

Saving Generations of Future Myopic Eye Disease



Justin Kwan, OD, FAAO

Financial Disclosures

- ▶ Visioneering Technologies, Inc.
- ▶ Speakers bureau

Contact Lens SPECTRUM

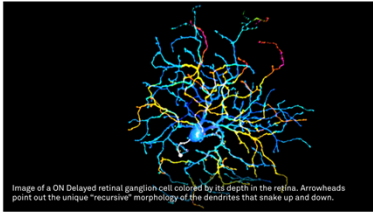
- ▶ Based on a poll of the readers of Contact Lens Spectrum, 24% of eye care professionals regularly practice myopia control with contact lenses. (n = 500)
- ▶ That number should be closer to 75%
- ▶ Friday, May 29, 2015
 - ▶ Can we afford to do nothing?

Myopia cell discovered in retina

Dysfunction of cell may be linked to amount of time a child spends indoors

February 06, 2017 | By Marla Paul



Trending

- Unprecedented look at electron brings us closer to understanding the universe
October 17, 2018 - Science & Tech
- Liberal arts behind bars
October 17, 2018 - University
- Researchers further unravel mystery of how black widow spiders create steel-strength silk web
October 22, 2018 - Science & Tech

CHICAGO - Northwestern Medicine scientists have discovered a cell in the retina that may cause myopia when it dysfunctions. The dysfunction may be linked to the amount of time a child spends indoors and away from natural light.

You Might Also Like




Screen time at close range could lead to 'tsunami of myopia' and eyesight issues
ABC Online · Mar 12, 2018

An app to tackle myopia
ADP · Mar 13, 2018


Canadian kids and myopia
ADP · Feb 27, 2018

Gene changes driving myopia reveal new focus for drug development: Pathways underlying nearsightedness and farsightedness are different, not opposite
Science Daily · 17 days ago


Myopia in Children: Can You Prevent or Treat it? | Health Plus
AsiaOne · 20 days ago

MicroPine phase 3 trial for myopia to begin in 2019
Heallo · Feb 21, 2018



Flowchart details:
 - SCREENING: Age 5-13, Myopia 1-6D
 - ENROLLMENT (N=337): MicroPine vs Placebo
 - Randomization:
 - MicroPine (MP) μD1 OD: N=167
 - MicroPine (MP) μD2 OD: N=167
 - Placebo: N=167
 - Primary EP: 12M, 24M, 36M
 - Follow-up: 12M



Faculty

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THOMAS ALLER, OD is a professor and medical director of Contact Lens Spectrums at the University of North Carolina at Chapel Hill. He is also a member of the American College of Optometry and the American Society of Contact Lens Specialists. He has been practicing optometry for over 20 years and is currently serving as the president of the American Society of Contact Lens Specialists.

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The Truth About Myopia PART 2

Myopia management in clinical practice

S. Barry Ecker, OD (Invited) Welcome to the second in a series of guest discussions addressing myopia and its management. In the first discussion, the guest authors set forth multiple relevant issues that are critical to the success of myopia management. They talked about the importance of myopia management as a disease rather than a refractive error. They also discussed approaches to the management of myopia and the current and potential role of myopia management in the overall management of myopia. In addition, they presented findings and experience related to the most common options for myopia management: orthokeratology, low-dose atropine, and contact lenses with optical center blur. A summary of the first discussion can be found on the Contact Lens Spectrums website.

In this second discussion, we also delve into the clinical and practice management aspects of myopia management, which are crucial for doctors and practices to understand as they establish a myopia management program. A solid framework for such an initiative is built out for you.

1. Care has been taken about myopia progression.
 2. Control of axial elongation is achieved.
 3. Communication effectively about myopia management with patients and families.
 4. Customized treatment for each patient.
- “The first step is to learn as much as you can about myopia to understand why it's something that needs to be treated differently than it has been treated historically.”**
 THOMAS ALLER, OD

RINGSTED HIGH SCHOOL CLASS OF '58

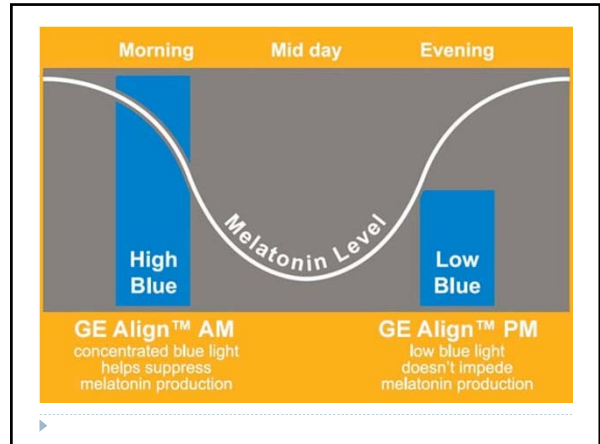
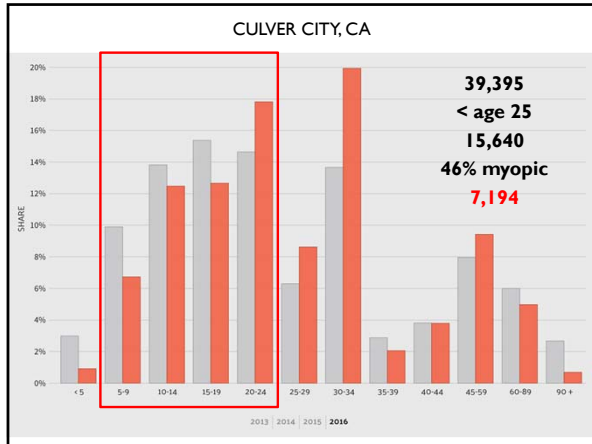
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Fourth Grade

Ben B.	Henry B.	Harold B.	Gaby C.	Maxim C.	Garrett C.
Payton C.	Camden D.	Coris D.	Tessie D.	Trina D.	Daniel D.
Nicholas E.	Brady E.	Colin E.	Matthew G.	Alexander H.	Daniel L.
Stacy L.	Phyllis L.	Eric M.	Joe M.	Jack M.	



Why is my child nearsighted?

HEREDITY IS A FACTOR FOR HYPOPIA. But not the only one. If both parents are nearsighted, there is a greater risk that their kids will be nearsighted, too.

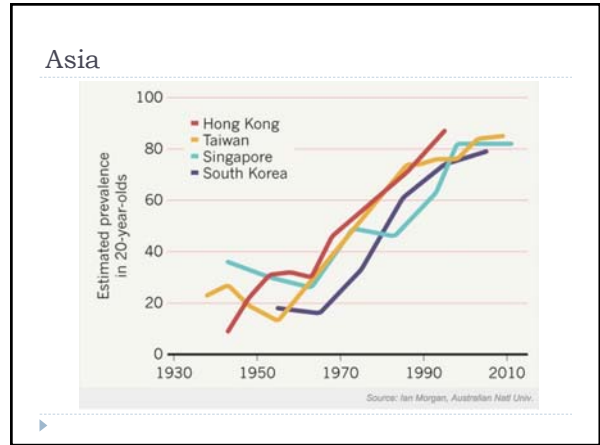
More People Are Becoming Nearsighted
In the early 1970s, only 25% of Americans were nearsighted. Today the prevalence of myopia in the U.S. is about 42%.

Myopia is even more prevalent in Asia. In some countries, UP TO 80% OF THE POPULATION is myopic.

Children who spend a lot of time engaged in near activities (reading, using hand-held electronics, etc.) appear to have a greater risk of becoming nearsighted. Research also shows **SPENDING MORE TIME OUTDOORS LOWERS THE RISK** of childhood myopia. So tell your kids to go outside and play!

25% (1970s) vs **42%** (2000s)

80% Asia



Global eye health alert:

number of people who will be nearsighted by 2050 will increase from 1.4 billion (2000) to **5 billion (2050)**

Global eye health alert:
number of high myopes (refractive error greater than 3.00 diopters) will increase from 183 million (2000) to **1 billion (2050)**

New Australia & New Zealand eye health alert:

number of myopes (short-sightedness) in Australia & New Zealand will increase from 2 million (2000) to **22 million (2050)**

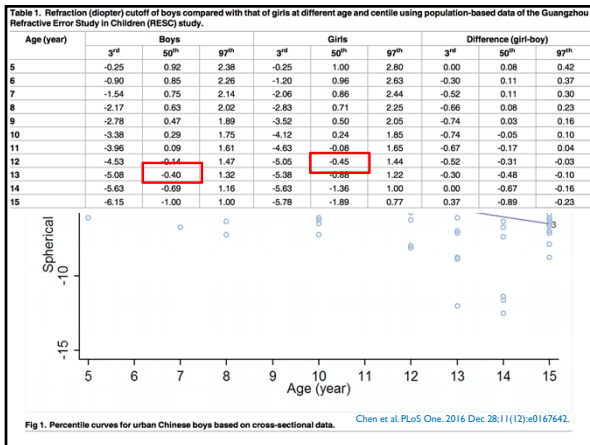
New East Asia eye health alert:

number of myopes (short-sightedness) in East Asia will increase from 133 million (2000) to **941 million (2050)**

Brien Holden

Near Work

- ▶ Johannes Kepler, 1611
 - ▶ Blamed his own shortsightedness on all his study



Parents, make sure you

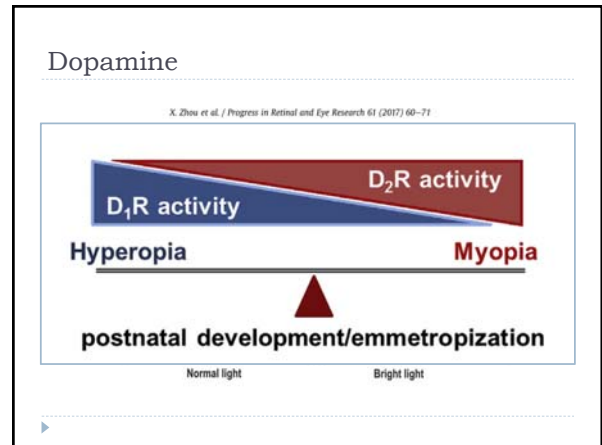
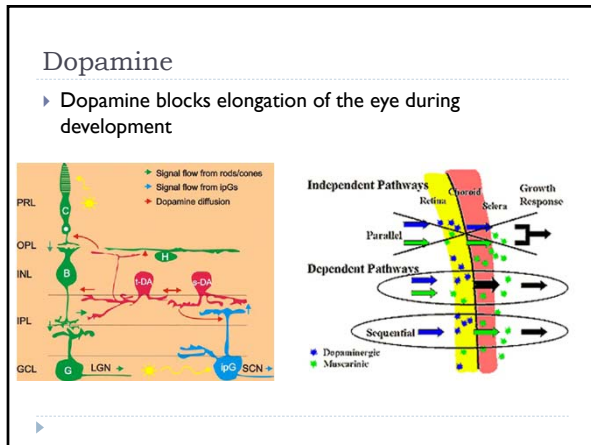
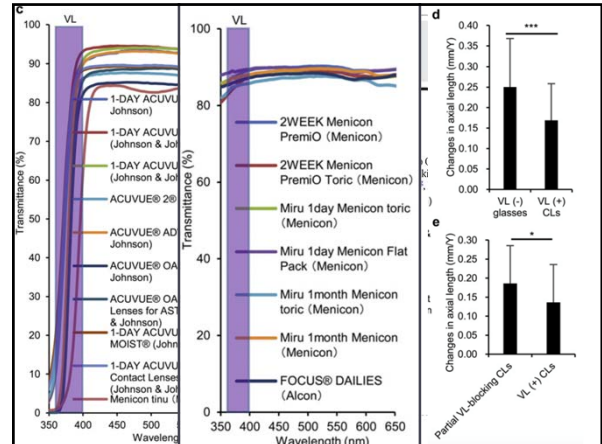
- ▶ Southern Taiwan
 - ▶ Teachers asked to send children to their daily break time instead inside
 - ▶ After one year, doctors had 18% of children, compared with 18%
- ▶ Guangzhou (Zhongshan Op
 - ▶ Three year trial, 900+ kids
 - ▶ 40 minute outdoor class added for a group of six and seven schools
 - ▶ 30% developed myopia by age of those at the control school

Science National Myopia Program/Health Promotion



Table 2. Association of Ultraviolet B Radiation Exposure, Education, Serum Vitamin D₃ Concentrations, and Lutein Concentrations With Myopia

Characteristic	Adjusted OR (95% CI) ^a	P Value ^b	Adjusted OR (95% CI) ^c	P Value ^b
UVB exposure (1 SD increase)	0.72 (0.56-0.93)	.01	0.75 (0.58-0.97)	.03
Years of education, median		.001		< .001
First tertile (7)	1 [Reference]	NA	1 [Reference]	NA
Second tertile (10)	1.26 (0.99-1.58)	.06	1.22 (0.96-1.57)	.10
Third tertile (14)	2.08 (1.41-3.06)	.001	2.04 (1.40-2.96)	.001
25(OH)D ₃ concentrations (continuous)	0.99 (0.98-1.00)	.48	NA	NA
Quintiles of 25(OH)D ₃ median, nmol/L		.31		.31
First quintile (19.9)	1 [Reference]	NA	1 [Reference]	NA
Second quintile (33.1)	0.96 (0.79-1.31)	.78	0.95 (0.74-1.22)	.77
Third quintile (45.3)	0.87 (0.64-1.38)	.55	0.89 (0.59-1.36)	.62
Fourth quintile (58.9)	0.75 (0.47-1.20)	.24	0.78 (0.51-1.20)	.28
Fifth quintile (77.0)	0.87 (0.51-1.47)	.60	0.87 (0.56-1.38)	.59
Quintiles of plasma lutein, median, μmol/L		<.001		<.001
First quintile (0.03)	1 [Reference]	NA	1 [Reference]	NA
Second quintile (0.05)	0.93 (0.80-1.08)	.34	0.94 (0.81-1.10)	.48
Third quintile (0.11)	0.82 (0.55-1.20)	.30	0.83 (0.55-1.25)	.39
Fourth quintile (0.22)	0.89 (0.62-1.27)	.51	0.87 (0.63-1.19)	.41
Fifth quintile (0.48)	0.57 (0.46-0.72)	.001	0.59 (0.48-0.73)	<.001



Avon Longitudinal Study of Parents and Children

- Population based birth cohort
- Maternal report of time outdoors at age 8 years
- Vitamin D2 and D3 at age 10 years

Guggenheim et al. Invest. Ophthalmol Vis Sci. 2014 Nov 18;55(12):8550-8.

Avon Longitudinal Study of Parents and Children


- “On a weekend day, how much time on average does your child spend each day out of doors in summer?”
 - 3 or more hours = high
 - Less than 3 hours = low
- No independent association between **vitamin D** and **incident myopia**
 - HR = 0.83 [0.66-1.04], p = 0.11
- **Time outdoors** retained same strong negative association with **incident myopia**
 - HR = 0.69 [0.55-0.86], p = 0.001

Guggenheim et al. Invest. Ophthalmol Vis Sci. 2014 Nov 18;55(12):8550-8.

Polling et al. Invest Ophthalmol Vis Sci. June 2013, Vol. 54, 5702.


Rotterdam, Netherlands

- ▶ Generation R study
 - ▶ multi-ethnic population-based birth-cohort study
- ▶ 6,690 children (six year olds)
- ▶ Duration of time spent outdoors **per day**
 - ▶ < 1 hour → 22.41 mm axial length OR: 1.34
 - ▶ 1-2 hours p < 0.001
 - ▶ > 2 hours → 22.33 mm axial length
- ▶ Near work per day (p = 0.14)
 - ▶ < 15 min
 - ▶ 15-30 min
 - ▶ > 30 min




ARVO 2015: Cebu, Philippines

- ▶ 1,272 children
- ▶ Myopia defined as less than -0.50 diopters



10.60 ± 2.79 years old
3.00%



9.93 ± 1.89 years old
12.50%

Review Article

Physical activity in relation to progression of myopia – a review

Anne Suhr Thykjær,^{1,2} Kristian Lundberg^{1,2} and Jakob Jensen^{1,2}

¹Research Unit of Ophthalmology, Department of Clinical Research, Odense University Hospital, Odense; ²Department of Ophthalmology, Odense University Hospital, Odense.

Discussion

In an evaluation of 17 634 subjects in nine clinical studies, we found a general connection between PA and a lower risk of myopia. This was statistically significant in five studies (Parssinen et al. 1985; Mutti et al. 2002; Khader et al. 2006; Jacobsen et al. 2008; O'Donoghue et al. 2015), and also indicated in three other studies (Rose et al. 2008; Dirani et al. 2009; Guggenheim et al. 2012).

- ▶ No evidence of physical activity as an independent risk factor for myopia was seen
- ▶ Evidence suggests that time outdoors remain the most important factor

Sydney Adolescent Vascular and Eye Study

Most Myopic
< 14 hours / week **outdoors** & > 25.5 hours / week of near work

Least Myopic
High time **outdoors** & < 17.5 hours / week of near work

Near work time > time outdoors
Baseline
2.69 greater odds of myopia


Follow-Up
1.95 greater odds of myopia

- ▶ Time outdoors reduces the incidence of myopia onset but the evidence is unclear if it slows the rate of myopia progression.

Zadnik et al. Prediction of Juvenile-Onset Myopia. JAMA Ophthalmol. 2015 Apr 2.

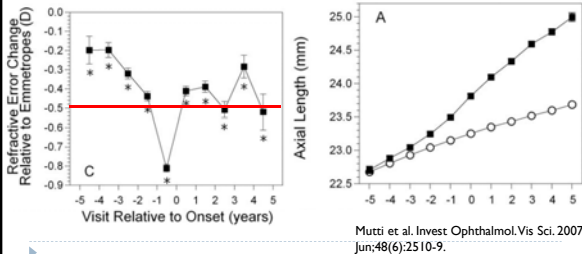
Who's going to be a myope?

- ▶ CLEERE: Sep 1989 to May 2010, 5 sites
- ▶ 4,512 ethnically diverse, non-myopic, grades 1-8
- ▶ 13 possible predictor variables
 - ▶ Cycloplegic spherical equivalent refractive error
 - ▶ BEST PREDICTOR
 - ▶ < +0.75 are at increased risk for developing myopia
- ▶ Myopic parents
 - ▶ 1 myopic parent: 2.94 (1.51-5.76)
 - ▶ 2 myopic parents: 7.73 (3.43-17.41)
- ▶ Time spent outdoors (hours/week)
 - ▶ Reduced risk by 2-4%



When is the fastest rate of progression?

- ▶ CLEERE Study
- ▶ Children 6 to 14 years of age participating between 1995 and 2003



Don Mutti, OD, PhD

“100% myopia control is delaying the onset of myopia by one year.”

Why does percentage slowing matter?

- ▶ Reducing the **rate** of myopia progression by
 - ▶ 33% would lead to a reduction of 73% in the freq of high myopia
 - ▶ 50% would lead to a reduction of 90% in the freq of high myopia
- ▶ High myopia (> 5 D) is accompanied by an increased risk
 - ▶ Choroidal neovascularization (CNV)
 - ▶ Retinal detachment
 - ▶ Glaucoma
 - ▶ Cataract



Brennan N. Predicted reduction in high myopia for various degrees of myopia control. Contact Lens & Anterior Eye. Dec 2012 Vol 35, Suppl 1, p e14-e15.

Myopia & Age-Related Cataracts

Type	Odds Ratio [95% confidence interval]
Nuclear	2.81 [1.94-4.06]
Cortical	1.08 [0.90-1.30]
Posterior subcapsular	1.93 [1.49-2.49]

- ▶ Systematic review of 12 population-based studies
- ▶ 38,007 subjects aged 30-97

Pan CW et al. Am J Ophthalmol. 2013 Nov;156(5):1021-1033.

Optic Disc Features in Highly Myopic Eyes: The ZOC-BHVI High Myopia Cohort Study

Zhixi Li, MD,¹ Xinxing Guo, MD, PhD,^{1,2} Ou Xiao, MD,¹ Pei Ying Lee, BOptom,³ Ran Liu, MD,¹ Decai Wang, MD, PhD,¹ Padmaja Sankaridurg, PhD,⁴ and Mingguang He, MD, PhD^{1,3*}

- ▶ -9.36 ± 3.46 D
- ▶ Axial length: 27.51 ± 1.63 mm
- ▶ Optic disc
 - ▶ Tilt: 81.2%
 - ▶ Rotation: 48.3%
 - ▶ β-zone PPA: 92.8%



 Hong Kong Laser Eye Centre
Hong Kong Eye Care Centre



Table 1: Characteristics of the Two Groups based on their Refractive Status

Variable	Myopia		p
	High (≤ -6.00 D)	Mild to Moderate (> -6.00 D)	
Number (%) of eyes	231 (55)	189 (45)	-
Age (Years)	36.55 (21-55)	32.74 (21-59)	<0.001
Sph Equ (D)	-8.19 (-14.88, -6.00)	-4.58 (-5.88, -2.38)	-
Axial length (mm)	26.74 (24.35-30.91)	25.41 (23.45-27.28)	<0.001
IOP (mm Hg)	13.31 (9-21)	12.53 (8-18)	<0.001
Average RNFL (µm)	87.82 (65.0-110.5)	91.74 (65.0-112.0)	<0.001
Vertical CDR	0.38 (0.06-0.83)	0.40 (0.06-0.75)	0.207
CCT (µm)	553.71 (490-656)	555.17 (471-663)	0.634

Biswas et al. Prevalence and risk factors of glaucoma in myopic subjects attending a corneal refractive surgery clinic in Hong Kong. ARVO Poster, 2014.

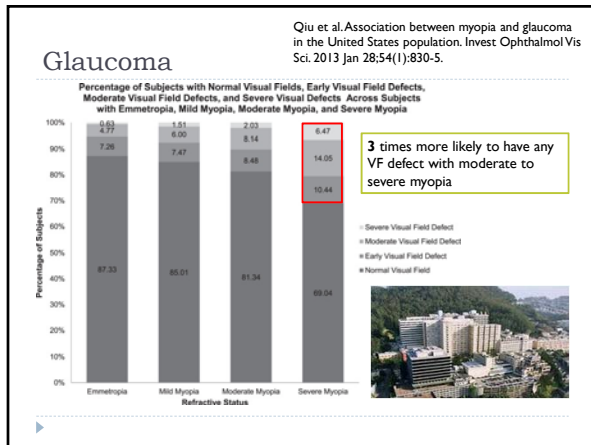
OCT-RNFL

Malakar et al. Optical Coherence Tomography Assisted Retinal Nerve Fibre Layer Thickness Profile in High Myopia. J Clin Diagn Res. 2015 Feb; 9(2): NC01-NC03.

▶ Age: 11 to 40 years old

RNFL Thickness	Group I Mean±SD (µm)	Group II Mean±SD (µm)	95% CI (µm)	p-value
Average	87.89±10.37	111.64±12.6	-28.59 to -18.91	=0.00001
Temporal	70.06±14.13	81.30±10.51	-16.57 to -05.90	=0.00068
Superior	109.47±19.83	137±23.64	-36.63 to -18.42	=0.00001
Nasal	67.06±17.37	86.80±14.95	-26.63 to -12.85	=0.00001
Inferior	104.74±14.05	141.5±19.63	-43.81 to -29.68	=0.00001

[Table/Fig-3]: Retinal nerve fibre thickness in Group I (Myopia) and Group II (Emmetropia)



Myopic Macular Degeneration

- ▶ Leading cause of impaired vision for persons aged between 55 and 75 years in the Netherlands
- ▶ In Italy and Taiwan, it is the second most common cause of low vision
- ▶ Bilateral, irreversible, frequently affects individuals during their **most productive years**

Ohno-Matsui et al. Myopic Macular Degeneration. Retina. Fifth Edition. 2013. Chapter 68, 1256-1266.

CHES: Chinese American Eye Study

USC Roski Eye Institute researchers publish largest eye study among Chinese Americans identify

- AREA 1: Check-in, participant verification, and informed consent
- AREA 2: Clinical questionnaire, blood pressure, pulse rate, height, weight, waist and hip measurement
- AREA 3: Presenting best-corrected visual acuity, presenting best-corrected near vision, refraction, lensometry
- AREA 4: Pupil assessment, visual fields (SITA Standard 24-2)
- AREA 5: IOP, IOL Master, angle assessment (gonioscopy, Goldmann), slit lamp examination, random blood glucose, glycosylated hemoglobin (HbA1c), DNA collection, pupil dilation
- AREA 6: Cirrus OCT, blood flow, fundus photography, stereo disc photography, pachymetry
- AREA 7: Posterior segment examination, summary report, referral, gift certificate, check-out

CHES: Chinese American Eye Study

- ▶ Monterey Park
- ▶ 4000+ participants aged 50 and older
- ▶ AMD: 8.1%
- ▶ Myopes: 1,523
 - ▶ 32% had myopic macular degeneration
 - ▶ Axial length: 2.6 greater odds per mm longer

Myopic Macular Degeneration

- ▶ Shihpai, Taiwan
- ▶ Population-based cross-sectional study
- ▶ 2,045 elderly Chinese 65 years of age or older
- ▶ Cause of visual impairment
 - ▶ Cataract: 41.7%
 - ▶ Myopic macular degeneration: 12.5%
 - ▶ Age-related macular degeneration: 10.4%

Hsu et al. Prevalence and causes of visual impairment in an elderly Chinese population in Taiwan: the Shihpai Eye Study. *Ophthalmology*. 2004 Jan;111(1):62-9.

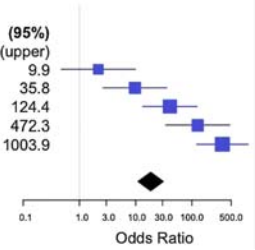


Myopic Maculopathy

Vonghanit et al.

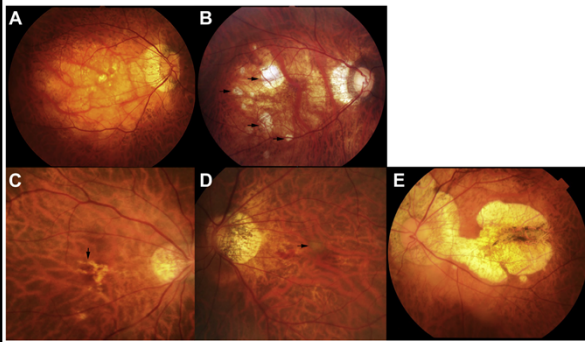
	OR	CI (95%) (lower)	CI (95%) (upper)
-1.0 to -2.99D	2.2	0.47	9.9
-3.0 to -4.99D	9.7	2.63	35.8
-5.0 to -6.99D	40.6	13.27	124.4
-7.0 to -8.99D	126.8	34.02	472.3
<=-9.0D	348.6	121.05	1003.9

Any Myopia 18



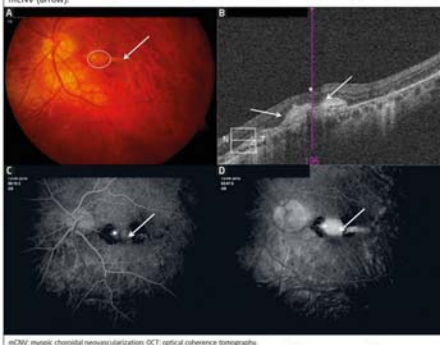
Vongphanit J, Mithcell P, Wang JJ. Prevalence and progression of myopic retinopathy in an older population. *Ophthalmology* 2002 Apr;109(4):704-11.

Fang et al · Long-Term Progression of Myopic Maculopathy



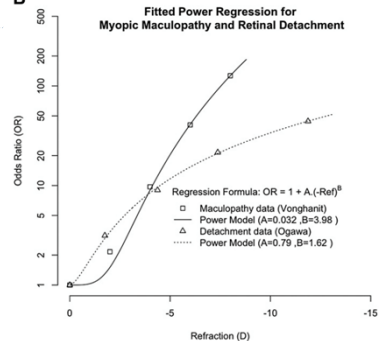
Characteristics	Total Cohort	High Myopia without Pathologic Myopia Cohort	Pathologic Myopia Cohort
No. of eyes (%)	810	289 (35.7%)	521 (64.3%)
Age, yrs			
Mean ± SD	42.3±16.8	32.4±16.5	47.7±14.2
Range	3-85	3-85	7-76
Axial length, mm			
Mean ± SD	28.8±1.9	27.6±1.4	29.4±1.8
Range	24.2-34.3	24.2-31.1	25.1-34.3
BCVA, logMAR			
Mean ± SD	0.26±0.41	0.03±0.19	0.39±0.44
Range	-0.18 to 2.00	-0.18 to 1.00	-0.18 to 2.00
Modified myopic maculopathy according to META-PM study, no. (%)			
Category 0 (no maculopathy)	22 (2.7)	22 (7.7)	10 (1.9)
Category 1 (retesclerated fundus)	277 (34.2)	267 (92.4)	361 (69.3)
Category 2 (diffuse atrophy)	361 (44.6)		115 (22.1)
Category 3 (patchy atrophy)	115 (14.2)		35 (6.7)
Category 4 (macular atrophy)	35 (4.3)		140 (26.9)
Myopic CNV (including CNV-related macular atrophy)	140 (17.3)		116 (22.2)
Lacquer cracks	116 (14.3)		

Figure 1. Fundus photograph of a highly myopic patient with a lacquer crack (arrow) and mCNV (encircled; A). OCT shows the relative position of the fovea (asterisk) and the mCNV (arrows; B). Note that the mCNV is located directly under the fovea. Early (C) and late (D) fluorescein angiogram phases show fluorescein leakage from the mCNV. Note that the fovea (asterisk) is within the limits of the mCNV (arrow).



mCNV: myopic choroidal neovascularization; OCT: optical coherence tomography.
Images courtesy of Retinmedia Journals.
http://www.retmedjournal.com/10.1007/s12078-012-0010-0
Retinmedia Journals Management of Myopic Choroidal Neovascularization

Fitted Power Regression for Myopic Maculopathy and Retinal Detachment



JAMA Ophthalmology | Original Investigation

Association of Axial Length With Risk of Uncorrectable Visual Impairment for Europeans With Myopia

Table 2. Risk of Visual Impairment by Axial Length and Spherical Equivalent Category by Age

Category	OR (95% CI)	
	<60 y	≥60 y
Axial length, mm		
<24	1 [Reference]	1 [Reference]
24 to <26	0.95 (0.51 to 1.80)	0.65 (0.29 to 1.48)
26 to <28	2.01 (0.88 to 4.62)	3.07 (1.26 to 7.49)
28 to <30	11.01 (5.23 to 23.20)	9.69 (3.06 to 30.71)
≥30	24.69 (11.02 to 55.31)	93.62 (38.35 to 228.55)
Spherical equivalent, D		
>-0.5	1 [Reference]	1 [Reference]
-0.5 to >-3	0.69 (0.34 to 1.43)	0.92 (0.62 to 1.35)
-3 to >-6	1.42 (0.66 to 3.05)	1.71 (1.07 to 2.74)
-6 to >-10	2.95 (1.35 to 6.42)	5.54 (3.12 to 9.85)
-10 to >-15	6.79 (2.87 to 16.06)	7.77 (3.36 to 17.99)
≤-15	27.85 (11.34 to 68.37)	87.63 (34.50 to 222.58)

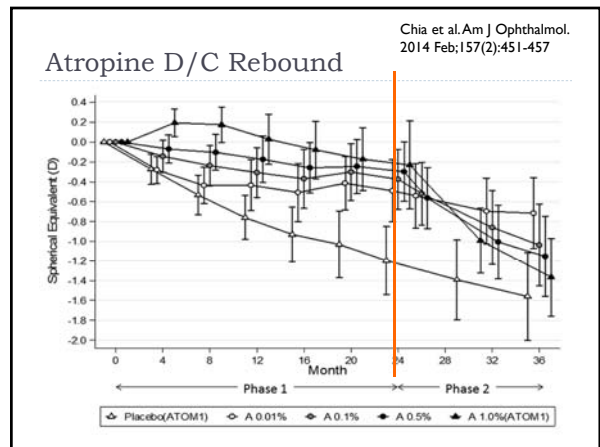
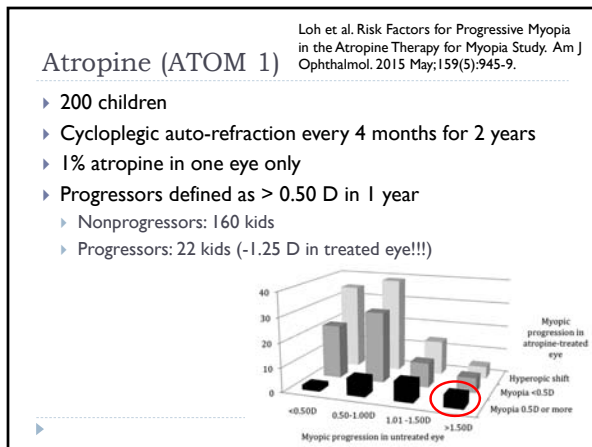
“There is no safe level of myopia.”
-Ian Flitcroft

- ### Better Candidates for LASIK
- ▶ Only 17% of patients that get LASIK were referred by their optometrist
 - ▶ Minimal central corneal thickness for a -6.00 ablation is 496 microns
 - ▶ Conservative 300 micron stromal bed
 - ▶ 100 micron flap thickness (Intralase 150 kHz, Ziemer Z4, or WaveLight FS200)
 - ▶ 96 microns (16 microns per diopter)

TREATMENTS

- ▶ Optical Corrections
 - ▶ Hyperopic defocus to myopic defocus
 - ▶ Long lasting effects
- ▶ Drug
 - ▶ Rebound effect?
 - ▶ Temporary control?

Bilberry **Blueberry**



Atropine 0.125% vs. Orthokeratology

▶ Baseline -4.12 sph, -0.62 cyl

Table 4 Increase of myopia, stigmatism and axial length in each year

Year/myopia (D)	OK lens ^a	Atropine ^b
1	0.29 ± 0.31	0.31 ± 0.19
2	0.27 ± 0.24	0.35 ± 0.25
3	0.28 ± 0.31	0.32 ± 0.23
Year/astigmatism (D)	OK ^a	Atropine ^b
1	±0.08 ± 0.11	±0.03 ± 0.02
2	±0.08 ± 0.42	±0.09 ± 0.12
3	±0.12 ± 0.35	±0.11 ± 0.16
Year/axial length (mm)	OK lens ^a	Atropine ^b
1	0.28 ± 0.08	0.38 ± 0.09
2	0.30 ± 0.09	0.37 ± 0.12
3	0.27 ± 0.10	0.36 ± 0.08

Lin et al. Overnight orthokeratology is comparable with atropine in controlling myopia. BMC Ophthalmol. 2014 Mar 31;14:40.

^aOK: Orthokeratology.
^b0.125% atropine.

LAMP study

▶ Low-concentration Atropine for Myopia Progression

- ▶ 438 children
- ▶ Age 4 to 12 years
- ▶ 1 gtt OU QHS x 1 year

Atropine concentration	Mean SE change	Axial length increase
0.05%	-0.27 ± 0.61	0.20 ± 0.25 mm
0.025%	-0.46 ± 0.45	0.29 ± 0.20 mm
0.01%	-0.59 ± 0.61	0.36 ± 0.29 mm
Placebo	-0.81 ± 0.53	0.41 ± 0.22 mm

Another diluted atropine study

Atropine concentration	Mean SE change Diopters / month	Axial length increase
0.05%	-0.019	0.019 mm
0.025%	-0.047	0.025 mm
0.01%	-0.07	0.037 mm
Before atropine	-0.134	0.046 mm

- ▶ 285 children
- ▶ 6.8% of the 0.05% atropine group still progressed 0.5 to 1 D / year
- ▶ NPA > 10 D in all three atropine groups
- ▶ Family history increases odds of myopia by 8.155 times [3.6 to 18.3]

▶ Moon JS, Shin SY. The diluted atropine inhibition of myopia progression in Korean children. Int J Ophthalmol. 2018 Oct;18(11):1657-1662.

Kate Gifford

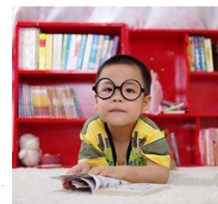
Atropine dosage:	ATOM2 study Chia et al 2012			LAMP study Yam et al 2018		
	0.5%	0.1%	0.01%	0.01%	0.025%	0.05%
Mydriasis (mm)	+3	+3	+1	+0.5	+0.8	+1
Amps baseline (D)	15.8	16.7	16.2	1 year amps reduction		
Amps 2 weeks	2.2	3.8	11.3			
Amps 2 years	4.0	6.8	11.8	-0.3D	-2D	-1.6D
Refractive efficacy (%)	75	68	59	27	43	66
Axial efficacy (%)	29	25	-8	12	29	51

Atropine

- ▶ Off label
- ▶ Eye Care & Cure
 - ▶ Atropine 1.0%
 - ▶ 5 mL \$14.50
 - ▶ 15 mL \$38.00
- ▶ Leiter's Compounding Pharmacy (San Jose, CA)
 - ▶ Atropine Sulfate Ophthalmic Solution (0.01%, 0.025%, 0.1%)
 - ▶ 5 mL \$60
 - ▶ 10 mL \$69.44 = \$253 per year (2 drops per night)



- Atropine Eye Drops
 - Most requested strength*: 0.01%
 - Low dose
 - For childhood myopia
- Anti-oxidants



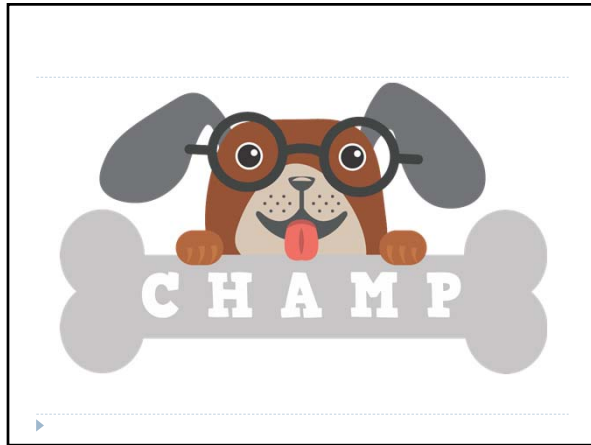
San Diego Optimum Compounding Pharmacy
 Call Us +1 (858) 433-1011 | 12265 Scripps Poway Parkway, Suite 114, Poway, CA 92064

- ▶ 5 mL = \$50
- ▶ 10 mL = \$95
- ▶ 15 mL = \$140
- ▶ Shelf life 30 days outside of fridge, 90 days inside of fridge
- ▶ Shipping included

Atropine
 1 eye dropper (5ml) 1%

Los Angeles, CA

CVS Pharmacy 2.4 miles	COUPON \$24.75
Target (CVS) 2.9 miles	COUPON \$24.75
Walgreens 0.8 miles	COUPON \$28.10
Community, a Walgreens Pharmacy 2.0 miles	COUPON \$28.10
Ralphs 1.0 mile	COUPON \$49.97
Rite Aid 2.1 miles	COUPON \$56.90



Actual Study Start Date: November 20, 2017
 Estimated Primary Completion Date: November 2021
 Estimated Study Completion Date: November 2022

- ▶ Multicenter randomized trial (FDA)
- ▶ 3 treatment arms (placebo, 0.01%, 0.02% atropine at 2:2:3 ratio)
- ▶ Instillation of drops every night; single use, preservative free vials
- ▶ 4-year study: 2 stages (efficacy for 3 years, cross over for last year)
- ▶ Baseline and 6-month visits
- ▶ 3-month visits (provide study drug; compliance check - short visit)
- ▶ No cost for drops or examination visits
- ▶ Study visit compensation provided to family (\$50/visit & \$5 gift card to child) and \$200/year toward optical

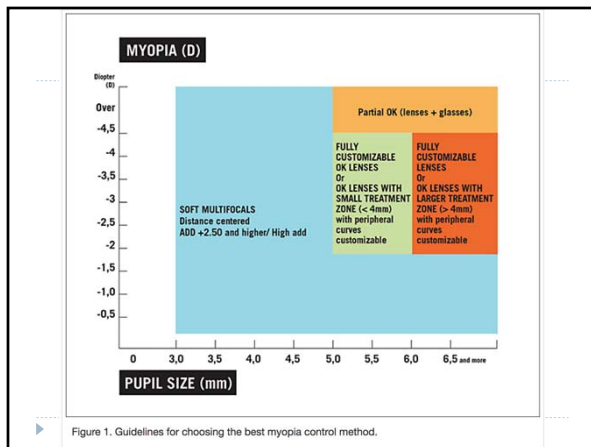


Figure 1. Guidelines for choosing the best myopia control method.

Stapleton et al. The incidence of contact lens-related microbial keratitis in Australia. *Ophthalmology*. 2008 Oct; 115(10): 1655-62.

Orthokeratology

Method	Incidence in 10,000
Glasses	1
Corneal GPs	1.2
SCL (hydrogel) daily wear	1.9-4.2
SCL (silicone hydrogel) daily wear	11.9
SCL (hydrogel) extended wear	19.5
SCL (silicone hydrogel) extended wear	25.4

- ▶ National Taiwan University Hospital
 - ▶ 10 cases in 15 months
- ▶ Chang Gung Memorial Hospital
 - ▶ 68 cases in 4 years

Orthokeratology

Stapleton et al. The incidence of contact lens-related microbial keratitis in Australia. *Ophthalmology*. 2008 Oct;115(10): 1655-62.

Microbial Keratitis	_____ in 10,000
▶ Orthokeratology	7.7 [0.9-27.8]
▶ Ortho-k (kids)	13.9 [1.7-50.4]
▶ Ortho-k (adults)	0.0 [0.0-31.7]
▶ SCL (silicone hydrogel) daily wear	11.9
▶ SCL (hydrogel) extended wear	19.5
▶ SCL (silicone hydrogel) extended wear	25.4

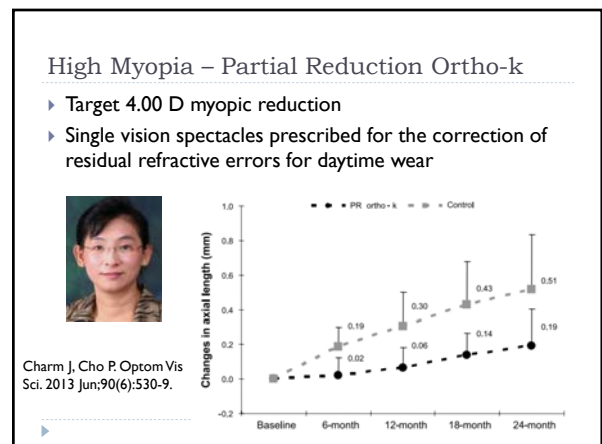
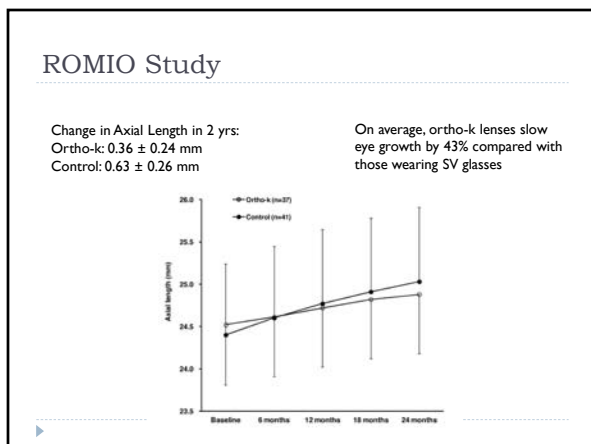
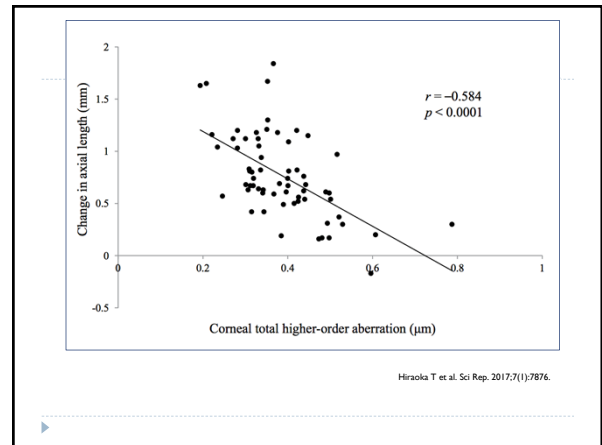
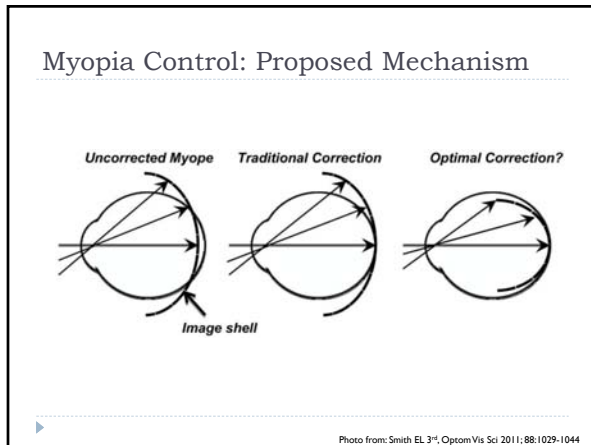
Bullimore et al. The Risk of Microbial Keratitis With Overnight Corneal Reshaping Lenses. *Optom Vis Sci*. 2013 Sep;90(9):937-44.

Orthokeratology

Cheung SW. Microbial Contamination of Peri-orbital Tissues and Accessories of Children. *Optom Vis Sci*. 2016 Jun;93(6):612-8.

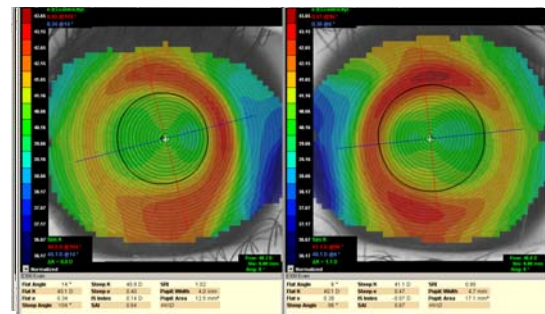
Level of normal flora in the peri-orbital tissues was comparable between subjects wearing ortho-k lenses and those wearing spectacles

- ▶ Decrease in CNS in the conjunctiva of rigid gas permeable extended wear users
 - ▶ Fleiszig and Efron
- ▶ No increase in the number of conjunctival microbes
 - ▶ Larkin and Leeming and Edrogan et al.
- ▶ Increase in CNS after the use of extended wear silicone hydrogel lenses
 - ▶ Iskeleli et al.

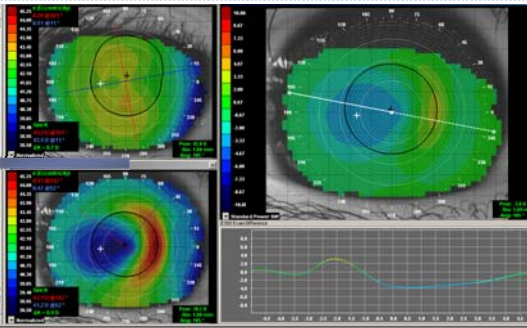


In ortho-k, how much peripheral plus / myopic defocus are we creating?

18 year old Chinese male



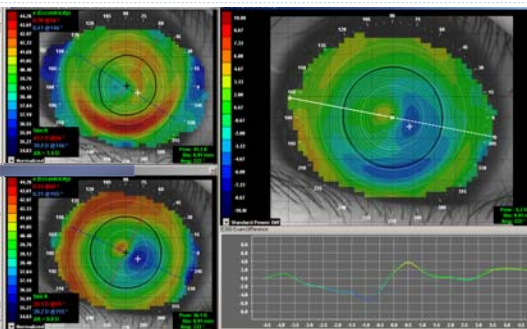
11 year old Chinese male



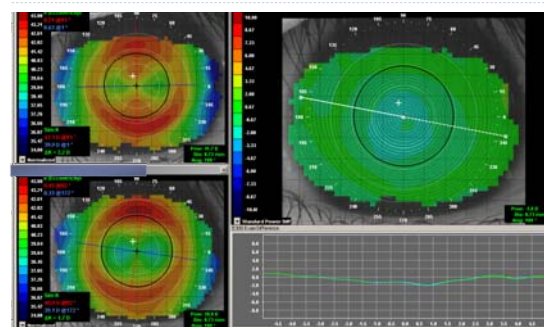
What happens when you put a Paragon CRT (non dual axis) on a 1.75 delta K toric cornea?

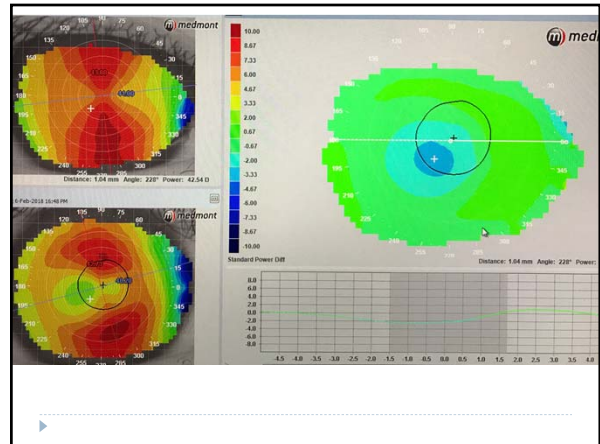
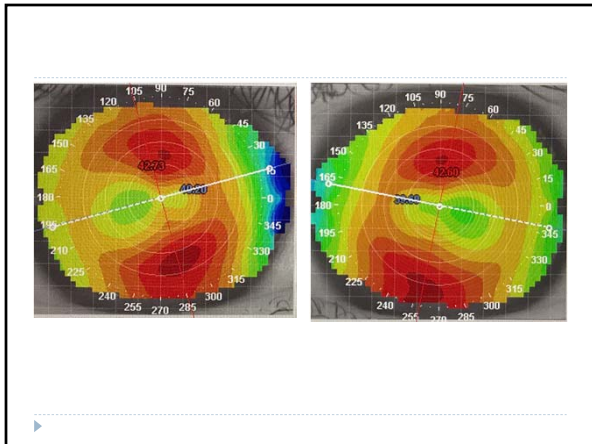
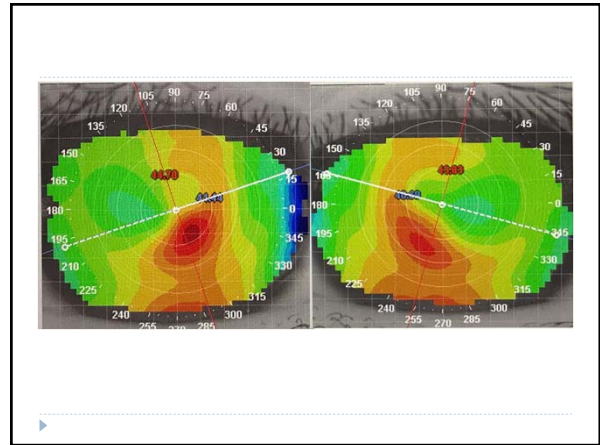
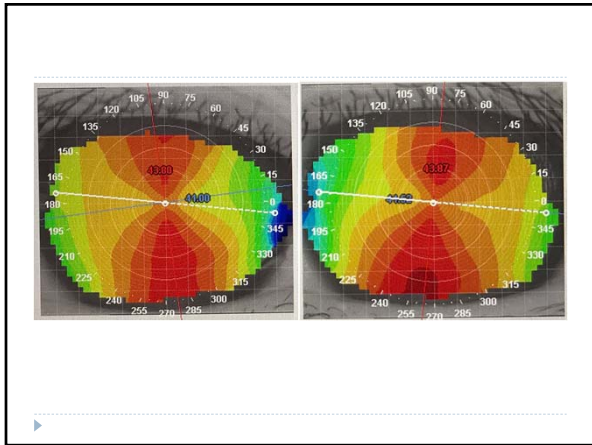
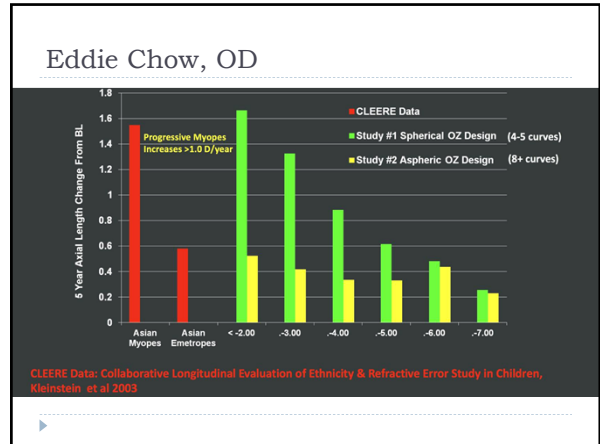
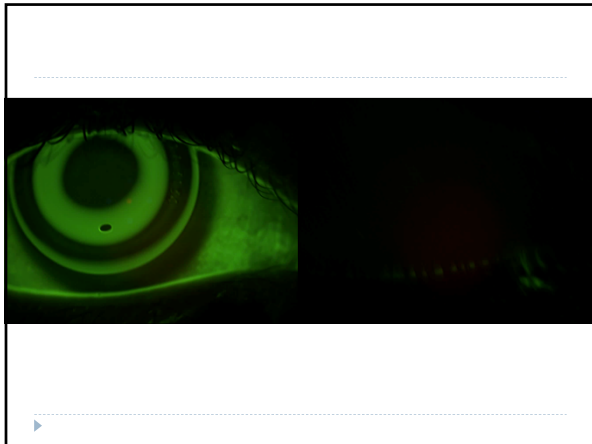
- Incomplete treatment
- Decentered treatment
- Central island
- Residual WTR refractive astigmatism

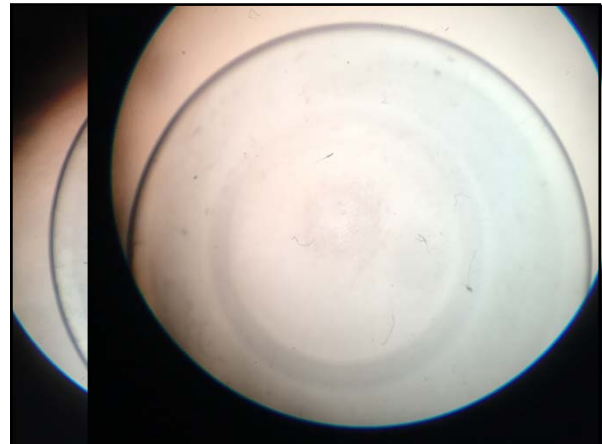
8 year old Korean female



8 year old Korean female







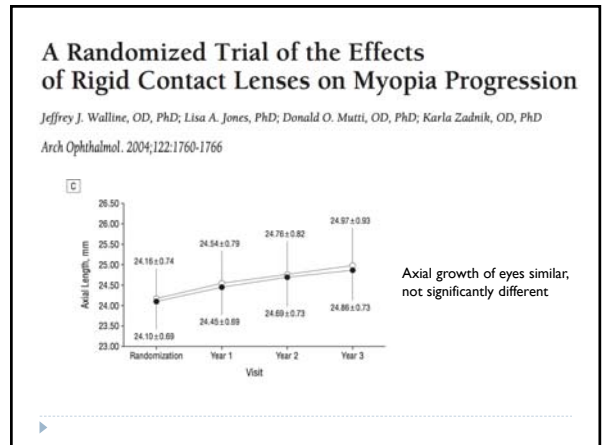
What about combination therapy?

- ▶ 40 subjects, aged 8 to 12 years
- ▶ -1.00 to -6.00 sph eq and ≤ 1.50 astigmatism

Results

- ▶ Ortho-k 0.19 ± 0.15 mm
- ▶ Ortho-k + 0.01% atropine 0.09 ± 0.12 mm
- ▶ $p = 0.0356$

▶ Kinoshita N et al. Suppressive effect of combined treatment of orthokeratology and 0.01% atropine instillation on axial length in childhood myopia. ARVO Baltimore, May 2017. Abstract number: 2386 – B0535.



Soft Multifocals

▶ Acuvue Oasys for Presbyopia

▶ Higher minus powers in fitting set (i.e. -8.50 MID add)

ORIGINAL ARTICLE

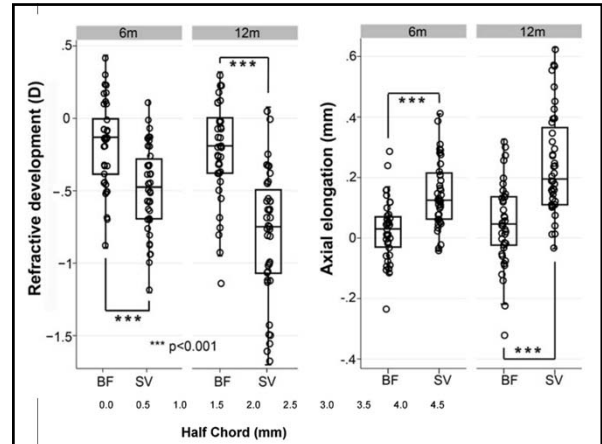
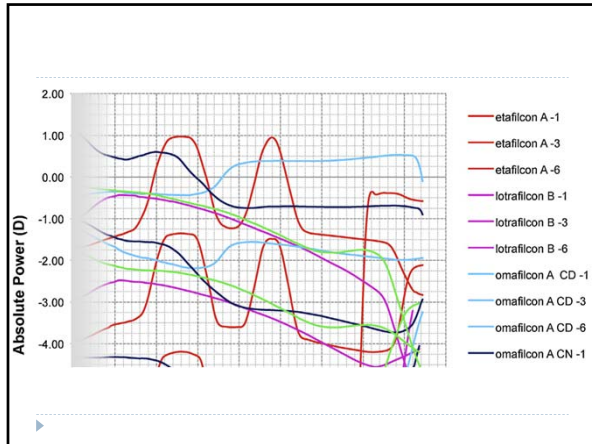
Myopia Control with Bifocal Contact Lenses: A Randomized Clinical Trial

Thomas A. Aller*, Maria Liu*, and Christine F. Wildsoet²

2 WEEK

About the BIFOCAL Lens

- Outer Distance Zone
- Edge Design
- Precision Junctions
- Multiple Alternating Concentric Zones
- Center Distance Zone



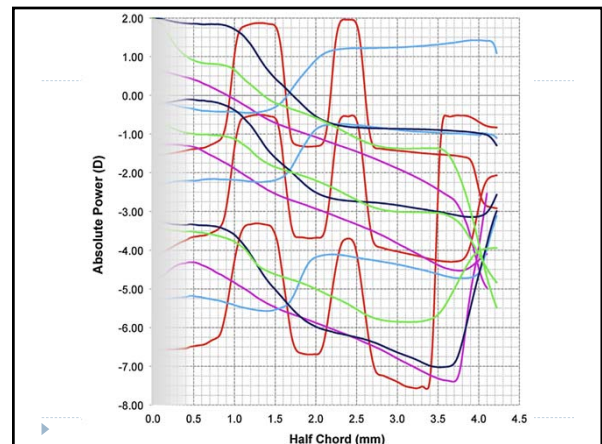
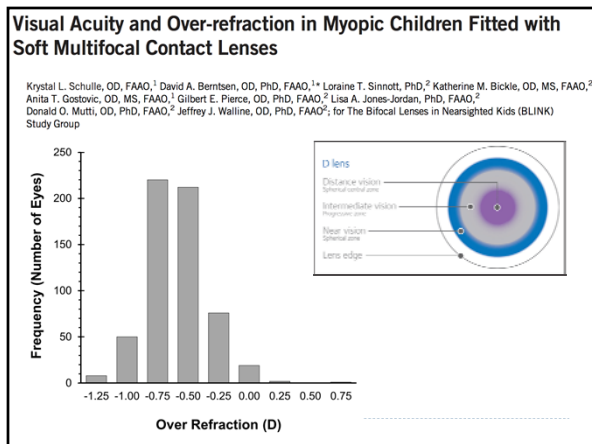
Soft Multifocals

- ▶ **Biofinity Multifocal (distance center)**
 - ▶ See if patient can tolerate a +2.50 add

- ▶ Biofinity single vision vs. Biofinity multifocal (+2.50 add)
 - ▶ Largest difference: 2.35 D temporally
 - ▶ Smallest difference: 1.06 D

National Eye Institute (NEI)

- ▶ Jeff Walline, OD, PhD
- ▶ September 2014 – August 2017
- ▶ 294 kids, 7 to 11 years old
- ▶ Randomize to
 - ▶ Biofinity
 - ▶ Biofinity Multifocal D +1.50 add
 - ▶ Biofinity Multifocal D +2.50 add



Proclear multifocal toric
CooperVision

MATERIAL/H ₂ O CONTENT	omaflacon B / 62%
BASE CURVE (Mm)	8.8
DIA(Mm)	14.4
SPHERE POWER	+20.00D to -20.00D (0.50 steps after +/-6.50D)
CYLINDER POWER	-0.75 to -5.75 (0.50 steps)
AXIS	5° to 180° (5° steps)
ADD POWER	+1.00 to +4.00 (0.50 steps)
DESIGN	D lens / N lens
WEARING SCHEDULE	Daily
Dk/T (At -3.00D)	48.6
REVENUE CARTON SIZE	6-pack blisters
REPLACEMENT SCHEDULE	Monthly

Soft Multifocals

add powers up to +4.00 diopters; quarterly replacement

specialeyes Multifocal Simulator

Multifocal Type: Distance Center

Add Power: +2.50

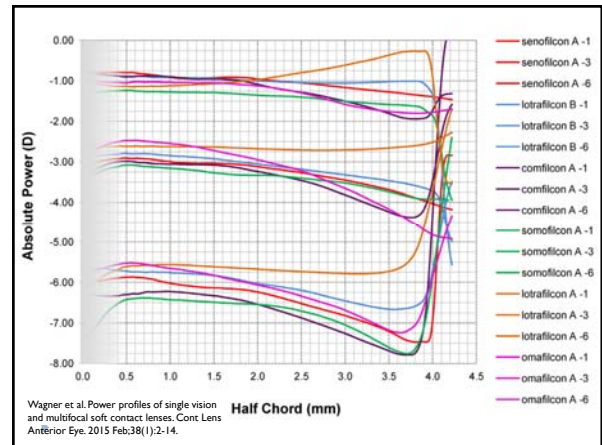
Pupil Size: 4.00

Multifocal Center Zone (mm): 1.0, 2.5, 3.0, 3.0, 4.0, 6.0

Multifocal Peripheral Zone (mm): 1.0, 2.5, 3.0, 3.0, 4.0, 6.0

0.00 [D] +0.63 [D] +1.25 [D] +1.88 [D] +2.50 [D]

Distance Vision Intermediate Vision Near Vision



Corneal Astigmats

Reclaim HD multifocal (Blanchard)
Renovation multifocal (Art Optical)
X TriVision multifocal (ABB Optical Group)

RECLAIM 2.0
Progressive add up to +2.00
Anterior distance zone 3.5mm

RECLAIM 2.5
Progressive add up to +2.50
Anterior distance zone 3.5mm

RECLAIM 3.0
Progressive add up to +3.00
Anterior distance zone 2.5mm

Flexible automated thickness control reduces lens mass for maximum centration and wearing comfort even at higher add powers

Duette PROGRESSIVE CONTACT LENSES

The Presbyopic Package for the Continuum of Presbyopia

Base Curves (mm)	Skirt Radius	Diameter (mm)	Lens Powers (D)	Materials	Enhanced Profile
7.1 to 8.3 in 0.1mm steps	8.1 (Medium) 8.4 (Flat) 8.7 (Flat2)	14.5	+5.50 to -10.00 D +5.50 to -8.00 D in 0.25 D steps -8.50 to -10.00 D in 0.50 D steps	+130 Dk GP center +84 Dk Silky skirt •Class II UVA/UVB Blocker* •Tangible Hydra-PEG Coating	Center Thickness option available

Center Distance (CD) Design: Adjustable Central Distance Zone (mm): 1.8 - 4.0, Add Powers (D) +0.75 to +5.00 in 0.25 D Steps

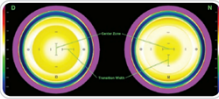
Center Near (CN) Design: Central Near Zone (mm) 3.0, Add Powers (D) +1.00, +1.75, +2.50

Adjustable central distance zone (mm)
1.8 to 4.0 mm

Add powers (D)
+0.75 to +5.00 in 0.25 D steps

Custom Stable Aurora

The back surface of the CS Aurora is that of the CS Elite (toric periphery) use the fitting principals listed under the CS Elite section. Over-refract the patient with a spherical component only. Attempt to achieve good visual acuity without over-minusing the patient. Simply record dominant eye, add power and the basic elements of Custom Stable fitting: central clearance, limbal clearance and a healthy, aligned Scleral Landing Zone.




Lens Options

- The CS Aurora is available with center zones of 1.0mm-3.5mm. Fitting sets contain options of distance and near in standard zone sizes of 1.5 (Clear), 2.0 (Green) and 2.5 (Blue).
- 6.0 mm intermediate add zone on both eyes. This gives progressive add power on the distance lens and our progressive "reverse add" on the near lens.
- Add power is available +1.00 to +3.50


Soft Multifocals

▶ NaturalVue Multifocal 1 Day
 ▶ Contact Lenses Today: 04/26/2015
 ▶ Neurofocus Optics




See Naturally.™


The Science of Natural Vision
 NaturalVue™ Multifocal 1 Day Contact Lenses with Neurofocus Optics™ are unlike any other multifocal contact lenses on the market. The science inside is inspired by how the brain enhances vision and how a camera channels light!



▶ +6.00 to -12.00 D
 ▶ 1 Universal ADD
 ▶ 8.3 / 14.5, etafilcon A

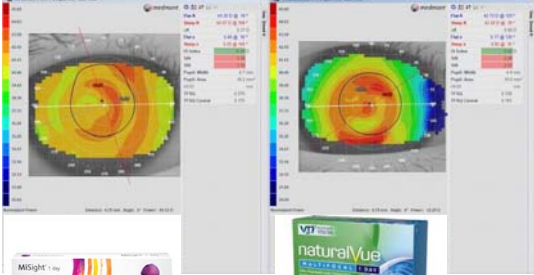




Cycloplegic sph eq: 59% Axial length: 52%



- Compared to single vision Proclear 1 day lenses, children wearing MiSight were 10 times more likely to show **no meaningful myopia progression**
- For every 3 eyes treated, 1 stopped progression
- Most children noticed ghosting or haloes, but few found it annoying; adaptation
- 75% first fit success rate

Philip Cheng

See Naturally.™

Case: 7 year old Hispanic female

Date	Refraction	
4/2/2015	-3.50-0.75x180	
	-3.00-0.75x180	
3/15/2016	-4.75-1.00x010	Ortho-k attempted
	-4.50-0.75x180	
8/9/2016	-5.00-0.75x180	Atropine 0.05%
	-5.00-0.75x180	
5/30/2017	-6.25-1.00x180	Naturalvue MF 1-day
	-6.50-0.75x180	
12/13/2017	-5.75-0.25x180	
	-5.50-0.75x180	

Case: 13 year old male

▶ NaturalVue Multifocal 1 day

- ▶ OD: -4.50
- ▶ OS: -4.50


▶ Axial Length

- ▶ OD: 26.07 mm
- ▶ OS: 26.30 mm

Manifest Refraction

- 4.75 DS
- 5.00 DS

▶ Ks: 43.00/42.25xWTR



14 year old male

How long do I keep kids on myopia control treatments?

- ▶ University of Waterloo
- ▶ January 2007 to January 2008
- ▶ Myopia prevalence
 - ▶ 72% at 20 to 30 years of age
 - ▶ 22% in patients older than 70 years
- ▶ **MYOPIC PEAK OCCURRED AT 24 YEARS OF AGE**

Hrynchak PK et al. Increase in myopia prevalence in clinic-based populations across a century. Optom Vis Sci. 2013 Nov;90(11):1331-41.

MyoVision by Zeiss

- ▶ Reduction of myopia progression by an average of 30% in East and Southeast Asian children between 6 and 12 with history of parental myopia

A corrected myopic eye with a flat-form lens. The image is projected on the retina centrally, BUT behind the retina peripherally

A corrected myopic eye with MyoVision™. The image is projected on the retina centrally, BUT in front of (or on) the retina peripherally

Spectacle Lens designed by PolyU

- ▶ Slows progression by **60%**
- ▶ **21.5%** had their myopia halted
- ▶ Defocus incorporated multiple segments (DIMS)
 - ▶ Central optical zone
 - ▶ Multi-segments of constant myopic defocus
- ▶ Subjects
 - ▶ 160 children
 - ▶ Age 8 to 13
 - ▶ -1.00 to -5.00
 - ▶ Astig and aniso 1.50 D or less

Table 1

Table 2

Changes in axial length (mm)

Table 4

Axial elongation in 24 months among individuals in two groups

Change in AL (mm)	No. and % of subjects	
	DIMS	Control
≥ 0.3	23 (29.1%)	68 (84%)
>0 and <0.3	45 (57%)	13 (16%)
0 or less	11 (13.9%)	0 (0%)
Total	79 (100%)	81 (100%)

MORNING CHECKUP
Olivia Kwan

INTERNATIONAL MYOPIA INSTITUTE
Advancing myopia research and education, to prevent future blindness.

Resources

- Professional meetings
 - American Academy of Optometry (Fall)
 - American Optometric Association (AOA), Optometry's Meeting (June)
 - Global Specialty Lens Symposium (January)
 - Vision by Design (May this year)

May 15th - 19th 2019

Hyalis Regency Hill Country Resort & Spa, San Antonio Texas

[Send Me Updates!](#)
[Exhibiting](#)
[2018 Website](#)

Vision By Design 2019

Wednesday May 15th	Thursday May 16th	Friday May 17th	Saturday May 18th	Sunday May 19th
Registration & Breakfast 8:00 am - 12:00 pm Eye Camp for Myopia 9:00 am - 6:00 pm Lunch in the Exhibit Hall 12:00 pm - 1:30 pm	Registration and Breakfast 8:00 am - 8:00 am Registration Continues 8:00 am - 2:00 pm Lunch in the Exhibit Hall 12:00 pm - 1:30 pm Pre-Conference Track - Myopia Management Symposium 9:00 am - 1:00 pm	Registration and Breakfast 8:30 am - 8:00 am Vision by Design Day 1 8:00 am - 3:00 pm Lunch in the Exhibit Hall 12:00 pm - 2:00 pm	Registration & Breakfast 8:30 am - 8:00 am Vision by Design Day 2 8:00 am - 6:15 pm Lunch in the Exhibit Hall 12:00 pm - 2:00 pm	Registration & Breakfast 7:00 am - 8:00 am Vision by Design Day 3 8:00 am - 12:00 pm

Treehouse Eyes
MYOPIA CARE FOR KIDS

THE MYOPIA EPIDEMIC MYOPIA AND EYE DISEASE THE TREEHOUSE EYES SOLUTION MAKE AN APPOINTMENT

- Venture capitalist funding
- 150 center goal
 - D.C. Metro: Bethesda, MD and Tysons Corner, VA

Brien Holden Calculator

Ethnicity: Asian | Child's Age (Years): 9 | Refractive Error (D): -2.00

Myopia Management Option: Multifocal soft contact lenses | Control Rate (%): 25

Myopia Management Option: **Multifocal soft contact lenses**

Percentage reduction in progression of myopia compared to standard correction e.g. single vision spectacles: **49%**

If treated with Multifocal soft contact lenses that provides 49% control, then the level of myopia at 17 may be: **-3.88D**

If myopia control treatment is not commenced immediately, the final level of your child's myopia at 17 may be: **-5.69D**

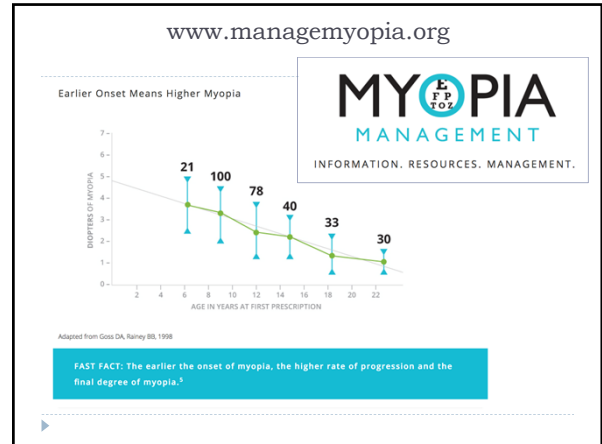
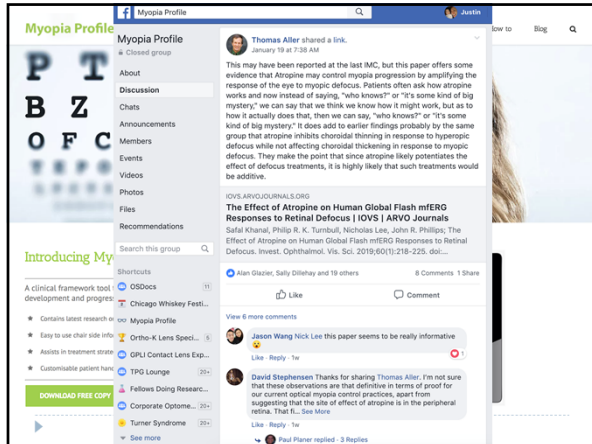
My Kid's Vision is a free online tool that helps parents assess and manage myopia risks for their kids.

Myopia (often called short-sightedness) is an eye health issue that every parent should be aware of but may not know about.

[Assess my child's risk](#)

What is this? A 6 question survey and specific advice based on your child's risk of myopia development or worsening.

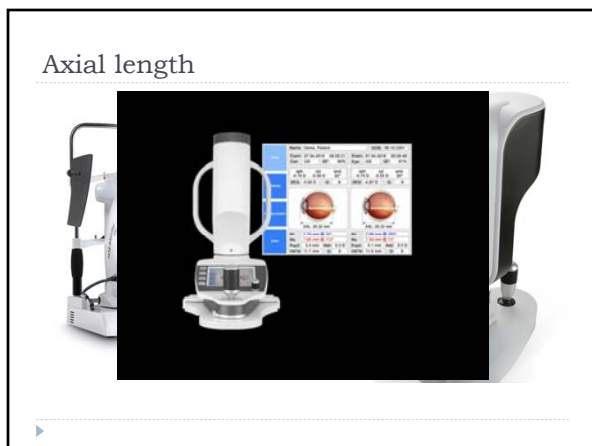
<p>Genetics Risk High</p> <p>With both parents being myopic, your child has a six times higher risk of myopia development or progression.</p>	<p>Environmental Risk Medium</p> <p>Low outdoor time and medium near work time is a low to medium risk. Head outdoors to reduce risk!</p>	<p>Individual Risk High</p> <p>There is greater likelihood of myopia progression in the first few years from becoming myopic, so it is important to keep up regular eye exams.</p>
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- ### Strategies
- ▶ Create a brochure that summarizes in layman terms the three methods of myopia control
 - ▶ Atropine
 - ▶ Orthokeratology
 - ▶ Multifocal contact lenses
 - ▶ Customize your health history form
 - ▶ Consider setting 1 to 2 half days a week for myopia control and consultations, include evenings and weekends
 - ▶ Consider dedicating one staff member to identify myopia control candidates and be patient care coordinator

Grades 4 – 6 (Upper)

	Regular Day (M, Tu, Th, F)	Instructional Planning Wednesdays	Minimum Day
Breakfast	8:10 – 8:45	8:10 – 8:45	8:10 – 8:45
Start/Dismissal	8:50 – 3:17	8:50 – 2:08	8:50 – 12:19
Recess – Gr. 4	11:00 – 11:15	11:00 – 11:15	n/a
Recess – Gr. 5-6	11:20 – 11:35	11:20 – 11:35	n/a
Lunch – Gr. 4-6	1:00 – 1:45	1:00 – 1:45	10:40 – 11:00 (4) 11:00 – 11:20 (5-6)



- ### Take home points
- ▶ Starts with education
 - ▶ Myopia is one of the strongest but modifiable risk factors in health
 - ▶ Will take at least a generation to undo some of this epidemic
 - ▶ Keep all kids < -6.00 and < 26.00 mm axial length