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Myopia And Light

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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 VL deprivation."

Facts About Myopia

Risk Factor

Urban versus Rural living
2.6 > chance of developing myopia

Facts About Myopia

Risk Factor

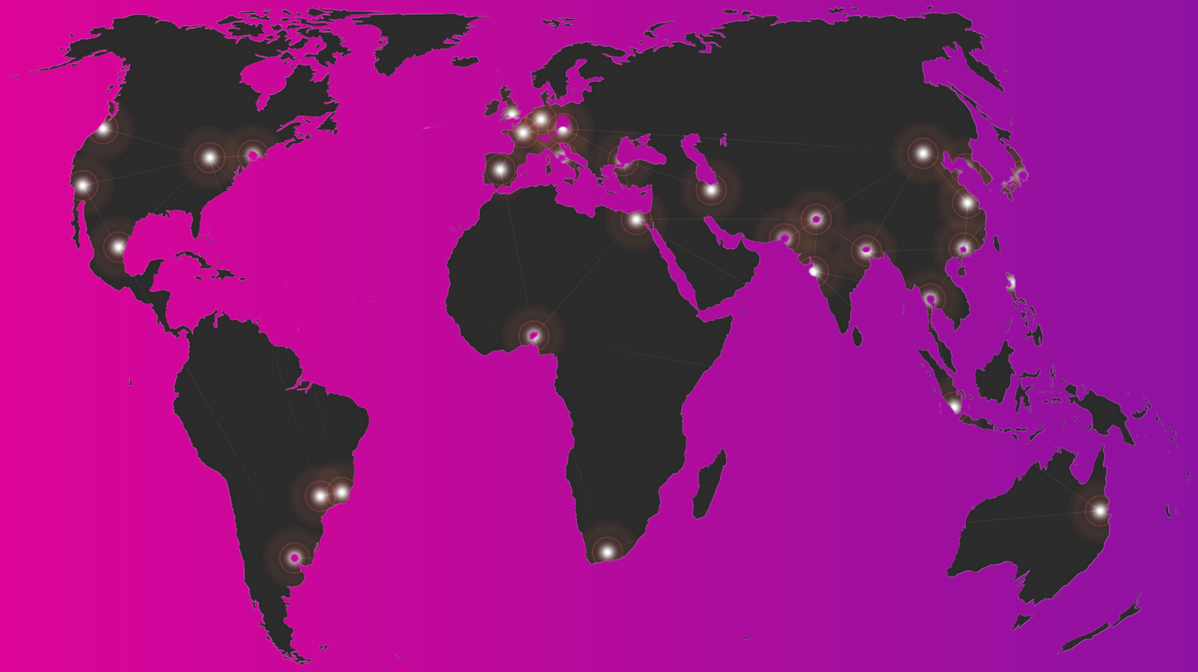
Genetics
Greatest chance if both parents are myopic

Facts About Myopia

Risk Factor

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

Facts About Myopia



Risk Factor

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

Facts About Myopia

Risk Factor

Years of education correlate with greater % of myopia.

Facts About Myopia

Risk Factor

Duration of digital device use

Facts About Myopia

Risk Factor

Working Distance

Randomized Trial

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.
doi: 10.1016/j.ophtha.2021.11.023. Epub 2021 Dec 1.

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

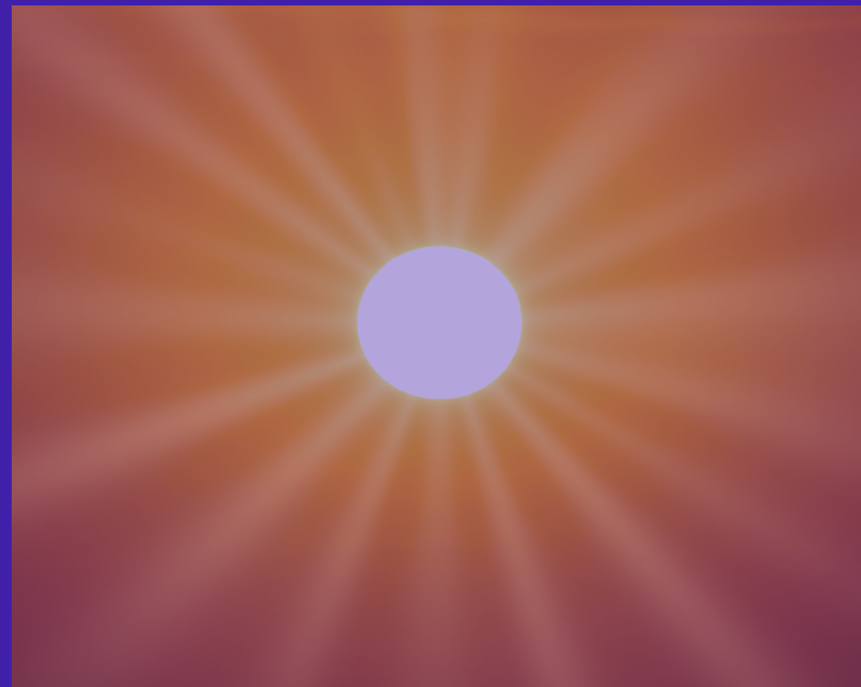
Far red/near-infrared light uses

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

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

Light And Myopia: Taking Action

Get Outside !!!

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

Violet Light

OPN5 New Photoreceptor Protein Discovered

THE PROTECTIVE EFFECTS OF VIOLET LIGHT DEPEND ON A NEWLY DISCOVERED PHOTORECEPTOR PROTEIN IN THE EYE CALLED **OPN5**, OR NEUROPSIN, WHICH WAS KNOWN TO BE SENSITIVE TO VIOLET LIGHT.

OPN5 New Photoreceptor Protein Discovered

GRANTS:

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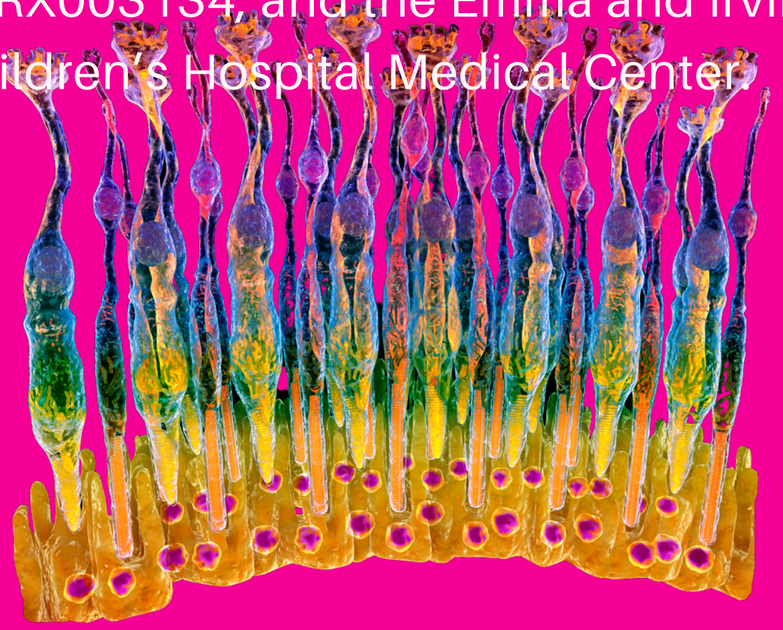
2. Tsubota Laboratory, Inc.; the United States National Eye Institute (grant Nos. EY016435, EY027077, EY027711
3. U.S. Department of Veterans Affairs (grant No. IK6 RX003134; and the Emma and Irving Goldman Scholar Endowed Chair at Cincinnati Children's Hospital Medical Center.



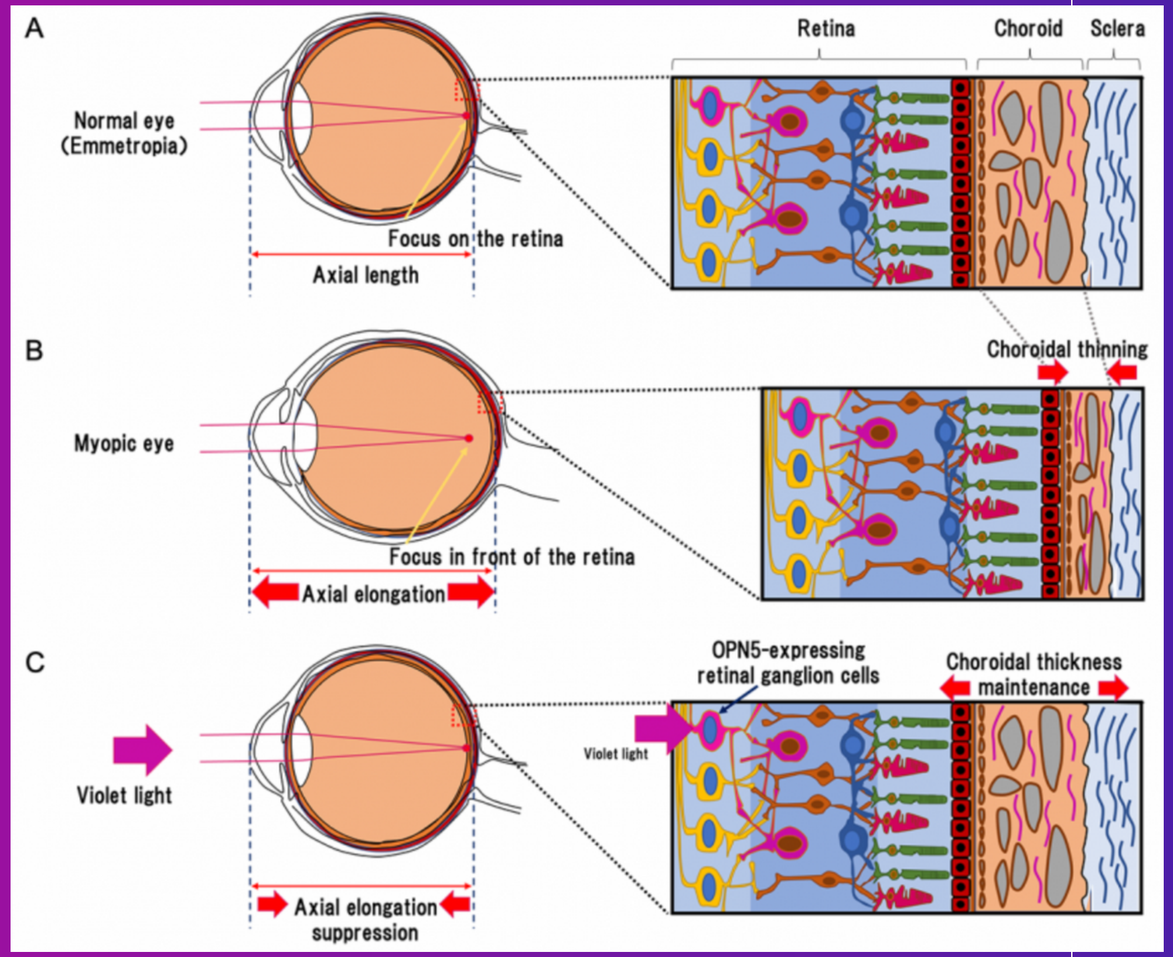
OPN5 New Photoreceptor Protein Discovered

- 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

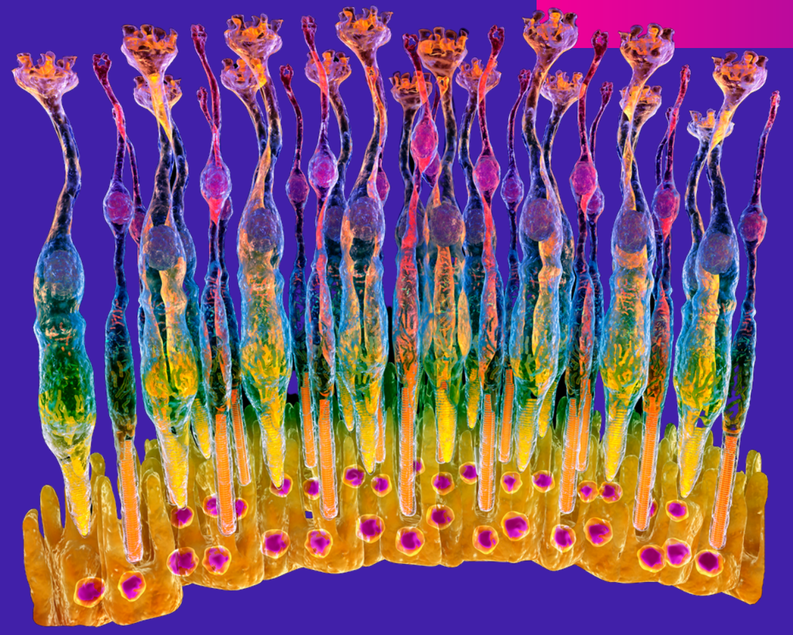
Violet light interacts with the photoreceptor protein OPN5 to prevent progression of myopia.

A. Normal eye.
B. Myopic eye with elongation between the cornea and the retina and thinning of the choroid.
C. Shows violet suppresses the elongation and thinning of the choroid.

(Illustration: Toshihide Kurihara)



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.

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

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.

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.
- The requirement for OPN5 also explains why VL has a protective effect on myopia development.

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

- 400 nm
- For mice the effect occured in the evening.
- Hypothesis is that humans will see this effect at dawn.
- Choroidal thickness is regulated by VL and Opn5-expressing RGCs are crucial for this response.

Wavelength Specificity of Violet Light to...

- 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 AL in mice.

- Neither red light nor green light produced any significant suppression refractive change or axial length
- Blue light produced a modest suppression of refractive change and a change in AL
- 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.

- Blue light is not suitable for preventing myopia since it stimulates intrinsically photosensitive RGCs (ipRGCs), causing unpredictable influences on the SCN circadian clock
- The VL source in the study was very narrow and emitted almost no light that would 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

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.

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.

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.

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

Aspects to Consider

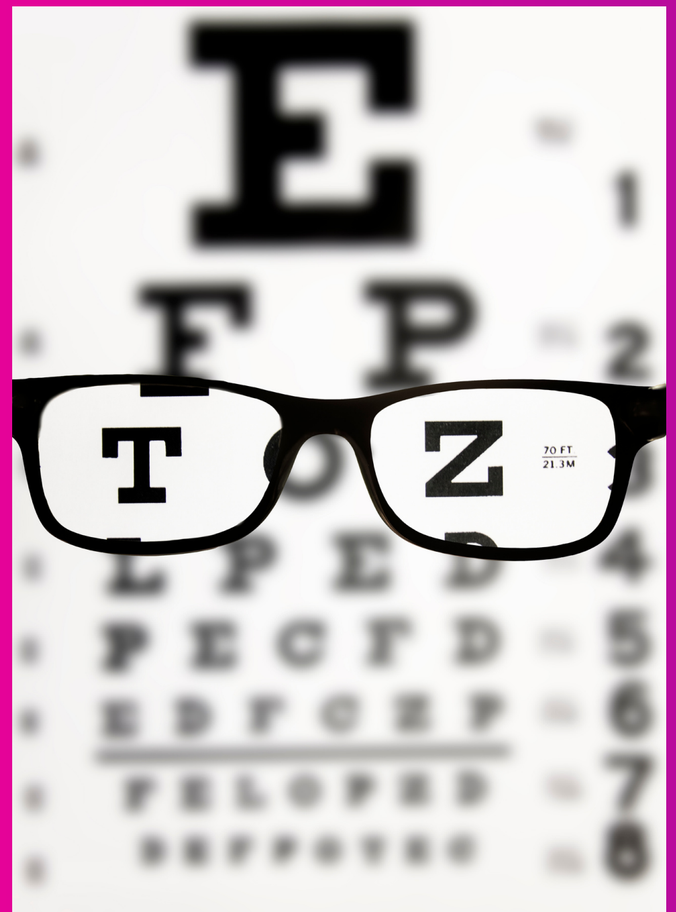
Violet Light

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.

Aspects to Consider

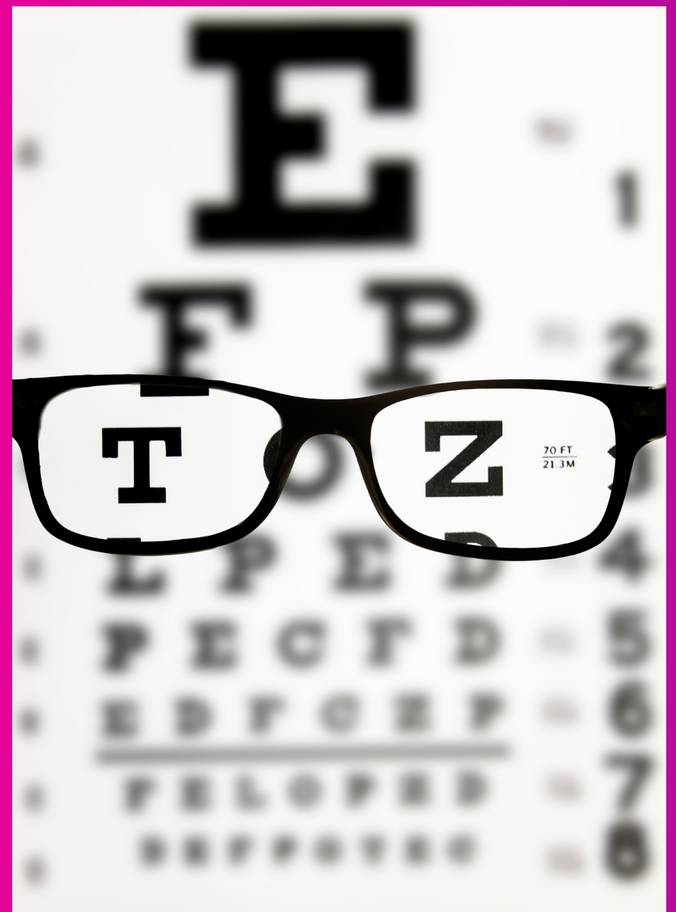
Case: Syntonogram
Vol. 18 No. 2 March-April 1955



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

Deadline was 4 months.

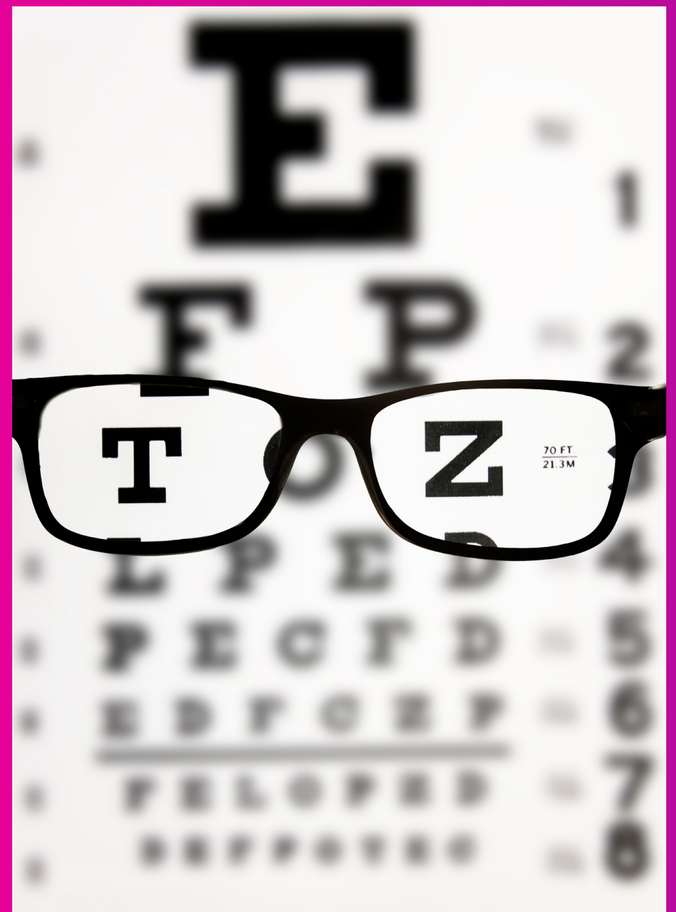
Case 1955



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

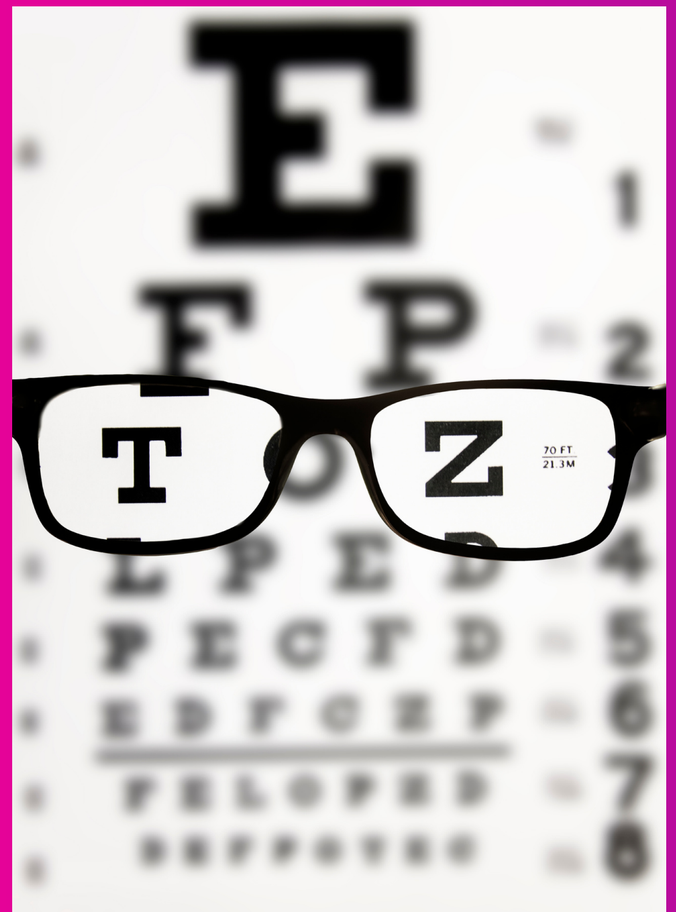
Achieved 20/20 in 2 months with each eye.

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

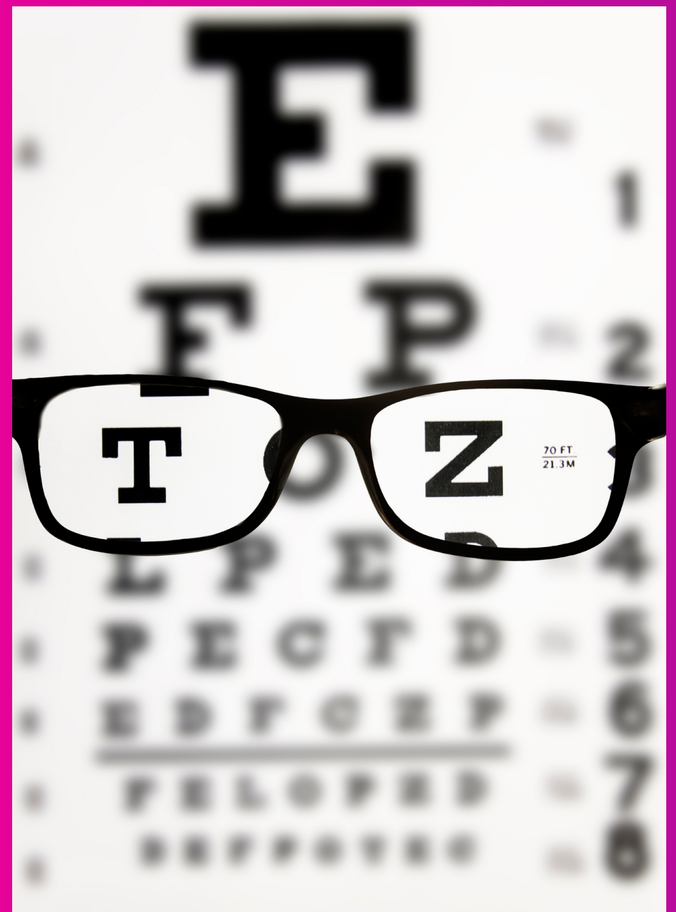


15yo

Subjective: OD -0.50 DS, OS -0.25 DS

Esophoria

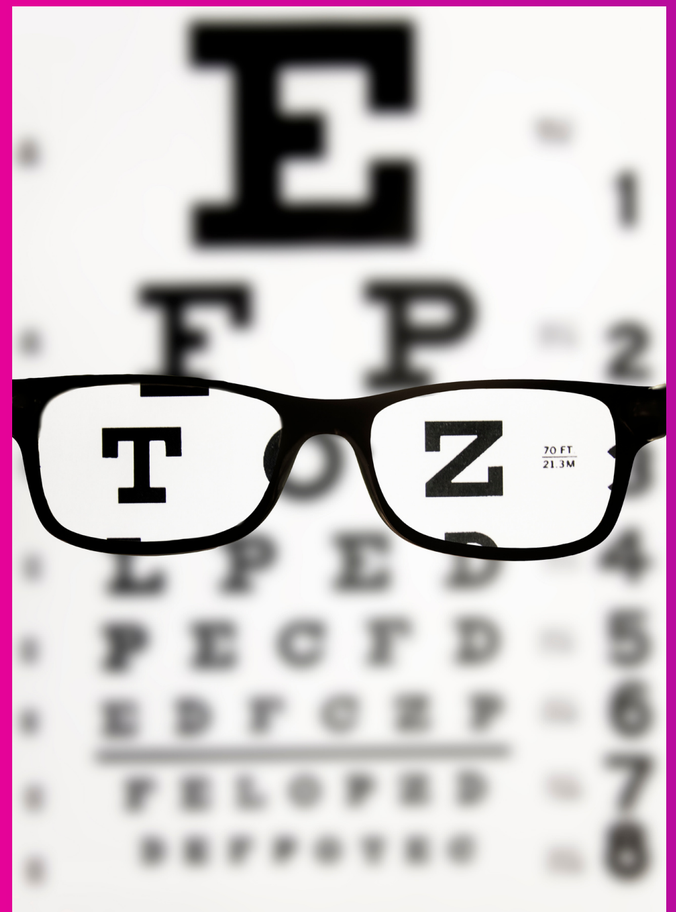
Case: Gabe
Early Myopic Shift



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**

  May simulate increase of intensity

- **Intensity**

  Brighter during mid-day
  Dim earlier or later in day

- **Time of Day**

  Red in the morning
  Violet use mid-day

- **Use Different Filters**

  Red: Alpha/delta
  Blue: Upsilon/Omega D

Myopia And Light

“Give light and people will find the way.”

Ella Baker

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