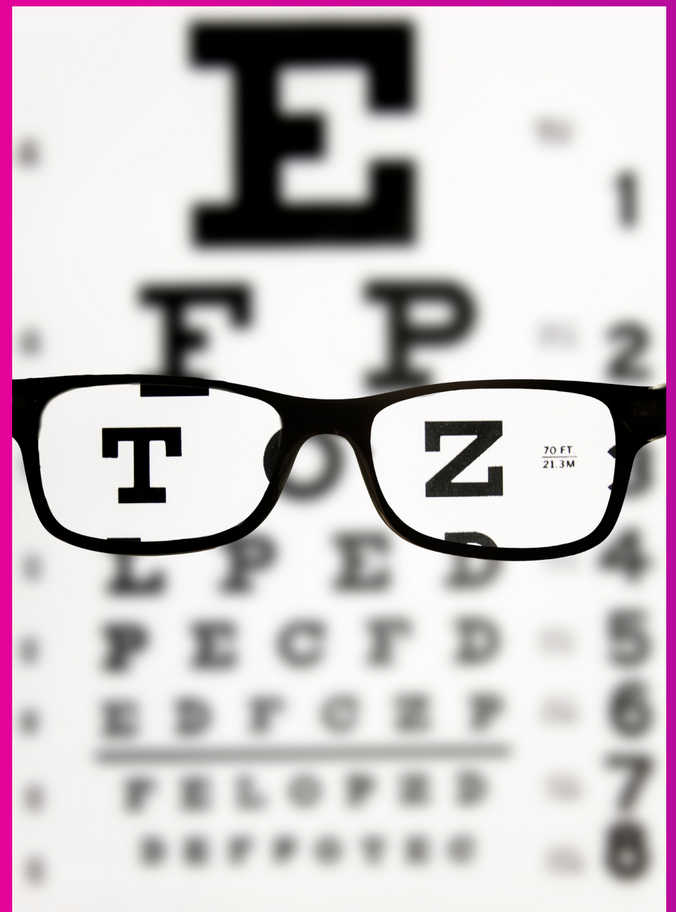
Case 1955



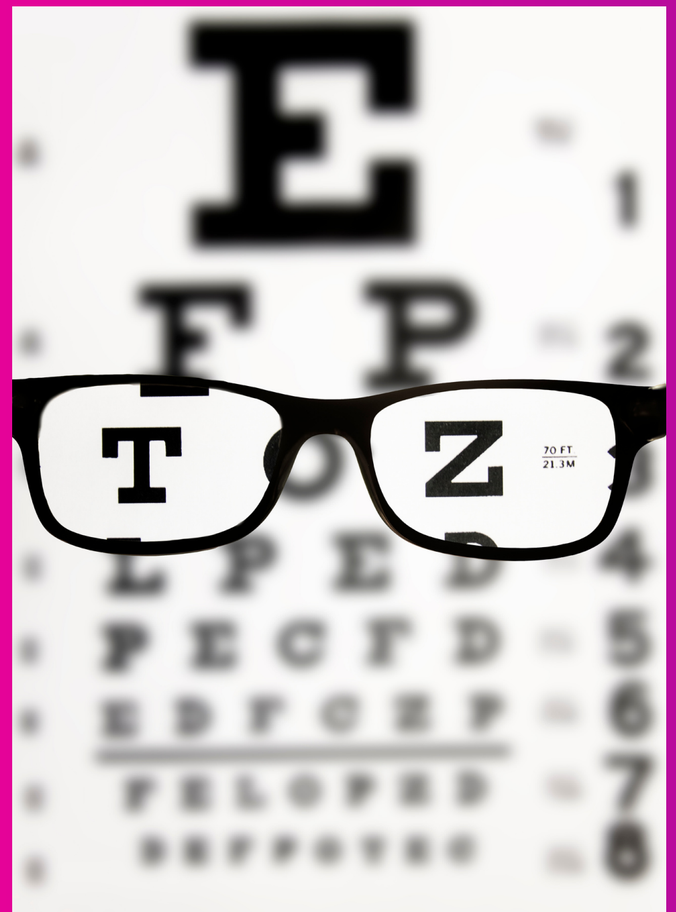
Rx +1.25 DS for near work
20 sessions of Syntonic applications.
All frequencies were flashed.

Achieved 20/20 in 2 months with each eye.

Case 1955



N/L 3,
Alpha Delta 5,
Mu Delta 5,
Alpha Theta S 8,
Mu Theta S
(last two frequencies on R. only)
Alternate with N/L 3, (Flash all).



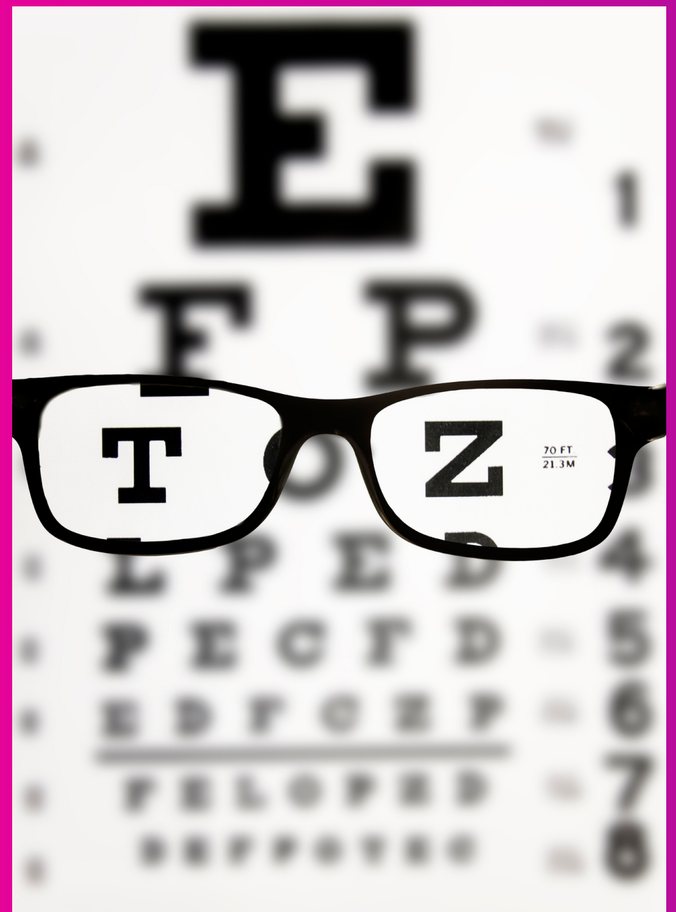
Case: Gabe
Early Myopic Shift

15yo

Subjective: OD -0.50 DS, OS -0.25 DS

Esophoria

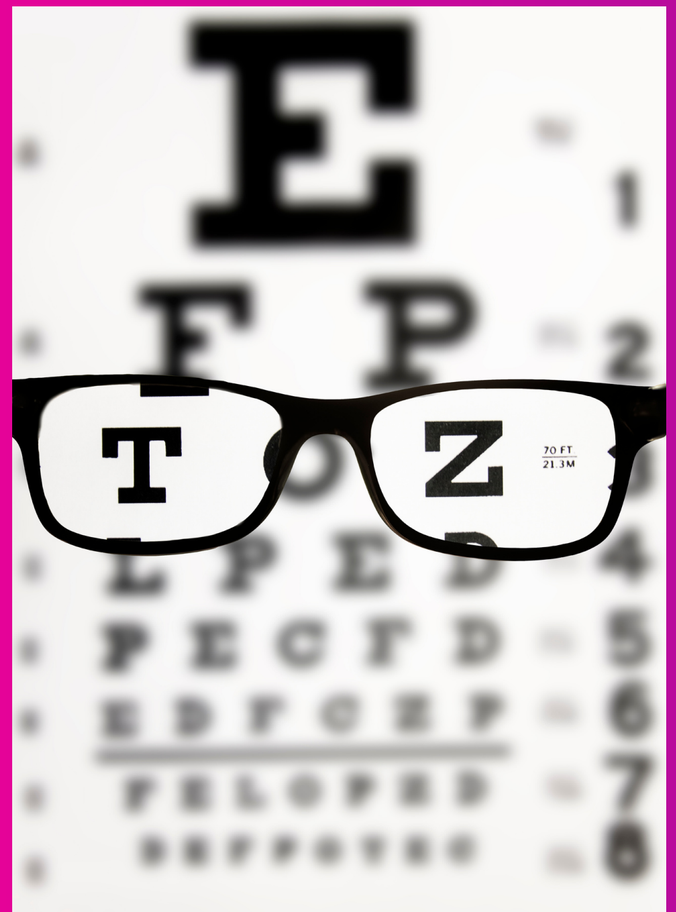
Case: Gabe
Early Myopic Shift



15yo: 21 Sessions

Alpha/Delta for 10 min. in the morning and evening
Upsilon/Omega for 10 min. mid day

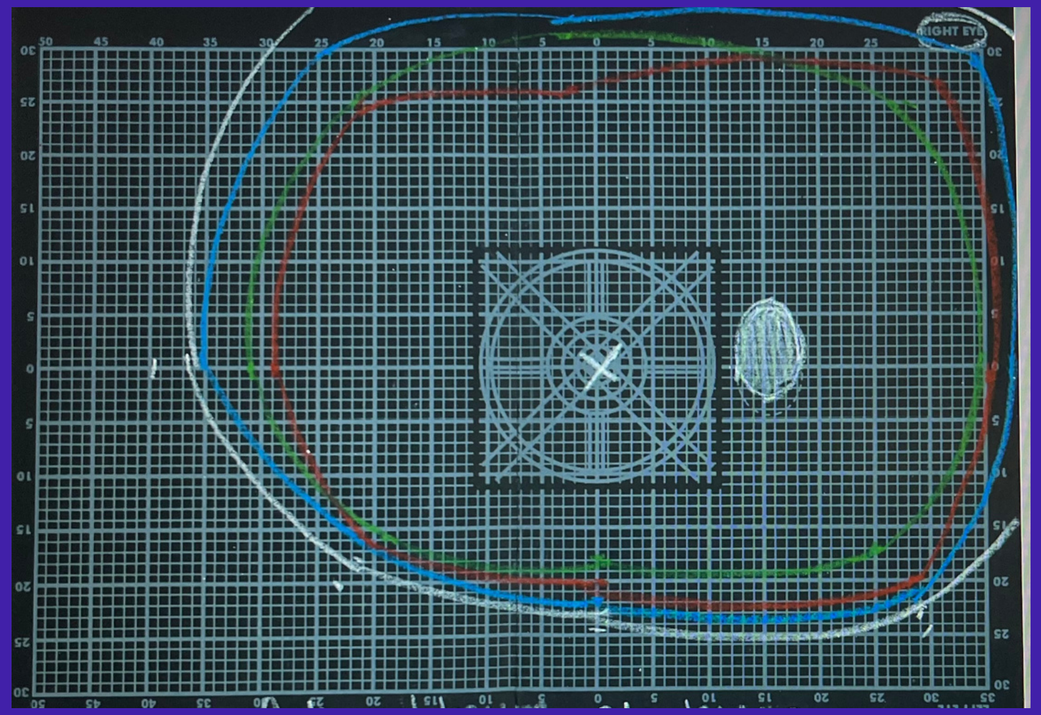
Case: Gabe
Early Myopic Shift

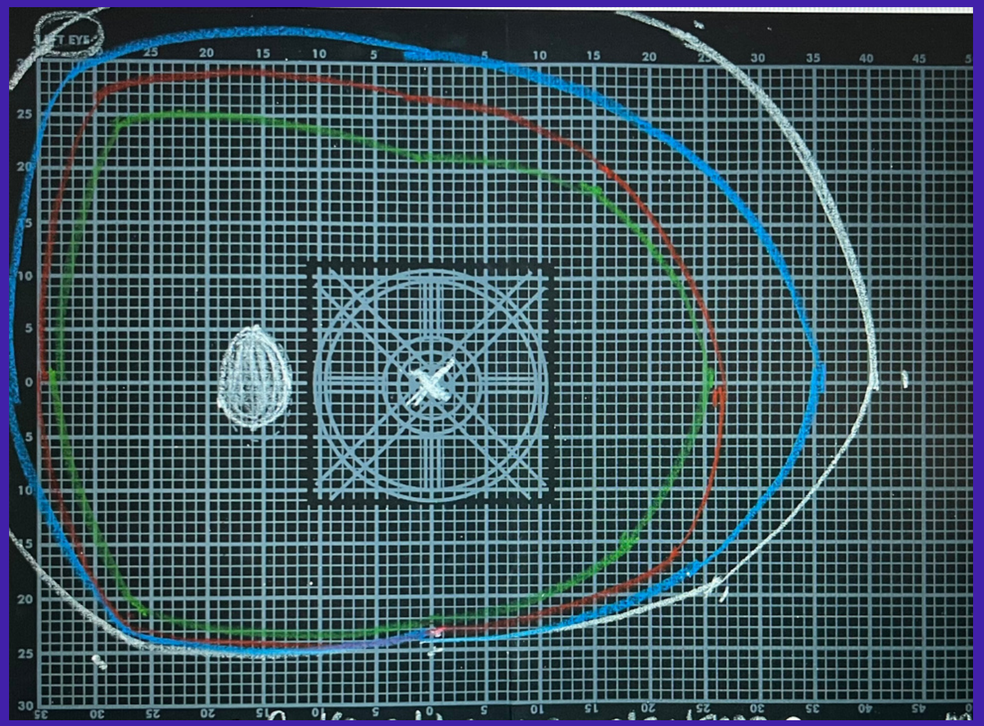


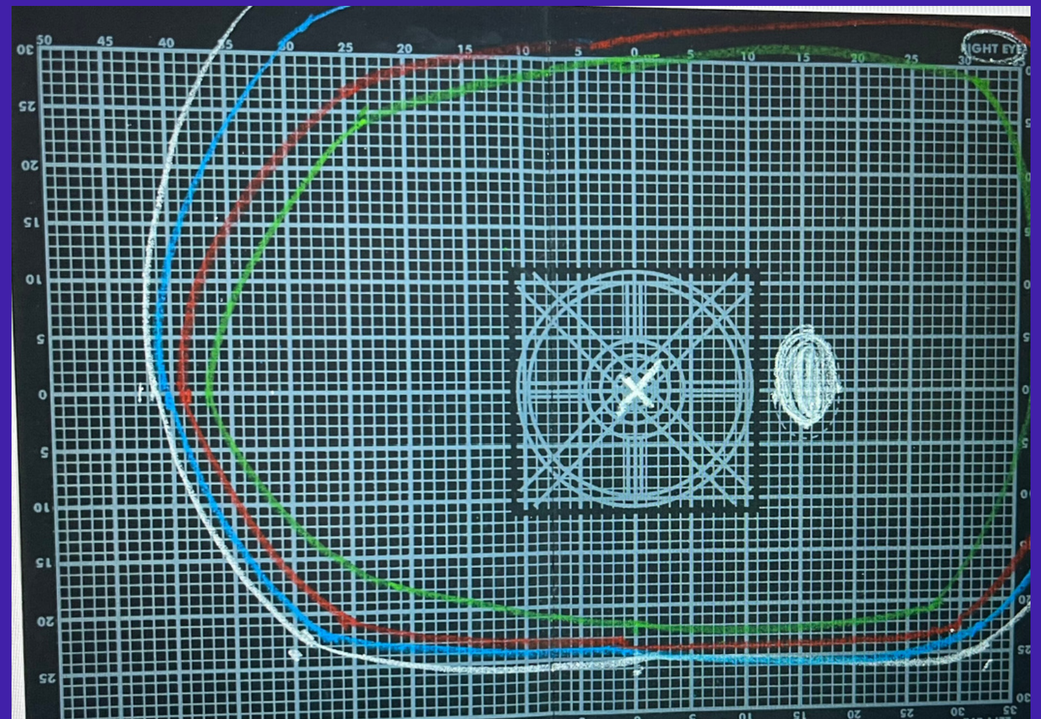
Progress Evaluation

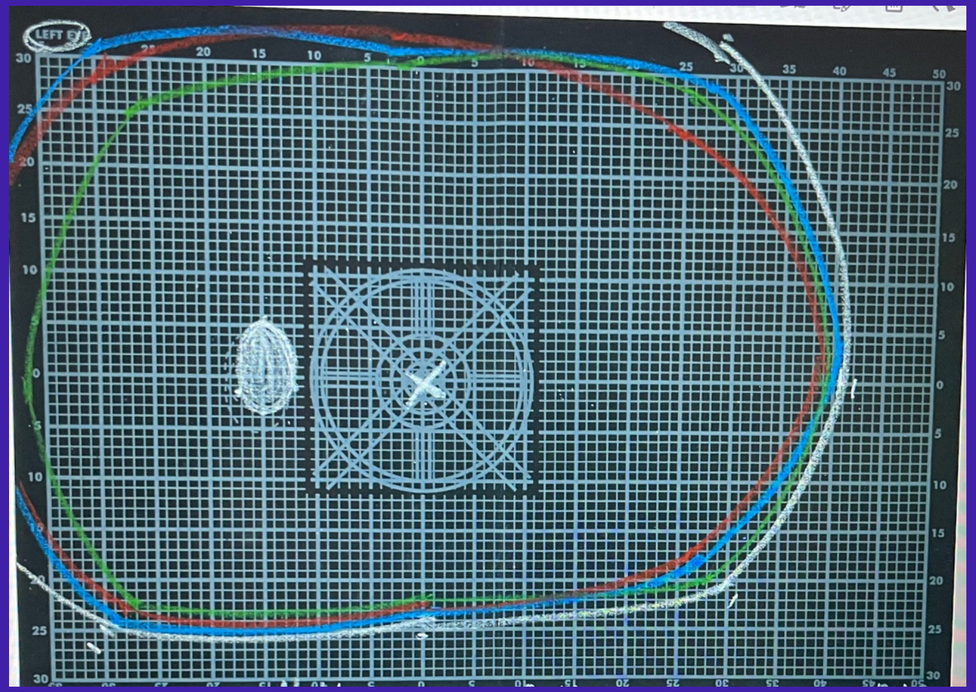
VA improved to
20/20- OD and 20/15 OS

Patient reported seeing better after doing each session, and this lasted for about an hour.









POTENTIAL PROTOCOL CONSIDERATIONS

- **Flicker/Pulsation**

  May simulate increase of intensity

- **Intensity**

  Brighter exposure for short duration

- **Time of Day**

  Red in the morning
  Violet use mid-day

- **Use Different Filters**

  Red: Alpha/Delta
  Blue: Upsilon/Omega

The Visual Triad

Skeletal

Fixation

Seeks and Holds Images

Visceral

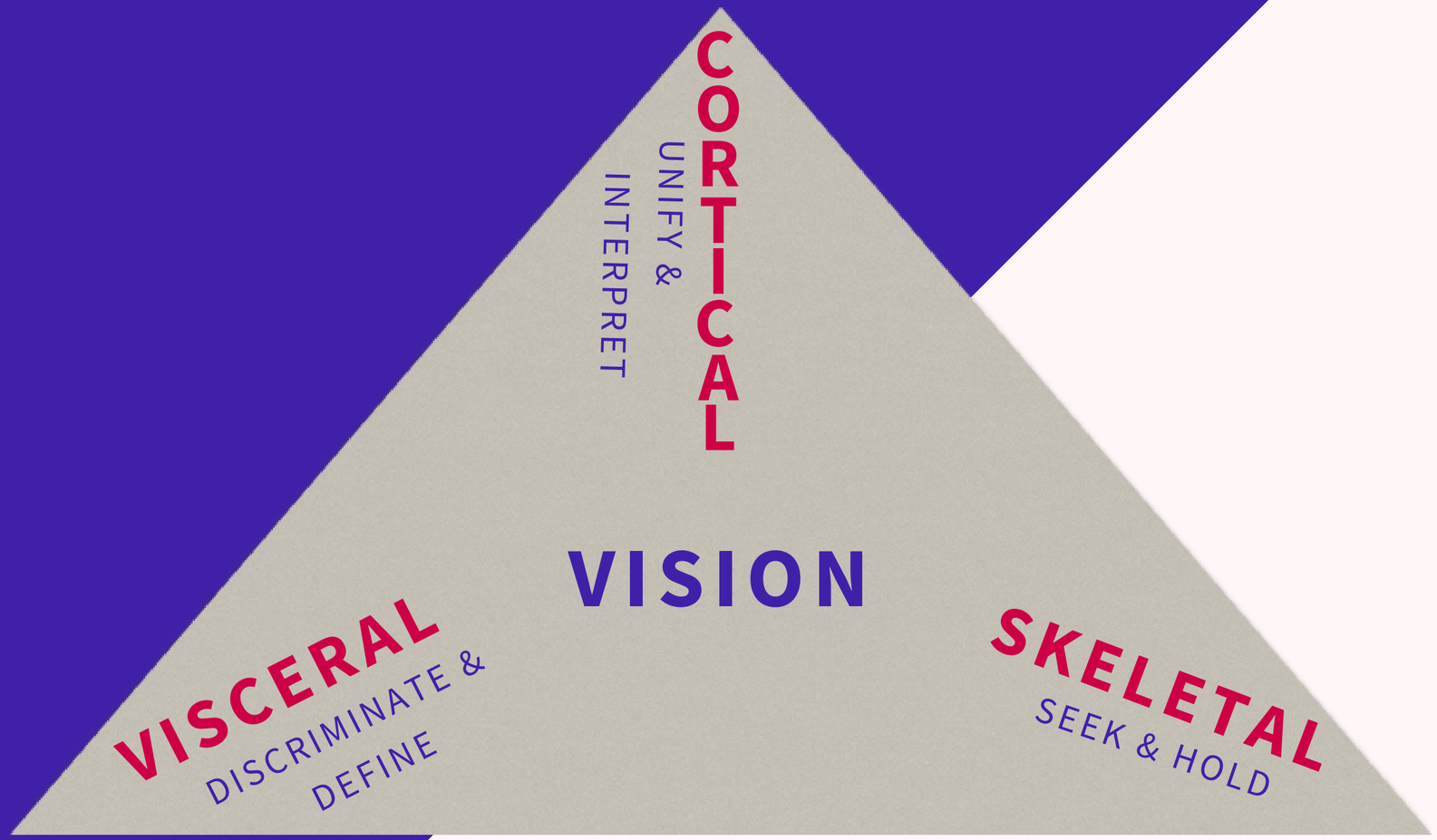
Focus

Discriminates & Defines Images

Cortical

Fusion

Unifies & Interprets Images



THE VISUAL TRIAD

ALL CONTRIBUTE TO VISION

They define
actuality, not reality

INCLUDE IMPORTANT EYE STRETCH ACTIVITY

- **Posture**

  Allows for improved visual movement

- **Lady Bug**

  Cortical increases stretch

- **Breathing**

  Increases flow to peripheral retina

- **Both Eyes Open**

  Occlude with hand

Myopia And Light

“Give light and people will find the way.”

Ella Baker

www.BrendaMontecalvo.com