Myopia Management Made Practical

Science, Candidacy, and Integration Into Daily Practice

By: Ariel Cerenzie, OD, FAAO, FSLS

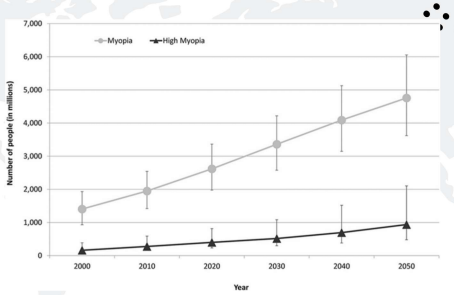
CHARLOTTE
CONTACT LENS INSTITUTE

The Importance of Myopia Management

- The Importance of Myopia Management
- Myopia Management Treatment Options & Prescribing Guide
- Risk Factors for Developing Myopia/High Myopia
- Setting Your Price

An Increasing Concern

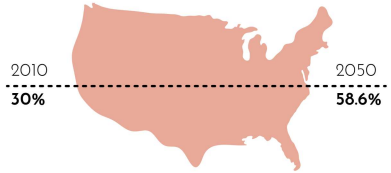
WORLDWIDE



Holden, et al. Ophthalmology. 2016

An Increasing Concern

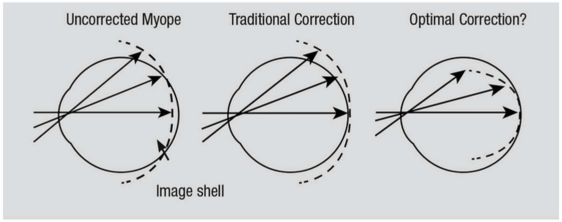
UNITED STATES



Holden, et al. Ophthalmology. 2016

Myopia

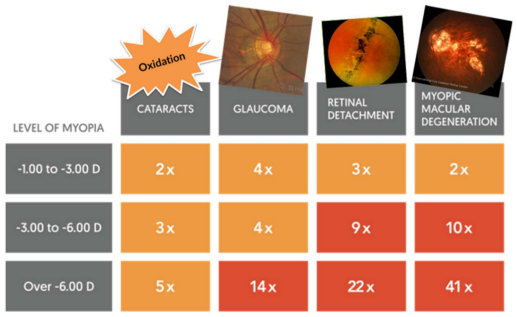
PATHOPHYSIOLOGY



Cooper, Jeffrey, and Andrei V. Tkatchenko. "A review of current concepts of the etiology and treatment of myopia." Eye & contact lens 44.4 (2018): 231.

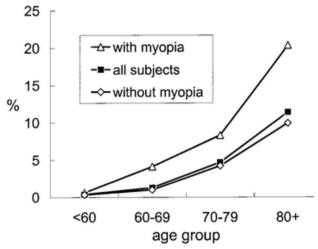
PATHOPHYSIOLOGY

RISKS ASSOCIATED WITH MYOPIA



Flitcroft, D. I. "The complex interactions of retinal, optical and environmental factors in myopia aetiology." Progress in retinal and eye research 31.6 (2012): 622-660.

GLAUCOMA

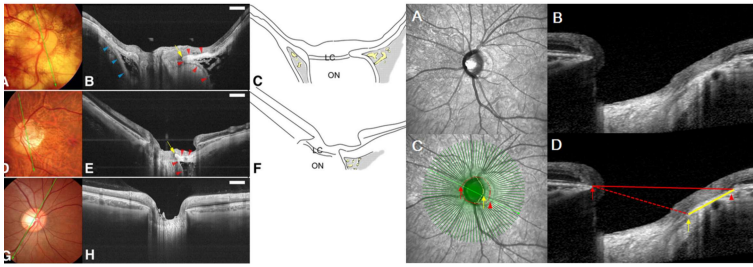


Ha, Ahnul, et al. "Degree of myopia and glaucoma risk: a dose-response meta-analysis." American Journal of Ophthalmology (2021).
Mitchell P, Hourihan F, Sandbach J, Wang JJ. The relationship between glaucoma and myopia: the Blue Mountains Eye Study. Ophthalmology. 1999;106(10):2010–2015.

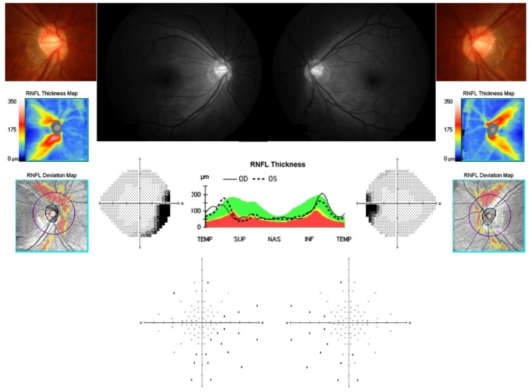
CONSEQUENCES

GLAUCOMA

For each unit (1-D) increase in myopia, the risk of glaucoma increases by approximately 20%.

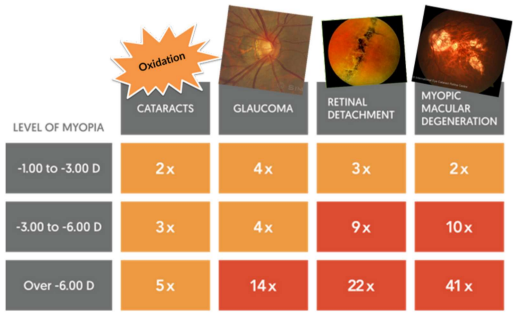


Geyte R, Yang H, Hua Y, Samuels BC, Sigal IA. Connective Tissue Remodeling in Myopia and its Potential Role in Increasing Risk of Glaucoma. Curr Opin Biomed Eng. 2020;15:40-50. doi:10.1016/j.cobme.2020.01.001



Park, Hae-Young Lopilly, et al. 'Vertical disc tilt and features of the optic nerve head anatomy are related to visual field defect in myopic eyes.' Scientific reports 9.1 (2019): 1-9.

RETINAL DETACHMENT



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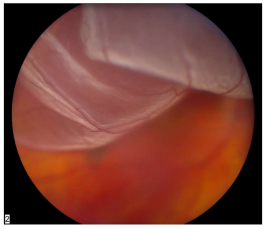


Each 1 D of myopia increases the incidence of retinal detachment by 30%

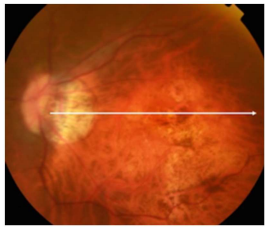
Bullimore, Mark A., et al. 'The risks and benefits of myopia control.' Ophthalmology 128.11 (2021): 1561-1579.

RETINAL DETACHMENT

Oxidation
CATARACTS
GLAUCOMA
RETINAL DETACHMENT
MYOPIC MACULAR DEGENERATION
LEVEL OF MYOPIA
-1.00 to -3.00 D
2x
4x
3x
2x
-3.00 to -6.00 D
3x
4x
9x
10x
Over -6.00 D
5x
14x
22x
41x

Flitcroft, D. I. 'The complex interactions of retinal, optical and environmental factors in myopia aetiology.' Progress in retinal and eye research 31.6 (2012): 622-660.

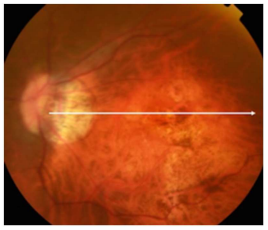
MYOPIC MACULAR DEGENERATION



1-diopter increase in myopia is associated with a 67% increase in the prevalence of myopic maculopathy.

Bullimore, Mark A., and Noel A. Brennan. 'Myopia control: why each diopter matters.' Optometry and Vision Science 96.6 (2019): 463-465.
Wong, Chee Wai, et al. 'Is choroidal or scleral thickness related to myopic macular degeneration?.' Investigative ophthalmology & visual science: 58.2 (2017): 907-913.

MYOPIC MACULAR DEGENERATION



- Stretched blood vessels
- Peripapillary atrophy
- Posterior staphyloma
- Lacquer cracks in Bruch's
- Geographic atrophy of RPE & choroid
- Subretinal hemorrhages
- Choroidal neovascularization

Bullimore, Mark A., and Noel A. Brennan. 'Myopia control: why each diopter matters.' Optometry and Vision Science 96.6 (2019): 463-465.
Wong, Chee Wai, et al. 'Is choroidal or scleral thickness related to myopic macular degeneration?.' Investigative ophthalmology & visual science: 58.2 (2017): 907-913.

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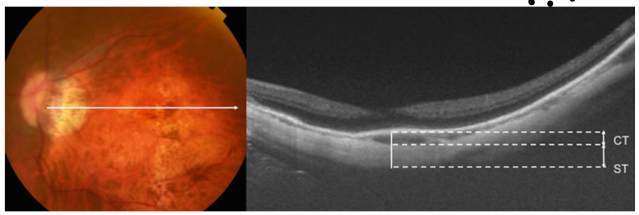
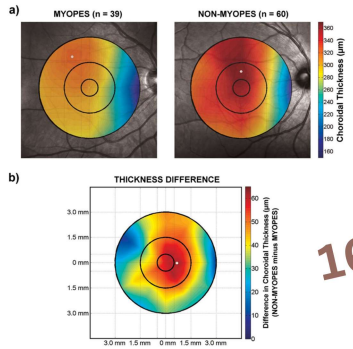


Wong, Chee Wai, et al. "Is choroidal or scleral thickness related to myopic macular degeneration?." Investigative ophthalmology & visual science 58.2 (2017): 907-913.

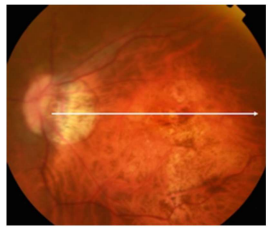
CHOROIDAL CHANGES



16%

Choroidal Thickness in Myopic and Nonmyopic Children Assessed With Enhanced Depth Imaging Optical Coherence Tomography Invest. Ophthalmol Vis. Sci. 2013;54(12):7578-7586. doi:10.1167/iovs.13-12772

MYOPIC MACULAR DEGENERATION



"**Slowing myopia by 1 diopter** should reduce the likelihood of a patient developing myopic maculopathy by **40%**.

Furthermore, this treatment **benefit accrues regardless of the level of myopia.** Thus, while the overall risk of myopic maculopathy is higher in a -6 diopter myope than in a -3 diopter myope, slowing their myopic progression by 1 diopter during childhood should lower the risk by 40% in both"

Bullimore, Mark A., and Noel A. Brennan. "Myopia control: why each diopter matters." Optometry and Vision Science 96.6 (2019): 463-465.

"NUMBER NEEDED TO TREAT"

Table 7 Mean Lifetime Years of Visual Impairment as a Function of Level of Myopia Using the United States Definition of 20/40, Which Is the World Health Organization Definition of Mild Visual Impairment

Myopia Level (D)	No. Needed to Treat to Prevent 5 Years of Visual Impairment
−3	6.75
−4	5.97
−5	5.35
−6	4.85
−7	4.44
−8	4.11

D = diopter.
Also shown are mean years of visual impairment prevented by a 1-D reduction in a patient's ultimate level of myopia, the number of patients needed to treat to prevent 5 years of visual impairment, and the reduction in myopia needed to prevent 1 year of visual impairment.

Bullimore, Mark A., et al. "The risks and benefits of myopia control." Ophthalmology 128.11 (2021): 1561-1579.

"NUMBER NEEDED TO TREAT"

EACH ADDITIONAL **1 D**

58% increased risk of **MMD**
20% increased risk of **OAG**
21% increased risk of **PSC**
30% increased risk of **RD**

Bullimore, Mark A., et al. "The risks and benefits of myopia control." Ophthalmology 128.11 (2021): 1561-1579.

QUALITY OF LIFE

QUALITY OF LIFE

Occupation / Role	Uncorrected Visual Acuity Requirement	Correctability Requirement
USAF Pilot Candidates	Near: 20/30; Distance: ≤20/70	Correctable to 20/20
Navy/Marine Aviation (Student)	20/40 in each eye	Correctable to 20/20
Army Helicopter Pilots	20/50 or better in each eye	Correctable to 20/20; post-training ≤20/400
DHS / ICE Law Enforcement	Varies (20/40+20/70, etc.) in one/both eyes	Correctable to 20/20
FBI Special Agents	One eye 20/20; other not worse than 20/40	Either corrected or uncorrected acceptable
Deputy U.S. Marshals	20/200 or better in each eye	Corrected binocular 20/20; near 20/40
Military Enlisted (PULHES E-1 / E-2)	Range from 20/200 to combinations up to 20/100	Must correct to 20/20 or meet medical eval

RISKS ASSOCIATED WITH LASIK

Lower preoperative levels of myopia:

- Easier to achieve minimal residual refractive error
- Fewer enhancements
- Better postoperative VAs sc & cc

Bullimore, Mark A., et al. "The risks and benefits of myopia control." Ophthalmology 128.11 (2021): 1561-1579.

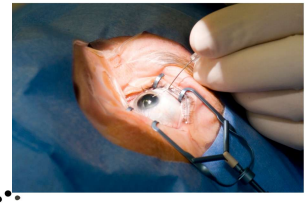
RISKS ASSOCIATED WITH LASIK

HIGHER preoperative levels of myopia:

- Reduced best-corrected low-contrast visual acuity by > 1 line vs. unchanged for low myopes
- More risk for postoperative corneal ectasia

Bullimore, Mark A., et al. "The risks and benefits of myopia control." Ophthalmology 128.11 (2021): 1561-1579.

RISKS ASSOCIATED WITH CATARACT SURGERY

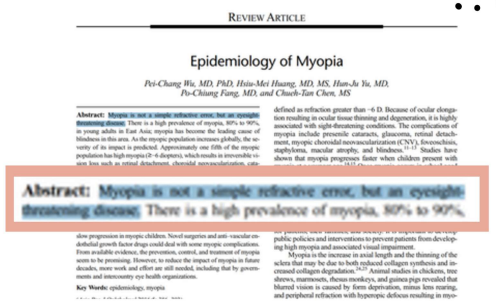


RRD was 4.9x higher in eyes that had an axial lens measurement ≥ 24 mm

Elzarrag, Hamad, et al. "Risk factors for postoperative retinal detachment following cataract surgery." Open Journal of Ophthalmology 9.3 (2019): 141-150.

Myopia

DISEASE OR REFRACTIVE ERROR?



REVIEW ARTICLE

Epidemiology of Myopia

Pei-Chang Wu, MD, PhD, Hsiu-Mei Huang, MD, MS, Hun-Ju Yu, MD, Po-Chiang Fang, MD, and Chueh-Tan Chen, MS

Abstract: Myopia is not a simple refractive error, but an eyesight-threatening disease. There is a high prevalence of myopia, 80% to 90%, in young adults in East Asia; myopia has become the leading cause of blindness in this area. As the myopic population increases globally, the severity of its impact is predicted. Approximately one fifth of the myopic population has high myopia (≥ −6 diopters), which results in irreversible vision loss such as retinal detachment, choroidal neovascularization, cata-

defined as refraction greater than −6 D. Because of ocular elongation resulting in ocular tissue thinning and degeneration, it is highly associated with sight-threatening conditions. The complications of myopia include presenile cataracts, glaucoma, retinal detachment, myopic choroidal neovascularization (CNV), foveoschisis, staphyloma, macular atrophy, and blindness.[1–3] Studies have shown that myopia progresses faster when children present with

slow progression in myopic children. Novel surgeries and anti-vascular endothelial growth factor drugs could deal with some myopic complications. From available evidence, the prevention, control, and treatment of myopia seem to be promising. However, to reduce the impact of myopia in future decades, more work and effort are still needed, including that by governments and intercountry eye health organizations.

public policies and interventions to prevent patients from developing high myopia and associated visual impairment.

Myopia is the increase in axial length and the thinning of the sclera that may be due to both reduced collagen synthesis and increased collagen degradation.[4,5] Animal studies in chickens, tree shrews, marmosets, rhesus monkeys, and guinea pigs revealed that blurred vision is caused by form deprivation, minus lens rearing, and peripheral refraction with hyperopic defocus resulting in myo-

Key Words: epidemiology, myopia

Myopia

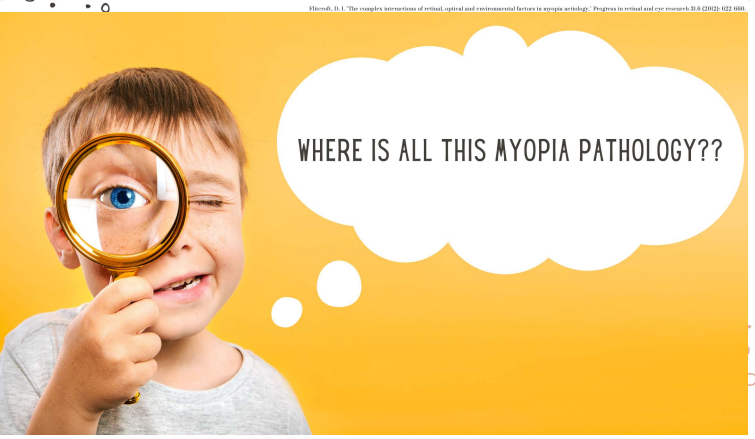
DISEASE OR REFRACTIVE ERROR?

2.1. *Physiological vs. pathological myopia*

The question whether myopia is merely an inconvenience or a 'disease' is often answered by dividing myopia into physiological myopia and pathological myopia (Curtin, 1985). Although this is a long-standing concept, it is still actively promoted by researchers in this field (e.g. Morgan et al., 2012). The cut-off between the two is conventionally, though arbitrarily, set at a spherical refractive equivalent of −6 Dioptres. Under this classification, physiological myopia represents an inconvenience correctable by optical or surgical means and pathological myopia is a medical condition subject to the complications of extreme levels of myopia. If this distinction was truly valid, low myopes would have no additional ocular disease risks over emmetropes. As the following analysis demonstrates significant disease associations exist even at low levels of myopia. Furthermore there is no evidence of a safe threshold level of myopia for any of the known ocular diseases linked to myopia including myopic maculopathy.

It is important to note that the following analysis addresses the potential disease associations of refractive errors. Low levels of myopia may certainly have some benefits in daily life, especially in later life after the onset of presbyopia (Rose and Tullo, 1998). Furthermore, as is discussed below, physiological mechanisms may create myopia as a consequence of optically misguided emmetropization. Neither of these possibilities prevents myopia also having adverse consequences for ocular health, which is the fundamental reason for rejecting the concept of 'physiological myopia'.

Flitcroft, D. I. "The complex interactions of retinal, optical and environmental factors in myopia aetiology." Progress in retinal and eye research 31.6 (2012): 622-660.



Call to Action

WORLD COUNCIL OF OPTOMETRY

WCO Passes Resolution for Myopia Management Standard of Care

reviewofoptometry.com/wco-passes-resolution-for-myopia-management-standard-of-care/

April 13, 2021

April 13, 2021

ST. LOUIS — The World Council of Optometry (WCO) passed a resolution that encourages eye care professionals to adopt and follow a standard of care when treating myopia patients.

The resolution defines the evidence-based standard of care as having three main components:

- **Mitigation** — optometrists educating and counseling parents and children, during early and regular eye exams, on lifestyle, dietary, and other factors to prevent or delay the onset of myopia.
- **Measurement** — optometrists evaluating the status of a patient during regular comprehensive vision and eye health exams, such as measuring refractive error and axial length whenever possible.
- **Management** — optometrists addressing patients' needs of today by correcting myopia, while also providing evidence-based interventions (e.g., contact lenses, spectacles, pharmaceuticals) that slow the progression of myopia, for improved quality of life and better eye health today and into the future.

"Myopia is increasing at an alarming rate, as are the risks for vision impairment associated with the condition[1]. With more than five billion people projected to be affected by myopia by

STATEMENT OF ENDORSEMENT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

Reducing the Global Burden of Myopia by Delaying the Onset of Myopia and Reducing Myopic Progression in Children

The American Academy of Pediatrics has endorsed the following publication: Modjtahedi BS, Abbott RL, Fong DS, Lum F, Tan D; Task Force on Myopia. Reducing the global burden of myopia by delaying the onset of myopia and reducing myopic progression in children [published online ahead of print December 30, 2020]. *Ophthalmology*. doi:10.1016/j.ophtha.2020.10.040.

All statements of endorsement from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

REFRACTIVE ERROR

Risk Factors for Developing Myopia/High Myopia

"Refractive error is the best single predictor of future myopia – more powerful of a predictor than genetics, near work, and other risk factors."

- CLEERE Study

REFRACTIVE ERROR

Age	Refractive Threshold for Risk of Myopia Development
6	< +0.75 D
7-8	≤ +0.50 D
9-10	≤ +0.25 D
11	≤ +0.00 D

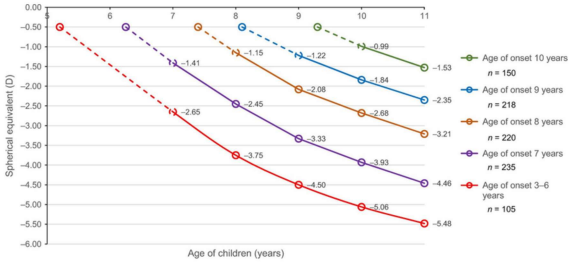
REFRACTIVE ERROR

YOUNGER AGE OF MYOPIA ONSET = **FASTER PROGRESSION**

ONSET <10 YEARS, 26% BECOME HIGH MYOPES

ONSET >10 YEARS, 1% BECOME HIGH MYOPES

REFRACTIVE ERROR



Chua, et al. Ophthalmic Physiol Opt 2016.

REFRACTIVE ERROR

YOUNGER AGE OF MYOPIA ONSET = **FASTER PROGRESSION**

ONSET <10 YEARS, 26% BECOME HIGH MYOPES

ONSET >10 YEARS, 1% BECOME HIGH MYOPES

COMET STUDY: WHEN DOES MYOPIA STABILIZE? AGE OF 15, 18, OR 21?

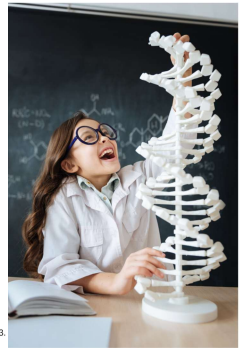
50% 75% 90%

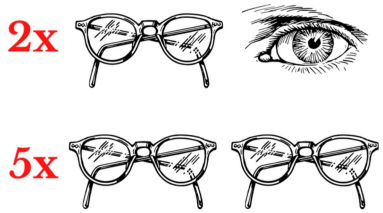
REFRACTIVE ERROR

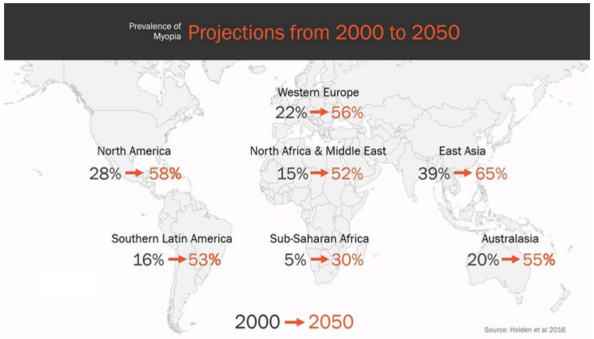
Baseline Age (y)	Frequency of Progression of At Least -0.75D (%)	Frequency of Progression of At Least -1.00D (%)
20 - 25	48.2 (40/83)	34.9 (29/83)
25 - 30	35.3 (36/102)	19.6 (20/102)
30 - 35	27.3 (18/66)	13.6 (9/66)
35 - 40	25.0 (10/40)	10.0 (4/40)
Total	35.7 (104/291)	21.3 (62/291)

Bullimore, Mark A., et al. "A retrospective study of myopia progression in adult contact lens wearers." Investigative ophthalmology & visual science 43.7 (2002): 2110-2113.

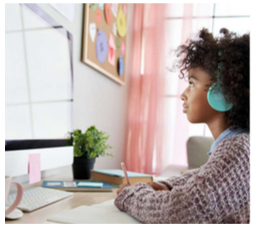
GENETICS

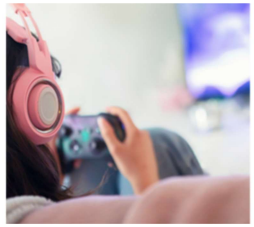


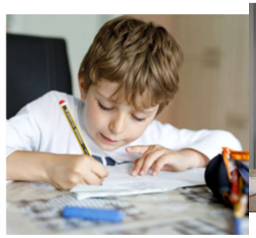




NEAR WORK

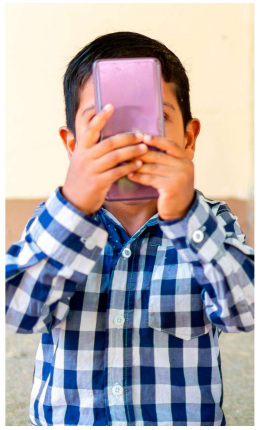






- **> 3 hours** of near work
- **Close** working distance
- 2% increased odds of myopia/ **additional diopter-hour of time** spent on near work/ week
- **Continuous** > cumulative work
- **Digital devices**/Screen time.

Huang HM, Chang DS, Wu PC. The Association between Near Work Activities and Myopia in Children-A Systematic Review and Meta-Analysis. PLoS One. 2015 Oct 20;10(10):e0140419



NEAR WORK

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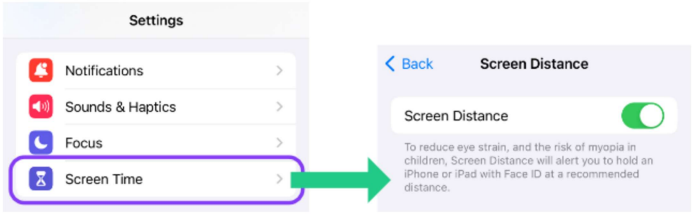
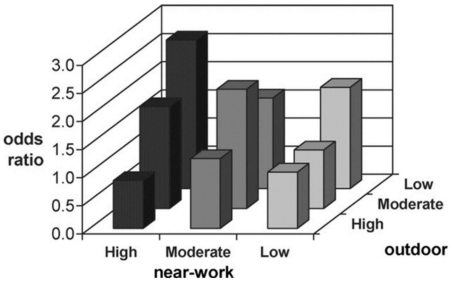
NEAR WORK



OUTDOOR TIME



Gajjar, Shail, and Lisa A. Ostrin. "A systematic review of near work and myopia: measurement, relationships, mechanisms and clinical corollaries." Acta Ophthalmologica 100.4 (2022): 376-387.

- Brighter light
- Peripheral defocus
- Circadian rhythms
- Spatial frequency
- Vitamin D
- Retinal dopamine

Lingham, Gareth, et al. "How does spending time outdoors protect against myopia? A review." British Journal of Ophthalmology 104.5 (2020): 593-599.

High accommodative lag: Potential feature + cause of myopia

- Pre-myopes show a higher accommodative lag compared to those who do not become myopic (1)
- Correlation becoming stronger after onset of myopia (2)

1. Mutti DO, Mitchell GL, Hayes JR et al. (CLEERE Study Group) Accommodative Lag before and after the Onset of Myopia. Invest Ophthalmol Vis Sci 2006;47:837-846.
2. Mutti DO, Jones LA, Moeschberger ML, Zadnik K. AC/A Ratio, Age, and Refractive Error in Children. Invest Ophthalmol Vis Sci 2000;41:2469-2478.

Esophoria & **accommodative lag + lower than age-normal level of hyperopia** (+0.75 or less at age 6-7 is the strongest risk factor for future myopia)1

- Recommend BV therapy + more time spent outdoors.2

image cred: https://geekymedics.com/strabismus/

Intermittent exotropia (IXT)

- Associated with a higher prevalence of myopia
- 50% of children with IXT are myopic by age 10 and 90% are myopic by age 20.5

Esophoria

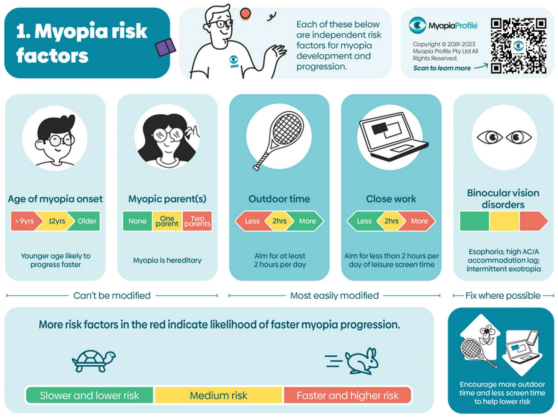
- Found to have more progressive myopia

image cred: https://geekymedics.com/strabismus/

1. Zadnik K, Sinnott LT, Cotter SA, Jones-Jordan LA, Kleinstein RN, Manny RE, Tweeten JD, Mutti DO; Collaborative Longitudinal Evaluation of Ethnicity and Refractive Error (CLEERE) Study Group. Prediction of Juvenile-Onset Myopia. JAMA Ophthalmol. 2015 Jun;133(6):683-9.
2. Xiong S, Sankaridurg P, Naduvilath T, Zang J, Zou H, Zhu J, Lv M, He X, Xu X. Time spent in outdoor activities in relation to myopia prevention and control: a meta-analysis and systematic review. Acta Ophthalmol. 2017 Sep;95(6):551-566.

Ekdawi NS, Nusz KJ, Diehl NN, Mohney BG. The development of myopia among children with intermittent exotropia. Am J Ophthalmol. 2010 Mar;149(5):503-7

Yang Z, Lan W, Ge J et al. The effectiveness of progressive addition lenses on the progression of myopia in Chinese children. Ophthal Physiol Opt 2009;29:41-48.



Myopia Management Treatment Options & Prescribing Guide

TIPS

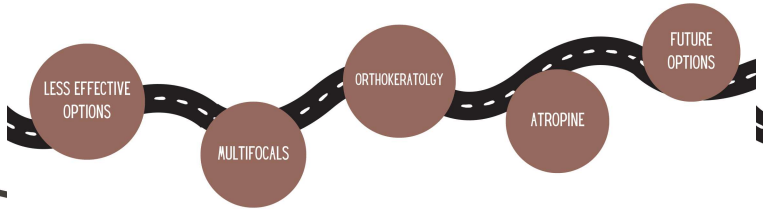
- ✓ Encourage outdoor time
- ✓ Discuss breaks from near work
- ✓ Perform cover test and assess for accommodative lag
- ✓ Start the discussion early

Increase follow up frequency

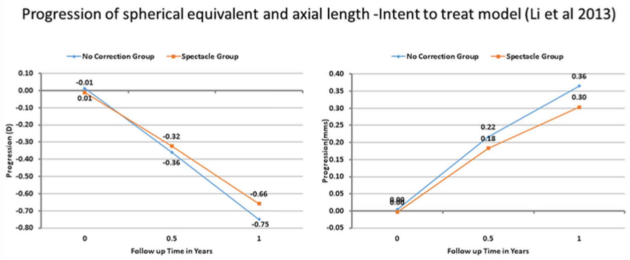
- Recent study finding a combined prevalence of keratoconus or suspected keratoconus at approximately 1:223 (or 0.45%) in a U.S. school-aged population
- Average age of keratoconus or keratoconus suspects was 13.7 years old.

Screen for KTC

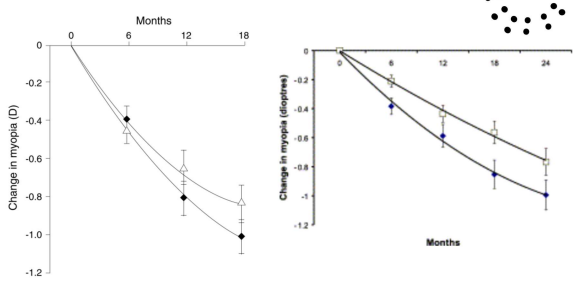
- Corneal topography/tomography
- Retinoscopy - scissoring reflex
- Keratometry- Normal values are below 48D, suspicious values are 48D to 50D and values above 50D are considered abnormally high



Undercorrection

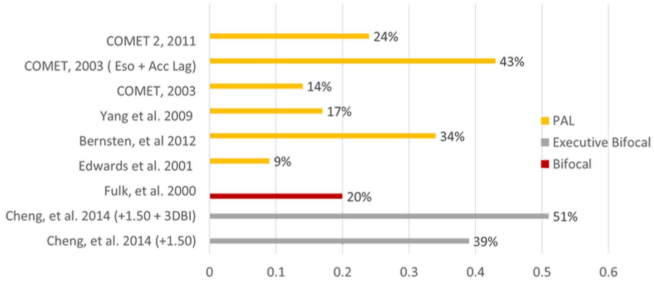


Undercorrection



Adler D, Millodot M. The possible effect of undercorrection on myopic progression in children. Clin Exp Optom 2006; 89: 315–321.
Chung K, Mohidin N, O'Leary DJ. Undercorrection of myopia enhances rather than inhibits myopia progression. Vision Res 2002; 42: 2555–2559.

Bifocals/Progressives



MULTIFOCALS

Multifocals

CANDIDATES

Refractive Error

- Monthly (center distance MF) SiHy:
  - Sphere: Up to -10.00 D
  - Cyl: Up to -5.75
- Monthly (center distance MF) Hydrogel:
  - Sphere: Up to -20.00 D
  - Cyl: Up to -5.75

Multifocals

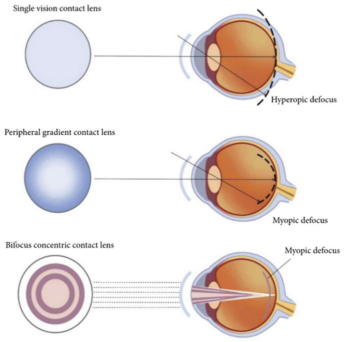
CANDIDATES

Refractive Error

- Daily FDA-Approved (+2.00 Concentric Rings):
  - Sphere: Up to -7.00 D
  - Cyl: Up to -0.75
- Daily (aspheric center D):
  - Sphere: Up to -12.25 D

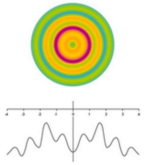
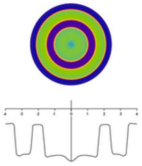
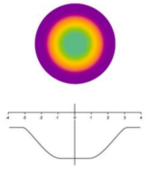
Multifocals

MECHANISM



Russo, Andrea, et al. "Myopia: Mechanisms and Strategies to Slow Down Its Progression." Journal of Ophthalmology (2022).

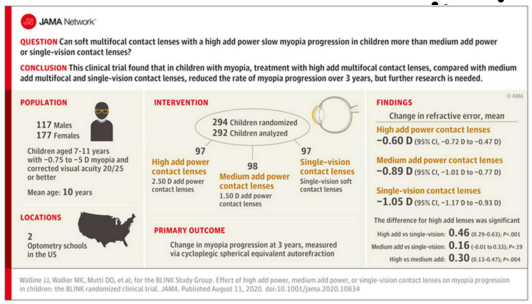
Naturalvue MiSight Biofinity/Proclear MF D

	Extended Depth Of Focus Contact Lens	Dual-focus Contact Lens	Centre Distance Contact Lens
Rationale	Global Retinal Image Quality that degrades rapidly for all points behind the retina	Simultaneous Defocus	Peripheral Defocus
Design	Optimisation of higher-order aberrations to extend the Depth of Focus	Central correction zone and concentric treatment zones (+2 addition)	Three zones: far, intermediate and near
Images (Colours represent the power profile)			

This fantastic summary image of various multifocal and dual focus contact lens optical profiles is adopted with attribution from www.hydrolens.se

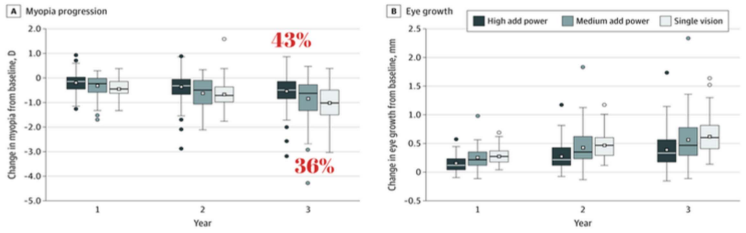
Multifocals

EFFICACY



Multifocals

EFFICACY



Walline JJ, Walker MK, Mutti DO, et al; for the BLINK Study Group. Effect of high add power, medium add power, or single-vision contact lenses on myopia progression in children: the BLINK randomized clinical trial. JAMA. Published August 11, 2020. doi:10.1001/jama.2020.10834

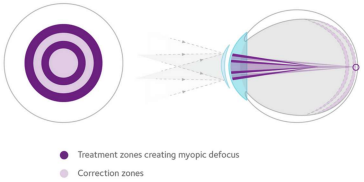
Multifocals

EFFICACY

FDA APPROVAL RANGES

Age
8-12 yo

Refraction
-0.75 D to -4.00 D SE
≤ 0.75 DC



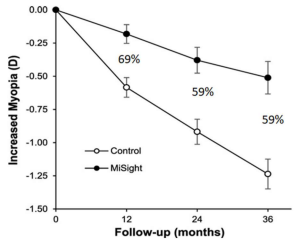
Multifocals

EFFICACY

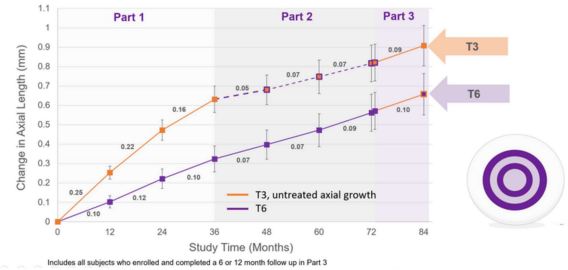
Design:
109 children (8-12 years old)
-0.75 to -4.00D of myopia and < 1.00D of astigmatism

Fit with either
MiSight 1-Day
Proclear 1-Day

Results (3 years):
-0.73 D (59%) reduction in myopia progression
0.32 mm (52%) reduction in axial elongation
No cases of serious ocular adverse events reported.



Multifocals
EFFICACY



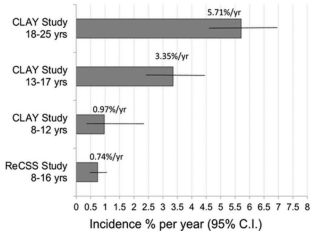
Chamberlain P et al. Myopia Progression in Children on Cessation of Dual-Focus Contact Lens Wear: MiSight 1-day 7-year findings AAO November 2021

Multifocals
SAFETY

> Across the 6-years, there were no contact lens related serious adverse events and biomicroscopy showed no significant changes. Results suggest that children this age can successfully wear daily-disposable hydrogel contact lenses with minimal impact on ocular physiology.

Woods, Jill, et al. "Ocular health of children wearing daily disposable contact lenses over a 6-year period." Contact Lens and Anterior Eye 44.4 (2021): 101591.

Multifocals
SAFETY



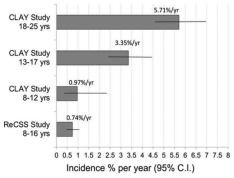
ReCSS Study

Retrospective Cohort Study of the Safety of Pediatric Soft Contact Lens Wear

- Studied children prescribed lenses <13 yo
- 1,000 children over 2,713 years of wear
- Annual incidence of inflammatory events: <1%
  - Conjunctivitis
  - FB abrasions
  - No vision loss

Chalmers, et al. Ophthalmic Physiol Opt. 2020.; Bullimore, et al. Ophthalmic Physiol Opt. 2020.

Multifocals
SAFETY



> A daily disposable modality should be preferred ....solutions and storage cases are two major risk factors for infectious and inflammatory events

Chalmers, et al. Ophthalmic Physiol Opt. 2020.; Bullimore, et al. Ophthalmic Physiol Opt. 2020.

Multifocals
PRESCRIBING

Prescribing Multifocals:

- Cycloplegic, baseline refraction
- Quick BV evaluation
- Biometry
- Start or RTC for dispense + I&R

Multifocals
EXPECTATIONS

Potential for

- Haloes
- Over-refraction
- Increased dryness/allergies
- Initial I&R challenges

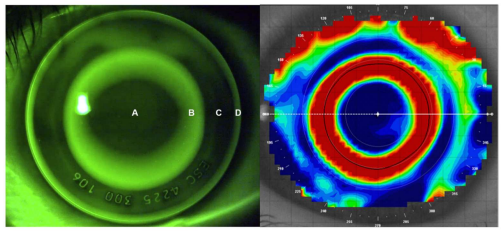
ORTHOKERATOLOGY

Orthokeratology
CANDIDATES

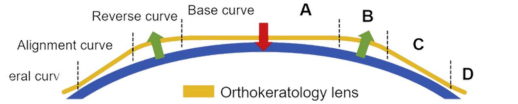
Refractive Error

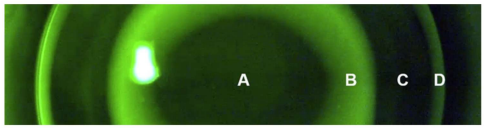
- Sphere: Up to -6.00D*
- Cyl: Up to -1.75D*

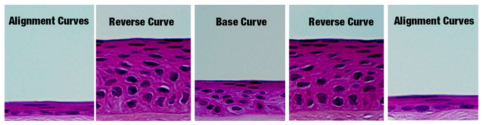
Orthokeratology
MECHANISM



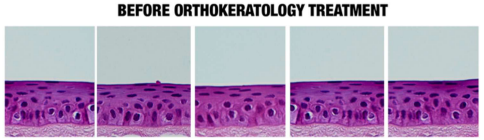
Vincent, Stephen J., et al. "RCLA CLEAR-Orthokeratology." Contact Lens and Anterior Eye 44.2 (2021): 240-269.

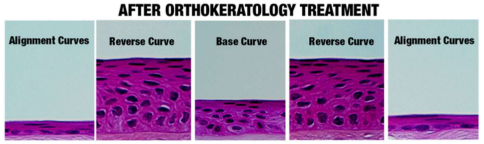






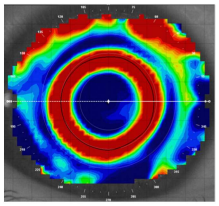
Orthokeratology
MECHANISM



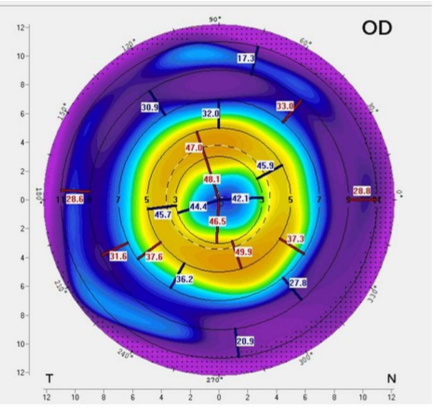


Orthokeratology
EFFICACY

"Lens decentration is a **common** phenomenon in orthokeratology. By excluding most of the interference factors, we found that OK lens being decentered less than 1.5 mm **can delay the development of myopia more effectively** than being centric**"**



Wang, A., & Yang, C. (2019). Influence of overnight orthokeratology lens treatment zone decentration on myopia progression. Journal of Ophthalmology, 2019.



5 mm vs. 6 mm BOZD
• 0.20 mm less AL

Guo, Biyue, et al. "Variation of Orthokeratology Lens Treatment Zone (VOLTZ) Study: A 2-year randomised clinical trial." Ophthalmic and Physiological Optics 43.6 (2023): 1449-1461.

Orthokeratology
EFFICACY

AXIAL ELONGATION

~50% **Ranging from 41-45% in most meta-analyses.**

Weiss RS, Park S. Recent updates on myopia control: preventing progression 1 diopter at a time. Curr Opin Ophthalmol 2019
Lipson MJ, Brooks MM, Koffler BH. The Role of Orthokeratology in Myopia Control: A Review. Eye Contact Lens 2018;44:224-30
Cheung SW, Boost MV, Cho P. Pre-treatment observation of axial elongation for evidence-based selection of children in Hong Kong for myopia control. Cont Lens Anterior Eye 2018
Hiraoka T, Kakita T, Okamoto F, Takahashi H, Oshika T. Long-term effect of overnight orthokeratology on axial length elongation in childhood myopia: a 5-year follow-up study. Invest Ophthalmol Vis Sci 2012;53:3913-9
Swarbrick HA, Alharbi A, Watt K, Lum E, Kang P. Myopia control during orthokeratology lens wear in children using a novel study design. Ophthalmology 2015;122:620-30

Orthokeratology
SAFETY

> The incidence of microbial keratitis was of 6.8 cases per 10,000 patient-years in adults and 0.0 cases per 10,000 patient-years in children...Corneal staining has been described as the most frequent adverse effect of ortho-k.

Gispets, Joan, et al. "Efficacy, predictability and safety of long-term orthokeratology: An 18-year follow-up study." Contact Lens and Anterior Eye 45.1 (2022).

Orthokeratology
SAFETY

> There is sufficient evidence to suggest that OrthoK is a safe option for myopia correction and retardation. Long-term success of OrthoK treatment requires a combination of proper lens fitting, rigorous compliance to lens care regimen, good adherence to routine follow-ups, and timely treatment of complications.

Liu, Yue M., and Peiying Xie. "The safety of orthokeratology—a systematic review." Eye & contact lens 42.1 (2016): 35.

Orthokeratology
PRESCRIBING

Prescribing Orthokeratology:
- Acuity sc and cc
- SLE with NaFl
- Cycloplegic, baseline refraction
- Quick BV evaluation
- Biometry
- Baseline Topography
- RTC for dispense + I&R

Orthokeratology
EXPECTATIONS

Potential for
- Haloes
- Residual refraction (0.00 to +0.75)
- Increased dryness
- Initial I&R challenges
- Initial comfort issues
- Vision expectations

Which one is better?

- **Esophoria and accommodative lag**: Likely to be **improved** in **orthokeratology** wear. 1,2
- Multifocal contact lenses can potentially cause small exophoric shift and/or increase in accommodative lag.3,4
- The **MiSight**/dual focus concentric contact lens design **does not appear to alter accommodation or phoria**.5,6

1.Gifford K, Gifford P, Hendicott PL, Schmid KL. Near binocular visual function in young adult orthokeratology versus soft contact lens wearers. Cont Lens Anterior Eye. 2017 Jun;40(3):184-189.
2.Gifford KL, Gifford P, Hendicott PL, Schmid KL. Zone of Clear Single Binocular Vision in Myopic Orthokeratology. Eye Contact Lens. 2020 Mar;46(2):82-90.
3.Gong CR, Troilo D, Richdale K. Accommodation and Phoria in Children Wearing Multifocal Contact Lenses. Optom Vis Sci 2017;94:353-360.
4.Schmid KL, Gifford KL, Chan P, Christie B, Crouther S, Nahuysen O, Sechenova K, Sevil L, Youssef M, Atchison DA. The effects of aspheric and concentric multifocal soft contact lenses on visual quality, vergence and accommodation function in young adult myopes. Invest. Ophthalmol. Vis. Sci. 2019;60(9):3893.
5.Gifford KL, Schmid KL, Collins J, Maher C, Makan R, Nguyen TKP, et al. Accommodative responses of young adult myopes wearing multifocal contact lenses. Invest Ophthalmol Vis Sci. 2019;60(9):6376.
6.Ruiz-Pomeda A, Pérez-Sánchez B, Cañadas P, Prieto-Garrido FL, Gutiérrez-Ortega R, Villa-Collar C. Binocular and accommodative function in the controlled randomized clinical trial MiSight® Assessment Study Spain (MASS). Graefes Arch Clin Exp Ophthalmol. 2019 Jan;257(1):207-215.

Which one is better?

Retrospective analysis (n+77) of real-world clinical data found no difference in annualized AL growth between PDCL and OK

PDCL: MiSight, Biofinity, Proclear, SpecialEyes Multifocal, Naturalvue
OK: Corneal Reshaping Therapy, Vison Shaping Treatment

Findings:
No difference in annualised AL growth between PDCL and OK

Skidmore, Kelsea V., et al. "Retrospective review of the effectiveness of orthokeratology versus soft peripheral defocus contact lenses for myopia management in an academic setting." Ophthalmic and Physiological Optics 43.3 (2023): 534-543.

Effect of Low-dose Atropine on Binocular Vision and Accommodation in Children Aged 6 to 17 Years

"Pupil size was significantly enlarged by **0.01%, 0.03%, and 0.05%** atropine in both dim and bright illumination with more effect at 60 minutes after application. However, low dose atropine eye drops **have no effect on binocular vision measurements**.

Thus, in respect to binocular vision, it is relatively safe to use low-dose atropine to treat myopia progression in children aged 6 to 17 years."

Which one is better?

Consider

- **Kid's/Parent's preference**
  - Previous CL experience
  - FDA approval
  - Wary of "drugs"
- **Hygiene**
- **Maturity**
- **Concerns of compliance**
- **Extracurricular activity involvement**
- **BV issues?**

ATROPINE

Atropine
CANDIDATES

Refractive Error

- No Limit!

Atropine
MECHANISM

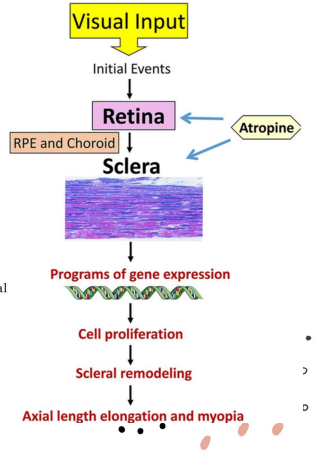
Non-selective antagonist of muscarinic acetylcholine receptors

Muscarinic ACh Receptors are found in the:

Retina: The layer involved in transferring the signaling cascade toward the choroid and/or the sclera. Atropine boosts dopamine release from cellular stores, which then controls eye growth.

Choroid: Atropine results in rapid and transient choroidal thickening and inhibited eye growth. Suggested that the choroidal thickening and eye growth may be linked. Atropine was found to inhibit choroidal thinning induced by hyperopic defocus.

Sclera: Blocks the proliferation of scleral fibroblasts and consequent axial elongation



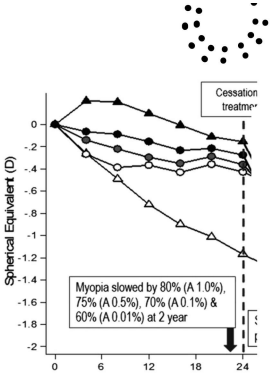
Atropine
EFFICACY - ATOM 1

Design

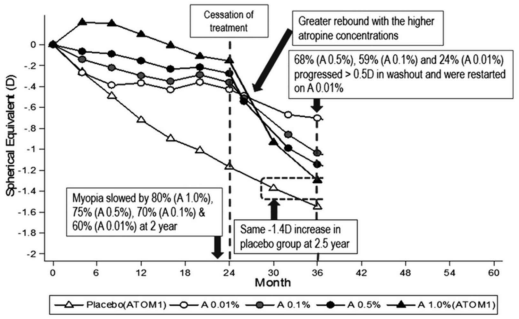
- 400 myopic children (6-12 yo)
- SE -1.00 to -6.00D
- 1% atropine or saline drops
- 1 gtt qd x 2 years

Results

- 80% reduction



Atropine
EFFICACY



Atropine
EFFICACY - ATOM 2

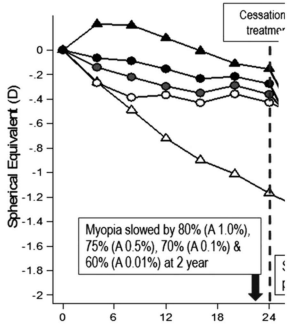
Design

Randomized into groups:

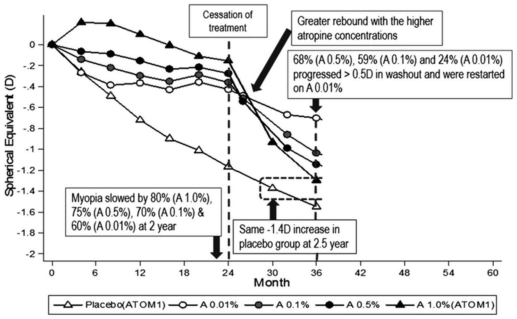
- 0.5%
- 0.1%
- 0.01%

Goal

Compare safety and efficacy of lower doses of atropine

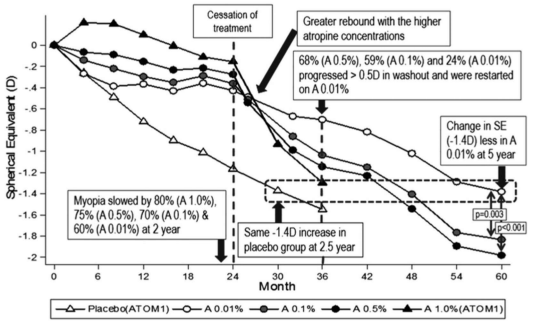


Atropine
EFFICACY



Atropine

EFFICACY



Atropine

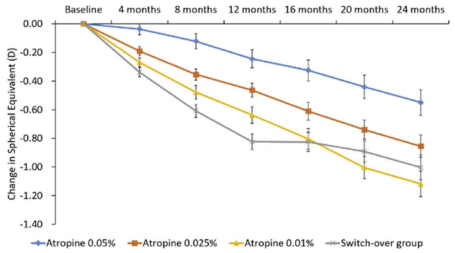
EFFICACY - LAMP

Design

383 myopic children
(4-12 yo) >/= -1.00 D

Randomized into groups:
- 0.05%
- 0.025%
- 0.01%
- Placebo

1 gtt qd x 2 years



Atropine

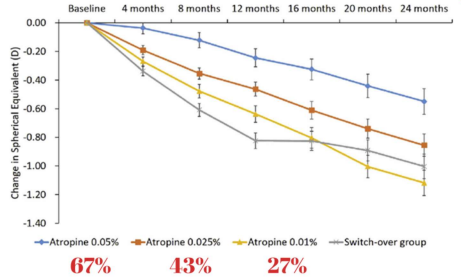
EFFICACY

Design

383 myopic children
(4-12 yo) >/= -1.00 D

Randomized into groups:
- 0.05%
- 0.025%
- 0.01%
- Placebo

1 gtt qd x 2 years



Atropine

EFFICACY

0.05% atropine remained the optimal concentration over 3 years

The difference in rebound effects were clinically small across all three studied atropine concentrations.

Stopping treatment at an older age was associated with a smaller rebound.

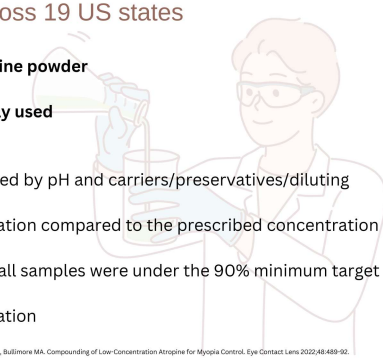
Atropine

EFFICACY

	ATOM 2			LAMP		
Atropine Dosage	0.5%	0.1%	0.01%	0.05%	0.025%	0.01%
Refractive Efficiency	75%	68%	59%	66%	43%	27%
Axial Efficiency	29%	25%	-8%	51%	29%	12%

What's in a Bottle

A Survey of 26 pharmacies across 19 US states



- **Diluted from 1% atropine gtts or atropine powder**
- **Preservatives may vary: BAK commonly used**
- **Atropine is an unstable compound**
  - Susceptible to hydrolysis - influenced by pH and carriers/preservatives/diluting agents
  - Analysis found the actual concentration compared to the prescribed concentration was:
    - As low as 70% and a quarter of all samples were under the 90% minimum target concentration.
    - More neutral pH = more degradation

Richdale K, Tomiyama ES, Novack GD, Bullimore MA. Compounding of Low-Concentration Atropine for Myopia Control. Eye Contact Lens 2022;48:489-92.

What's in a Bottle?

Variability in compounding may be why some studies report minimal side effects while other studies report problems with photophobia and accommodation.

Most common side effect of low-concentration atropine is **allergic conjunctivitis**

- Independent of concentration
- Occurred in placebo groups

Richdale K, Tomiyama ES, Novack GD, Bullimore MA. Compounding of Low-Concentration Atropine for Myopia Control. Eye Contact Lens 2022;48:489-92.
Watson CJ, Whitledge JD, Siani AM, Burns MM. Pharmaceutical Compounding: a History, Regulatory Overview, and Systematic Review of Compounding Errors. J Med Toxicol 2021;17:197-217.
Yam JC, Jiang Y, Tang SM, et al. Low-Concentration Atropine for Myopia Progression (LAMP) Study: A Randomized, Double-Blinded, Placebo-Controlled Trial of 0.05%, 0.025%, and 0.01% Atropine Eye Drops in Myopia Control. Ophthalmology 2019;126:113-24.

Atropine
EXPECTATIONS

Potential for

- Light sensitivity
- Initial burning
- Near vision blur
- Increased pupil size

Questions to Ask Your Pharmacy

- Shelf Life
- Preservatives Used
- Refrigerated or room-temp
- Frequency of testing concentrations

Richdale K, Tomiyama ES, Novack GD, Bullimore MA. Compounding of Low-Concentration Atropine for Myopia Control. Eye Contact Lens 2022;48:489-92.
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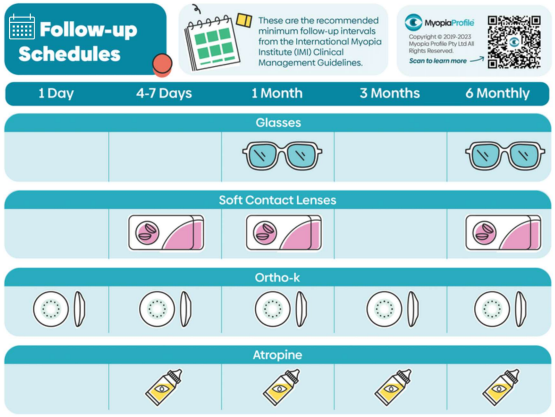
Atropine
PRESCRIBING

Prescribing Atropine:

- Cycloplegic, baseline refraction
- Quick BV evaluation
- Biometry
- Pupillometry - Size and Response
- Atropine 0.05%: 1 gtt OU qhs
- Consider visual fatigue lenses w. photochromic lenses

	0.05% Atropine	0.025% Atropine	0.01% Atropine	Placebo
Photopic pupil size (+mm)	1.03	0.76	0.80	0.13
Photophobia, 2 weeks	31.2%	18.5%	5.5%	12.6%
Photophobia, 1 year	7.8%	6.6%	2.1%	4.3%
Photochromic Lenses	30.3%	34.3%	30%	39.6%
Accommodative Amp (D), 4 mo	-2.38	-1.34	-0.50	-0.35
Accommodative Amp (D), 1 yr	-1.98	-1.61	-0.26	-0.32
PALS	0.96%	0%	1.8%	0.9%

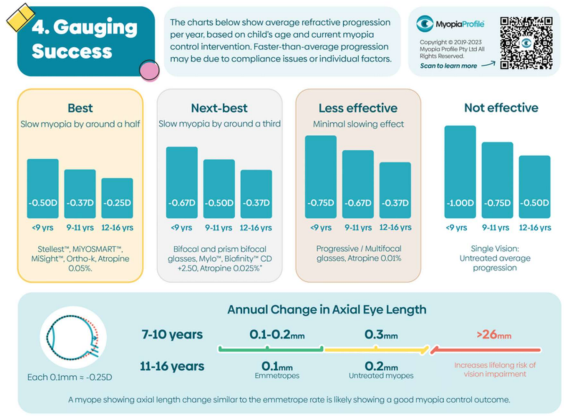


ATROPINE	MULTIFOCAL CLS	ORTHOKERATOLOGY
Visual Acuity Biometry Refraction Slit Lamp (w. stain)	+ Over-refraction	+ Slit Lamp (w. stain) with & without lenses

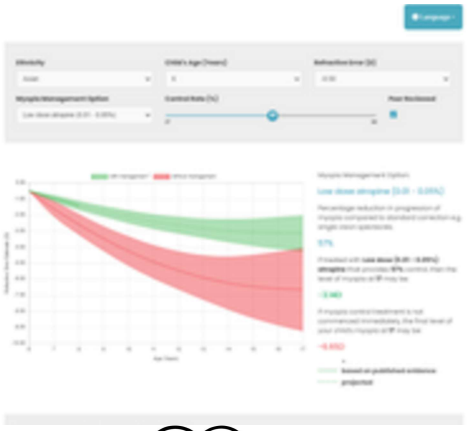
FOLLOW UP PROTOCOL

- **Aggressive Myopia**
  - High risk factors - young age, genetics, previous progression
  - Growth spurt
  - Winter months
- **Non-compliance**
  - A: burns?
  - MF CLs: Time in AM?
- **User Error**
  - A: Not instilling correctly
  - OK: Not wearing long enough

IS IT WORKING?



- **Binocular Vision**
  - High lag of accommodation?
  - Intermittent exo?
- **Visual Environment**
  - Outdoor time
  - Breaks from near work
- **Insufficient Treatment**
  - Pupil size
  - Treatment centration
  - Dosage



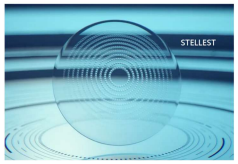
- ☑ **Consider all risk factors**
- ☑ **Increase ttx**
  - Higher add
  - Increase atropine concentration
  - Change ortho-k design
- ☑ **Add combination therapy**
- ☑ **Switch modalities**

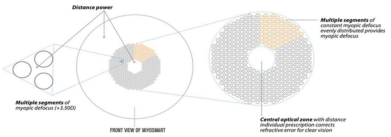
On the Horizon
SPECTACLES

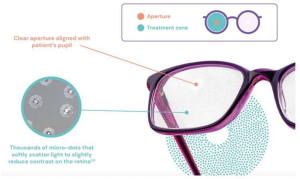
Study	Period (months)	Treatment Effect in Slowing Myopia Progression over the Study Period (compared to single vision lenses as control)	
		Mean Adjusted Difference in Dioptres	Mean Adjusted Difference in mm of Axial Length
MIYOSMART (DIMS)			
Lam et al. (2020)[11]	12	-0.27 (54%)	-0.22 (67%)
Lam et al. (2020)[11]	24	-0.44 (52%)	-0.34 (62%)
Stellest (DIMS)			
Bao et al. (2021) [8]	12	-0.50 (63%)	-0.21 (61%)
Bao et al. (2022)[9]	24	-0.77 (53%)	-0.34 (50%)
SightGlass (DOT)			
Rappon et al. (2022)*	24	-0.52 (?)^	-0.21 (?)^

*Interim data presented at ARVO 2022
^Statistical analysis method not disclosed. Percentage value not disclosed. Subjects who removed test spectacles for near tasks were excluded from this analysis

reviewofmm.com/myopia-control-with-innovative-spectacle-lenses/







On the Horizon: RED LIGHT THERAPY

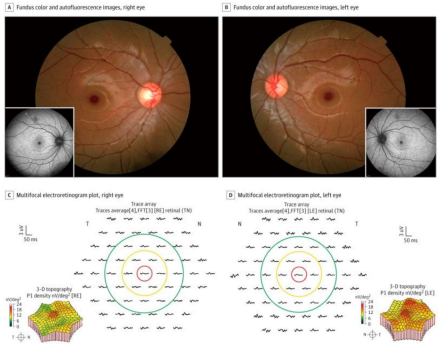
Participants: n= 264 children randomly assigned to the intervention group [RLRL treatment plus single vision spectacle (SVS)] and control group (SVS).
- 12 months

TTX: desktop light therapy device (red light of 650 nm wavelength with illuminance level of ~1600 lux and a power of 0.29 mW for a 4-mm pupil.
- At home under the supervision of parents, three minutes per session, twice per day with a minimum interval of four hours, five days per week.

Outcome: RLRL treatment slowed axial elongation by 0.26 mm and SER progression by 0.59D compared with SVS
- 69.4% and 76.6% slowing axial elongation and myopic refraction progression.

Jiang, Y., Zhu, Z., Tan, X., Kong, X., Zhong, H., Zhang, J., ... & He, M. (2021). Effect of Repeated Low-Level Red-Light Therapy in Myopia Control in Children: A Multicenter Randomized Controlled Trial. Ophthalmology.

On the Horizon: RED LIGHT THERAPY



12 year old female with bilateral vision loss after 5-month use of RLRL laser exposure

Vision: BCVA declined from 20/20 to 20/30 U

Ocular Health Findings:
- Darkened foveae with hypoautofluorescent plaque in autofluorescence images
- Foveal ellipsoid zone disruption, OU
- Interdigitation zone discontinuity
- ERG: moderately reduced response in macula

3 months later:
Bilateral outer retinal damage partially recovered
BCVA improved to 20/25 OU

On the Horizon: RED LIGHT THERAPY


Repeated Low-Level Red-Light Therapy: Critical Questions Remain

December 1, 2023

By Dwight Akerman, OD, MBA, FAAO, FBCLA, FIACLE


Low-Level Red Light Therapy: Safety Concerns Continue

February 15, 2024

By Dwight Akerman, OD, MBA, FAAO, FBCLA, FIACLE

Photo Credit: Prostockstudio, Dreamstime Photos

TALKING TO PARENTS

Develop a Script

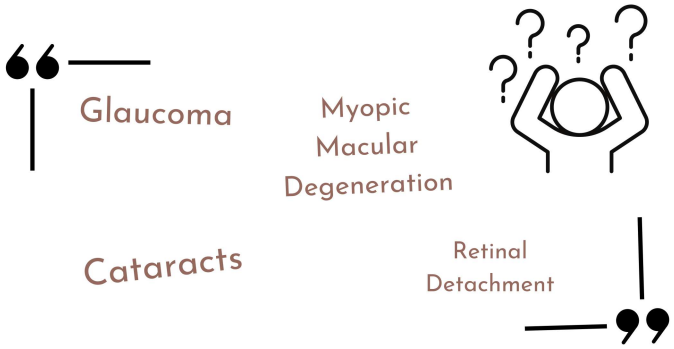
Provide Resources

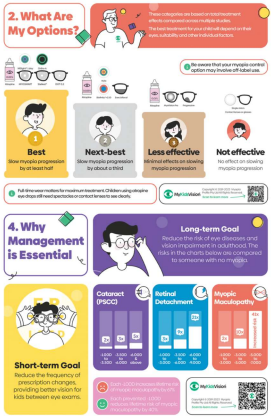
Brochures

Email

MM Specialty Tech

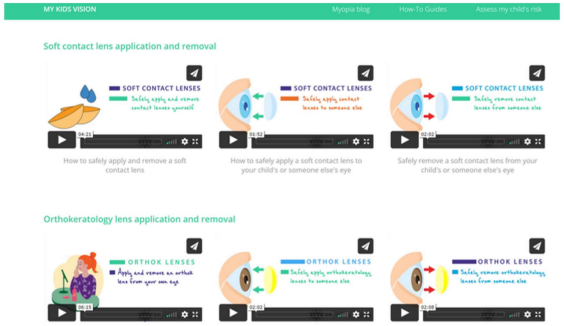
Focus on Emotion vs Scare Tactics





Use Examples that Resonate

Give Homework Before I&R



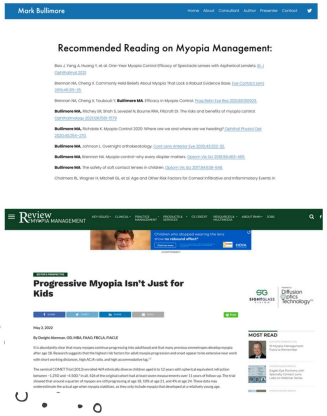
The Importance of Myopia Management

Risk Factors for Developing Myopia/High Myopia

Myopia Management Treatment Options & Prescribing Guide

THANK YOU!

Ariel Cerenzie, OD, FSLS, FAAO
drc@charlottecontactlens.com



Setting Your Fees