

Myopia: Thinking Globally, Acting Locally

Mark A. Bullimore, MCOptom, PhD, FAAO
University of Houston, College of Optometry,
Boulder, Colorado
bullers2020@gmail.com
bullers2020.com

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Disclosure Statement:

- | | |
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| Consultant:
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Mark Bullimore

Recommended Reading on Myopia Management:

- Boo J, Hoang T, Li K, et al. Spectacle Lenses with Aspherical Lenses for Myopia Control vs Single-Vision Spectacle Lenses: A Randomized Clinical Trial. <https://doi.org/10.1093/ptp/ptad012>.
- Brennan MA, Cheng A. Commonly held beliefs about Myopia that Lack a Robust Evidence Base. <https://doi.org/10.1016/j.ophtha.2019.05.026>.
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- Bullimore MA, Brennan MA. Myopia: An Ounce of Prevention is Worth a Pound of Cure. <https://doi.org/10.1016/j.ophtha.2019.05.026>.
- Bullimore MA, Michay MS, Shah S, Lenzell G, Bourne MA, Ribout D. The risks and benefits of myopia control. <https://doi.org/10.1016/j.ophtha.2019.05.026>.
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- Bullimore MA. The safety of soft contact lenses in children. <https://doi.org/10.1016/j.ophtha.2019.05.026>.
- Cheniers AL, Angier A, Mitchell CL, et al. Age and Other Risk Factors for Corneal Infections and Inflammatory Events in Young Soft Contact Lens Wearers from the Contact Lens Assessment in Youth (CLAY) Study. <https://doi.org/10.1016/j.ophtha.2019.05.026>.
- Chowdhury P, Reddy-de-Holla SC, Logan MS, et al. A 3-Year Randomized Clinical Trial of Myopia Control. <https://doi.org/10.1016/j.ophtha.2019.05.026>.

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Why Myopia?
Why Now?

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Why Myopia? Why Now?

- Increasing prevalence
- Better understanding of role in visual impairment
- Ability to do something about it

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"We should care about long-term visual health of every patient, and not just address their current visual needs"

Three long-term benefits of lowering young patient's ultimate level of myopia:

- Better vision when uncorrected *and* corrected
- Better options for, and outcomes from, surgical myopia correction
- Reduced risk of visual impairment associated with higher levels of myopia



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More Myopia = More Visual Disability

- Poorer uncorrected visual acuity
- Greater dependence on correction
- Poorer corrected visual acuity
- More difficulty performing everyday tasks
- Higher myopes take more risks with contact lenses

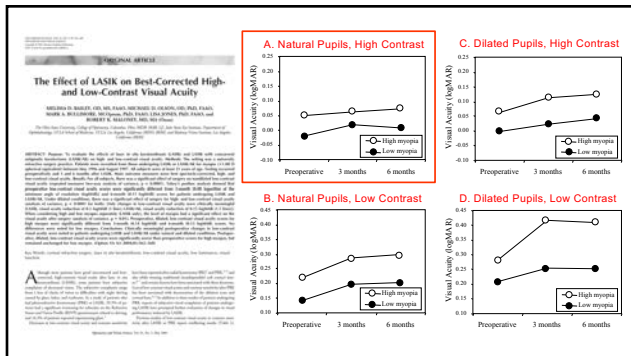
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Less Myopia = Better Options for Surgical Myopia Correction

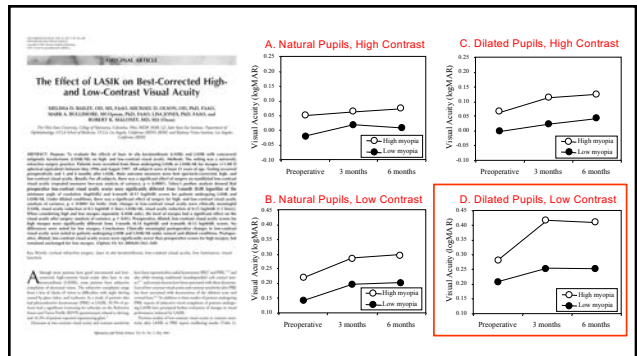
"The shorter putt is easier to sink"

- Easier to achieve minimal residual refractive error
 - better postoperative uncorrected visual acuity
 - fewer secondary surgical enhancements
- Less corneal stroma that needs to be removed
- With higher myopia, thinner corneas, or both,
 - increased risk for postoperative corneal ectasia
 - need alternative procedures, such as phakic intraocular lenses
- Better postoperative visual quality

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Less Myopia = Reduced Risk of Visual Impairment

- Higher levels of myopia associated with increased risk of:
 - Cataract
 - Glaucoma
 - Retinal detachment
- Greatest myopia-related cause of irreversible vision loss is:
 - myopic maculopathy, also referred to as myopic macular degeneration

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Classification of Myopic Maculopathy

FIGURE 3. MISA-PM classification of myopic maculopathy by color fundus photography. A, Category 1, tilted fundus. Outline of choroidal vessels can be seen throughout the posterior fundus. B, Category 2, tilted fundus. Multiple white and ill-defined choroidal atrophy spots in the center posterior pole. C, Category 3, patchy atrophy. Multiple lesions of patchy atrophy appear as well-defined, grayish white lesions on a background of diffuse atrophy. D, Category 4, large atrophy. Multiple thick linear patterns, which run in bands or arcs, are observed in the posterior fundus. E, Category 5, multiple atrophy. In some phases, myopic CNV can be covered by proliferating pigment cells. F, Category 6, myopic CNV-related macular atrophy develops resulting from the enlargement of the Bruch membrane rupture around neovascular CNV. Category 7, Category 8, macular atrophy. Multiple lesions of patchy atrophy enlarged and fused. Finally, macular region is involved.

Yokoi T, Ohno-Matsui K. Diagnosis and Treatment of Myopic Maculopathy. Asia Pac J Ophthalmol (Phila) 2018;2:435-21. doi: 10.22608/APO.2018390

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Prevalence of Myopic Maculopathy

Myopia Control: Why Each Diopter Matters

Each additional diopter increases risk by 67% (= 1.67 - 1)

Each diopter less, reduces risk by 40% (= 1 - 1/1.67)

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Prevalence of Myopic Maculopathy

Myopia Control: Why Each Diopter Matters

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Prevalence of Myopic Maculopathy

Each additional diopter increases risk by 67% (= 1.67 - 1)

Each diopter less, reduces risk by 40% (= 1 - 1/1.67)

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Prevalence of Myopic Maculopathy

- Myopes below 5 D contribute around 50%:
 - 43% of cases of myopic maculopathy in Australian Blue Mountains Eye Study
 - 57% of cases of myopic maculopathy in Singapore Epidemiology of Eye Diseases study
- Far more myopes at the low end of refractive spectrum

Flitcroft: "there is no safe level of myopia"

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The Risks and Benefits of Myopia Control

Mark A. Bullimore, MCCOptom, PhD,¹ Eric R. Basher, OD, PhD,¹ Saeed Shah, FRCOphth, FRCSEd,^{1,2} Nicola Liversid, MD, PhD,^{1,3,4,5,6,7,8,9} Robert R.A. Smeets, FRCOphth, MD,¹⁰ D. Ian Flitcroft, MA, DPhD^{11,12}

Purpose: The prevalence of myopia is increasing around the world, stimulating interest in methods to slow its progression. The primary justification for slowing myopia progression is to reduce the risk of vision loss through sight-threatening ocular pathologic features in later life. This article analyzes whether the potential benefits of slowing myopia progression by 1 diopter (D) justify the potential risks associated with treatments.

Methods: First, the known risks associated with various methods of myopia control are summarized, with emphasis on contact lens wear. Based on available data, the risk of visual impairment and predicted years of visual impairment are estimated for a range of incidence levels. Next, the increased risk of potentially sight-threatening conditions associated with different levels of myopia are reviewed. Finally, a model of the risk of visual impairment as a function of myopia level is developed, and the years of visual impairment associated with various levels of myopia and the years of visual impairment that could be prevented with achievable levels of myopia control are estimated.

Results: Assuming an incidence of myopia between 1 and 25 per 1000 patient-years and that 15% of cases result in vision loss leads to the conclusion that between 38 and 943 patients need to be exposed to 5 years of wear to produce 5 years of vision loss. Each additional 1 D of myopia is associated with a 56%, 20%, 21%, and 20% increase in the risk of myopic maculopathy, open-angle glaucoma, posterior subcapsular cataract, and retinal detachment, respectively. The predicted mean years of visual impairment ranges from 4.42 in a person with myopia of -3.0 D to 8.68 in a person with myopia of -8.0 D, and a 1-D reduction would lower these by 0.74 and 1.21 years, respectively.

Conclusions: The potential benefits of myopia control outweigh the risks; the number needed to treat to prevent 5 years of visual impairment is between 4.1 and 6.8, whereas fewer than 1 in 38 will experience a loss of vision as a result of myopia control. *Ophthalmology* 2023;132:1561-1570 © 2023 by the American Academy of Ophthalmology. This is an open access article under the CC BY-NC-ND license (<http://www.aao.org>).

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Myopia and Visual Impairment (6/20 or worse)

- Population-based data
 - Rotterdam Study I (1990-3), II (2000-2), and III (2006-8)
 - Erasmus Rucphen Family Study (2002 to 2005)
 - Myopia case-control Study (2010 to 2012)
- 15,404 individuals with spherical equivalent data
- 9,074 individuals with axial length data

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Myopia and Visual Impairment (6/20 or worse)

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Myopia and Visual Impairment

Each diopter increases visual impairment by 30% (= 1.30 - 1)

Each diopter less, reduces visual impairment by 25% (= 1 - 1/1.30)

$Log_{10} Odds \text{ of Visual Impairment} = 10(0.057 \text{Age} - 0.122 \text{Rx} - 4.03)$

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Benefits Far Outweigh the Risks

The Risks and Benefits of Myopia Control

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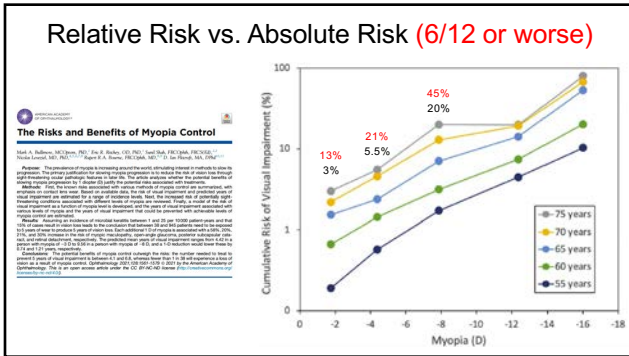
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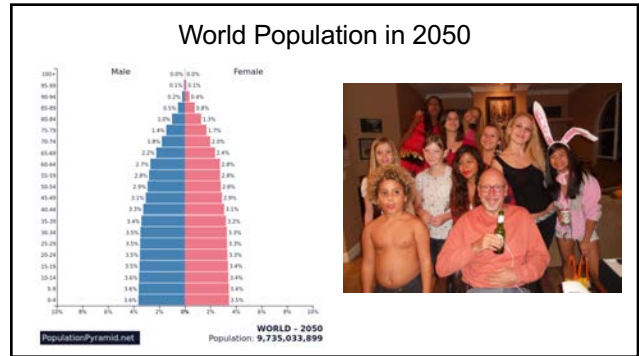
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Relative Risk vs. Absolute Risk (6/20 or worse)

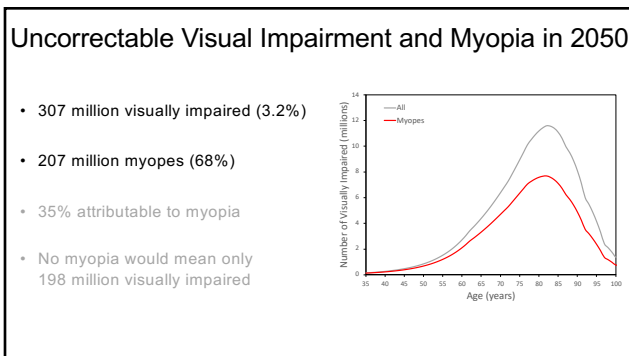
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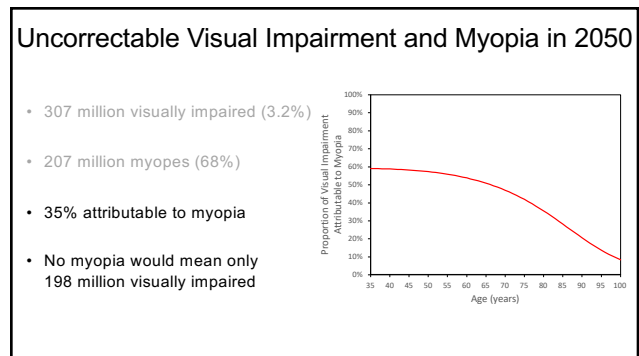
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Uncorrectable Visual Impairment and Myopia in 2050

Prevalence of Myopia	Visual Impairment (millions)	Visual Impairment Prevented by 1 D control (millions)	VI Prevented by 1 D control	
			Up to -6 D	Up to -3 D
30%	258	24	6	15
40%	281	33	9	20
50%	307	42	12	27
60%	340	52	17	36
70%	383	64	24	48

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Summary

- Myopia is a major contributor to global visual impairment
- We should continue our efforts to prevent myopia and slow its progression

“although higher degrees of myopia carry a greater risk of visual impairment to the individual, the population-based burden of lower degrees of myopia remains considerable”

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MYOPIA PLEDGE

Take the Pledge

Make Myopia Management a Part of Your Practice Today!

Join optometrists worldwide in pledging to make myopia management the standard of care in their practices

Since the World Council of Optometry introduced its myopia management Standard of Care resolution in 2021, more than **50,000** optometrists around the globe have taken the pledge to make it an integral part of their practices.

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ABOUT US

Myopia Management for Your Practice

This site, jointly developed by the World Council of Optometry and CooperVision, provides resources and approaches to enable optometrists regardless of geographic location to apply a standard of care to manage myopia.

By embracing a standard of care and collectively sharing our knowledge and experience, the optometric profession can have a positive impact in addressing myopia as a public health issue.

[Learn More](#)

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Why Myopia?
Why Now?

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Why Myopia?
Why Now?

Why Here?

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Australia and New Zealand Will Set
New Standard of Care for Myopia


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Why Australia and New Zealand Lead the World

- Manpower—size of profession
- Geographic distribution
- Scope of practice
- Awareness of myopia
- Access to all evidence-based treatments
- Knowledge base at universities
- Social media
- Industry and professional leadership
- History of public health campaigns

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A Useful Analogy?



CLINICAL PERSPECTIVE

Myopia Control: Why Each Diopter Matters

Mark A. Williams, MD, PhD, FRCO, FRCOphth and Mark A. Williams, MD, PhD, FRCO

Myopia control is a hot topic in ophthalmology, and it is important to understand the impact of each diopter of myopia on the risk of eye disease. This article discusses the clinical perspective on myopia control and the importance of understanding the impact of each diopter of myopia on the risk of eye disease.

Intervention	Sunscreen	Myopia Control
Short-term benefit	Reduced risk of sunburn	Better uncorrected vision Better refractive surgery candidate
Long-term benefit	Reduced risk of skin cancer	Reduced risk of eye disease Reduced risk of visual impairment

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Myopia Management—Aussie Rules


1. Appropriate care of the very young myope
2. Examining 6-year-olds to identify those at risk of onset
3. Counselling and preventing
4. Short checks on 6- to 9-year-olds
5. Starting promptly in new myopes
6. Administering best, evidence-based interventions to all young myopes
7. Setting treatment goals
8. Basing treatment duration on individual axial elongation
9. Eradicating higher levels of myopia
10. Managing myopia-related disease

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Reduced Best Corrected Visual Acuity?



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Managing High Myopia in Young Children

- Physical examination
- Ocular examination
- Ocular biometry
- Ocular imaging
- Electrophysiology
- Genetic testing


EMH—Management and Investigation of High Myopia in Infants and Young Children

See the full article at: [https://doi.org/10.1016/j.jamaophth.2022.08.001](#)

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Managing High Myopia in Young Children

- Myopia control modalities evaluated in:
 - 7- to 12-year-olds
 - 1 to -6 D
 - Normal visual acuity
 - Absence of systemic conditions
- No evidence on very young myopes
- Etiology may be different
- Response to treatment may differ



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Managing High Myopia in Young Children

Myopia Profile

What tests would you run to test for connective tissue disorder in a myopic child who is not responding to myopia control measures

Good question. I've got a handful of patients like this, where we have thrown everything but the kitchen sink at their myopia and yet AXL continues to progress unabated and at the same rate. Non-responsive to anything. I spoke to an ophthal and he recommended sending them to RCH for genetic testing but didn't say what tests. Some have seen ophthalmology but still no answers and quite vague on whether there is any genetic issues at play.

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Young high myopes:

1. Thoroughly evaluate
2. Don't expect "normal" results


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Predicting Myopia Onset

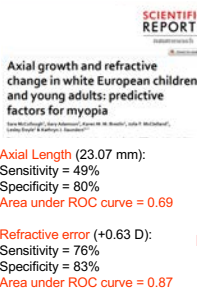


- Future myopia can be predicted in nonmyopic children using simple, single measure of refractive error:
- <+0.75 D at age 6 years
- <+0.50 D at ages 7 and 8 years
- <+0.25 D at ages 9 and 10 years
- Emmetropic at age 11 years

"Future trials for prevention of myopia should target the child with low hyperopia as the child at risk"

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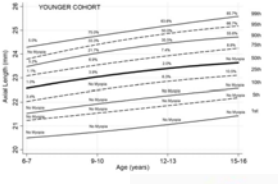
What About Axial Length?



SCIENTIFIC REPORTS

Axial growth and refractive change in white European children and young adults: predictive factors for myopia


YOUNGER COHORT



Axial Length (23.07 mm):
Sensitivity = 49%
Specificity = 80%
Area under ROC curve = 0.69

Refractive error (+0.63 D):
Sensitivity = 76%
Specificity = 83%
Area under ROC curve = 0.87

Refractive error much better predictor



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Young non-myopes:

1. Assess risk
2. Triage
3. Try to delay onset

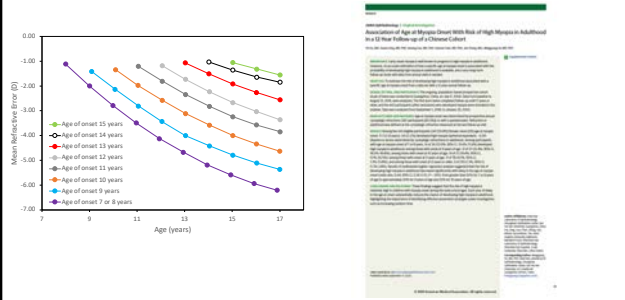
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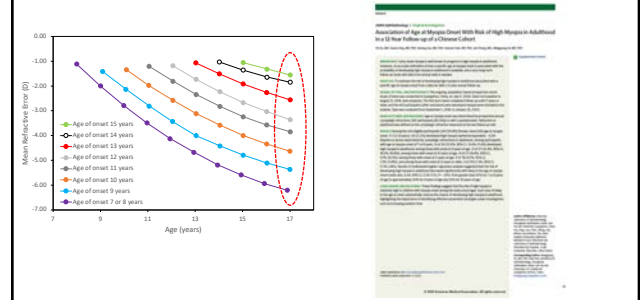
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Age of Onset and Final Level of Myopia



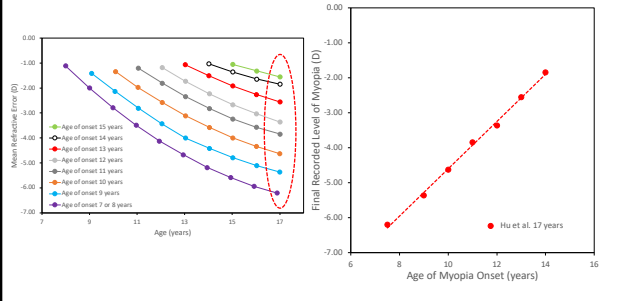
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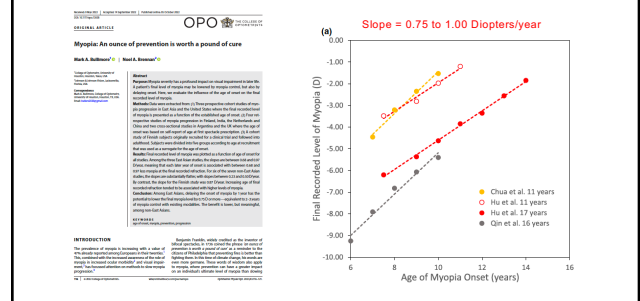
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Age of Onset and Final Level of Myopia



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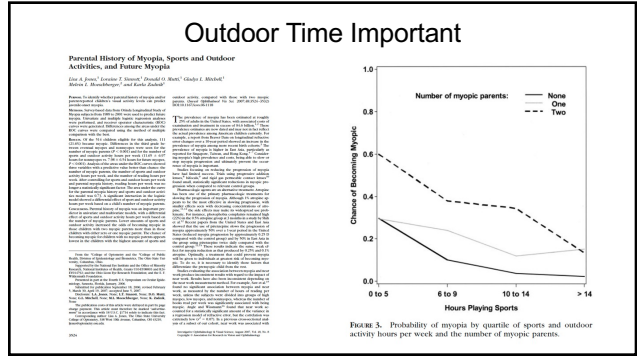
An ounce of prevention may be worth a pound of cure



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Myopia Prevention

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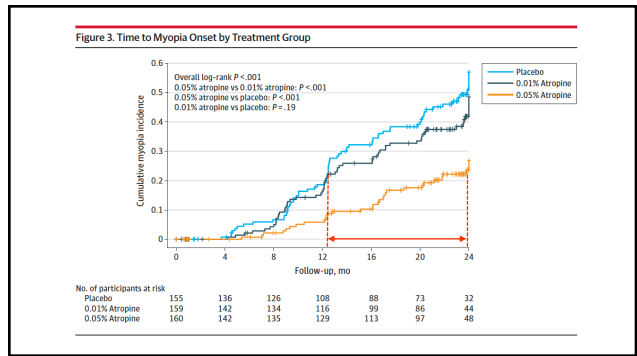
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Atropine for Myopia Prevention

Effects of Low Concentration Atropine Eye Drops vs Placebo on Myopia Incidence in Children: The SMART Randomized Clinical Trial

- 474 children 4 to 9 years (mean: 6.8 years) between plano and +1 D (cycloplegic) randomized to nightly:
 - 0.05% atropine,
 - 0.01% atropine, or
 - placebo
- 353 (74.5%) completed 2-year trial
- Cumulative incidence of myopia:
 - 53% with placebo
 - 46% with 0.01% atropine
 - 28% with 0.05% atropine

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- ### Myopia Management—Aussie Rules
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Young non-myopes:

1. See low-risk children less often

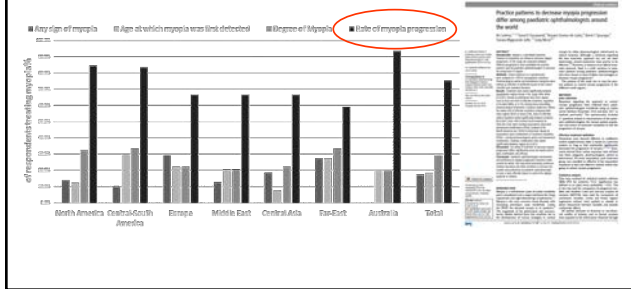
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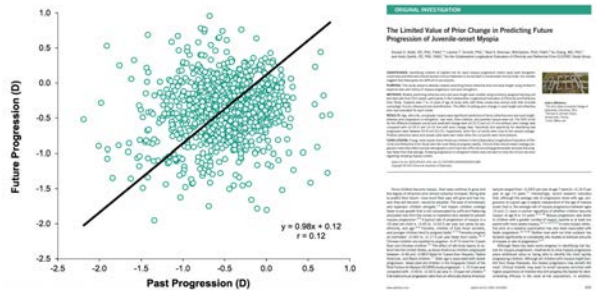
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Pediatric Ophthalmologists' Indication for Treatment



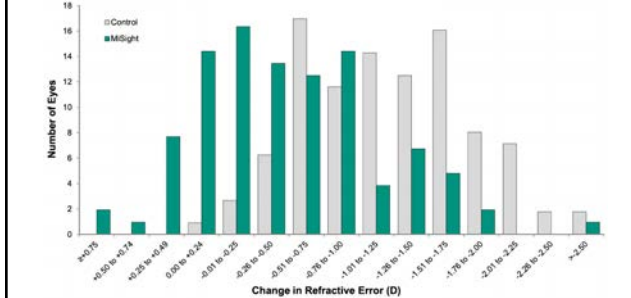
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Past Progression Does Not Predict Future Progression



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MiSight Dual-Focus Soft Contact Lenses



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New myopes:

1. Don't wait
2. Initiate treatment promptly

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Young non-myopes:

1. See low-risk children less often

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Which Treatment is Best?

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Disclosure Statement:

- Consultant:
- Alcon
 - CooperVision
 - EssilorLuxottica
 - Euclid Systems
 - Eyeovia
 - Genentech
 - Johnson & Johnson Vision
 - Lentechs
 - Novartis
 - Vyluma



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Which Treatment is Best?

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Which Treatment is Best?

The one the child will use

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Compliance is Key

- Comfort
- Vision
- Motivation
- Lifestyle
- Tangible benefits



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Two Biggest Challenges with Atropine

1. Doesn't correct refractive error
2. Doesn't correct refractive error

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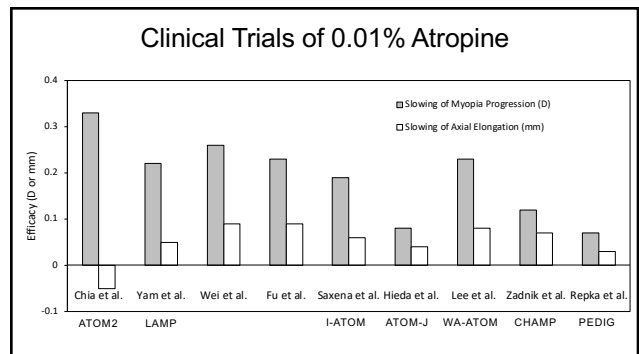
Two Biggest Challenges with Atropine

1. Doesn't correct refractive error
 - Child still needs correction
2. Doesn't correct refractive error
 - Less incentive for child to use

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Two Recent Studies with Conflicting Results

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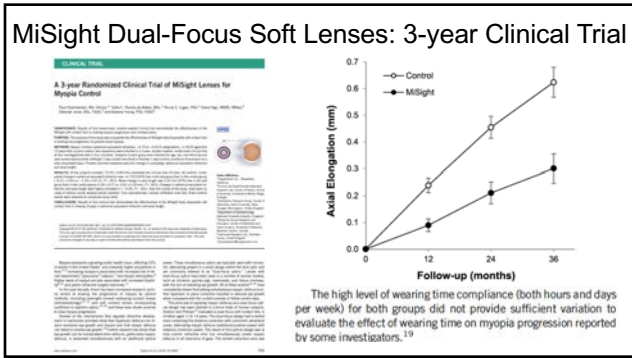


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Stellest Highly Aspherical Lenslets: 2-year Clinical Trial

- 170 children, 8-13 years, -0.75 to -4.75 D randomized to spectacle lenses with:
 - single-vision (SVL)
 - highly aspherical lenslets (HAL)
 - slightly aspherical lenslets (SAL)
- 157 completed 2-year visit (92%)
 - SVL -1.46 D and 0.69 mm
 - HAL -0.66 D and 0.34 mm
 - SAL -0.80 D and 0.35 mm

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Myopia control:

1. Use evidence base
2. Choose option child will use

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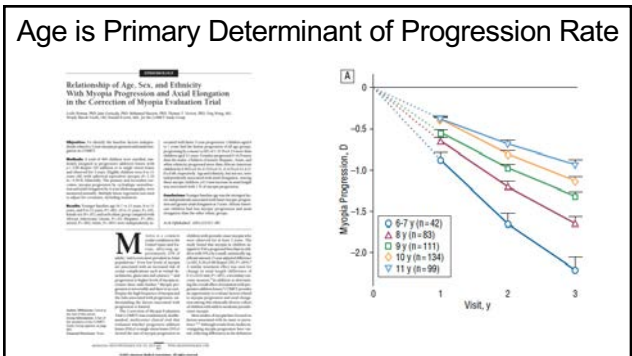
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- ### Setting Treatment Goals
- | Glaucoma | Myopia |
|--|--|
| <ul style="list-style-type: none"> • Measure IOP • Set Target IOP • Measure IOP • Rinse and Repeat | <ul style="list-style-type: none"> • Measure Refractive Error and Axial length • Set Target Refractive Error and Axial length • Measure Refractive Error and Axial length • Rinse and Repeat |

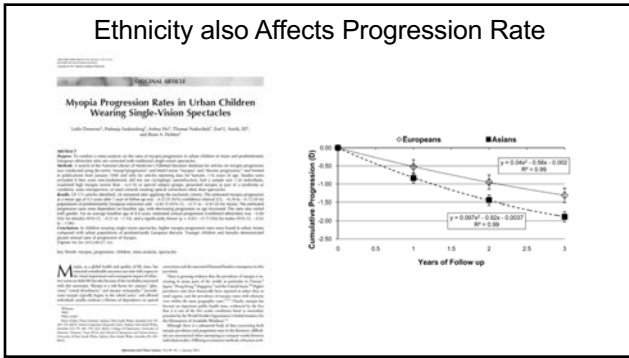
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What is Normal Progression?

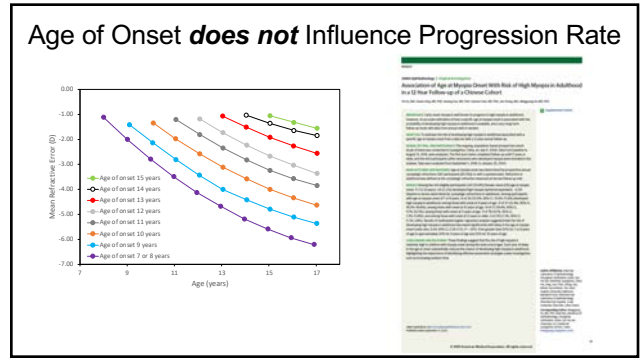
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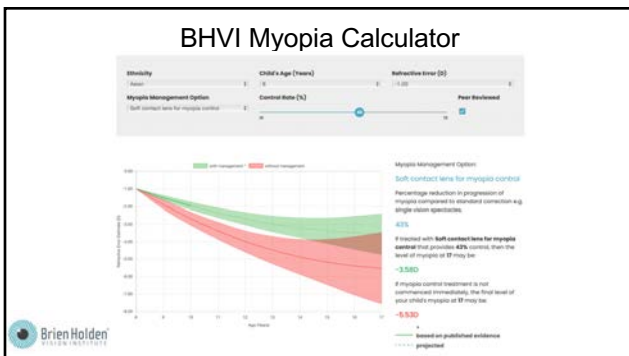
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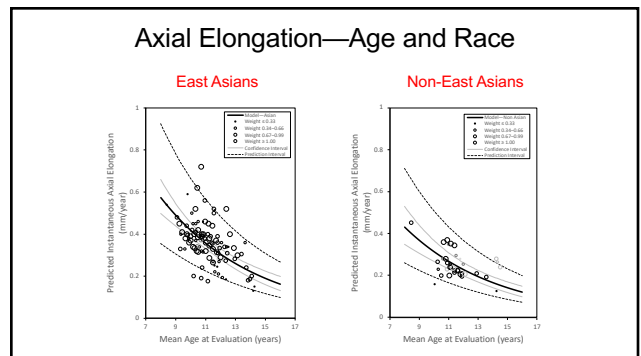
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Axial Elongation—Age and Race

Table 5: Mean progression for myopic Asians and non-Asians by axial length and refractive error across age²⁵

	AGE	7	8	9	10	11	12
AXIAL LENGTH (mm)	Asian	0.52	0.46	0.41	0.36	0.32	0.28
	Non-Asian	0.35	0.31	0.28	0.25	0.22	0.20
REFRACTIVE ERROR (D)	Asian	-1.12	-0.94	-0.78	-0.66	-0.56	-0.50
	Non-Asian	-0.98	-0.82	-0.69	-0.56	-0.45	-0.35

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MiSight Dual-Focus Soft Contact Lenses

Visit	Study group	Spherical equivalent change (D ± SD)	Difference (D ± SD)
12 mo	Control	-0.64 ± 0.07	0.38 ± 0.09
	MiSight	-0.27 ± 0.07	
24 mo	Control	-0.99 ± 0.07	0.52 ± 0.09
	MiSight	-0.47 ± 0.07	
36 mo	Control	-1.31 ± 0.08	0.67 ± 0.09
	MiSight	-0.65 ± 0.07	
		Axial length change (mm)	ifference (mm)
12 mo	Control	0.23 ± 0.03	-0.13 ± 0.04
	MiSight	0.10 ± 0.03	
24 mo	Control	0.45 ± 0.03	-0.22 ± 0.04
	MiSight	0.23 ± 0.03	
36 mo	Control	0.62 ± 0.03	-0.28 ± 0.04
	MiSight	0.34 ± 0.03	

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MiSight Dual-Focus Soft Contact Lenses

Visit	Study group	Spherical equivalent change (D ± SD)	Difference (D ± SD)
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	MiSight	0.23 ± 0.03	
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	MiSight	0.34 ± 0.03	

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Setting Target Axial Elongation

Table 5: Mean progression for myopic Asians and non-Asians by axial length and refractive error across age⁵⁵

	AGE	7	8	9	10	11	12
AXIAL LENGTH (mm)	Asian	0.52	0.46	0.41	0.36	0.32	0.28
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REFRACTIVE ERROR (D)	Asian	-1.12	-0.94	-0.78	-0.66	-0.56	-0.50
	Non-Asian	-0.98	-0.82	-0.69	-0.56	-0.45	-0.35

Treatment Efficacy = 0.13 mm
Target Axial Elongation = 0.12 mm

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Setting Target Axial Elongation

Table 5: Mean progression for myopic Asians and non-Asians by axial length and refractive error across age⁵⁵

	AGE	7	8	9	10	11	12
AXIAL LENGTH (mm)	Asian	0.52	0.46	0.41	0.36	0.32	0.28
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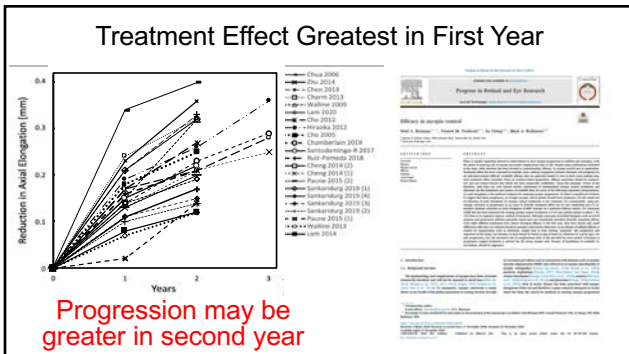
Setting Target Axial Elongation

Table 5: Mean progression for myopic Asians and non-Asians by axial length and refractive error across age⁵⁵

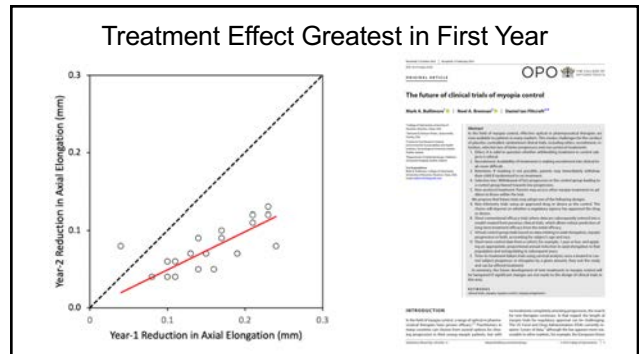
	AGE	7	8	9	10	11	12
AXIAL LENGTH (mm)	Asian	0.52	0.46	0.41	0.36	0.32	0.28
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	Non-Asian	-0.98	-0.82	-0.69	-0.56	-0.45	-0.35

Treatment Efficacy = 0.13 mm
Target Axial Elongation = 0.33 mm

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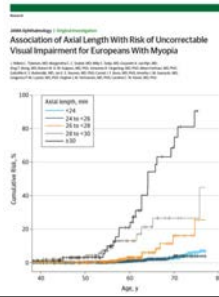
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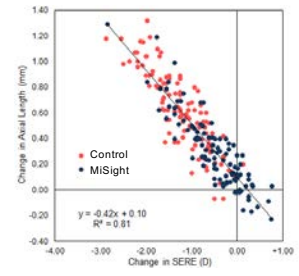
Axial Length is the Metric of Choice for Assessing Efficacy

- IMI and FDA
- Disease association
- No cycloplegia needed
- Treatment can influence optics independently of axial length
- Relatively more sensitive



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Axial Elongation and Myopic Progression Highly Correlated



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When to Change or Add

- Wait a year?
- Seasonal variations
- Check compliance
- Manage the child
- Manage the parents



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Setting treatment goals:

1. Use evidence-based progression norms
2. Set evidence-based targets
3. Move to axial measurements

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Myopia Management—Aussie Rules

1. Appropriate care of the very young myope
2. Examining 6-year-olds to identify those at risk of onset
3. Counselling and preventing
4. Short checks on 6- to 9-year-olds
5. Starting promptly in new myopes
6. Administering best, evidence-based interventions to all young myopes
7. Setting treatment goals
8. Basing treatment duration on individual axial elongation
9. Eradicating higher levels of myopia
10. Managing myopia-related disease

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When Does Myopia Stabilize?

- COMET Study: large ethnically diverse group of 469 myopic children
- 426 of the original cohort:
 - at least seven measurements
 - over 11 years and
 - could be fit with curves that described their progression and stabilization



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When Does Myopia Stabilize?

Large variation in age of stabilization:

- 50% stabilize by 15 years 50% progress beyond 15 years
- 75% stabilize by 18 years 25% progress beyond 18 years
- 90% stabilize by 21 years 10% progress beyond 21 years
- 95% stabilize by 24 years 5% progress beyond 24 years

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Discontinuing treatment:

1. Be aware of range of stabilization
2. Base decisions on individual data

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Myopia Management—Aussie Rules

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Visual Impairment and Myopia in AUS in 2050

- Population of 32.2 million
- Over 1.7 million visually impaired (6/12)
- Myopes will be overrepresented
- One third of all cases attributable to myopia
- 1 D of myopia control could prevent 200,000 cases
- Would still have 1.5 million high myopes



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Eradicating high myopia:

1. Strive to delay onset
2. Treat all myopes

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Myopia Management—Aussie Rules

1. Appropriate care of the very young myope
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3. Counselling and preventing
4. Short checks on 6- to 9-year-olds
5. Starting promptly in new myopes
6. Administering best, evidence-based interventions to all young myopes
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Classification of Myopic Maculopathy



FIGURE 3 Myopia-PM Classification of myopic maculopathy by color fundus photographs. A, Category 1, isolated fundus. Outline of choroidal vessels can be seen throughout the posterior fundus. B, Category 2, diffuse atrophy. Yellowish-white and ill-defined choroidal atrophy exists in the entire posterior pole. C, Category 3, patchy atrophy. Multiple lesions of patchy atrophy appear as well-defined, grayish-white lesions on a background of diffuse atrophy. D, Lacquer cracks (blue sign). Yellowish thick linear patterns, which can be branch or circumferential, are observed in the posterior fundus (arrow). E, Fuchs spot (blue sign). In early phase, myopic CNV can be covered by proliferating pigment cells (Fuchs spot). Afterwards, myopic CNV-related macular atrophy develops resulting from the enlargement of the Fuchs membrane rupture around regressed myopic CNV (arrowheads). F, Category 5, macular atrophy. Multiple lesions of patchy atrophy enlarged and fused. Finally, macular region is involved.

Yokoi T, Ohno-Matsui K. Diagnosis and Treatment of Myopic Maculopathy. *Asia Pac J Ophthalmol (Phila)* 2018;24:15-21. doi: 10.22608/APJO.2018290

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Managing myopia-related disease:

- 1. Evolve and remain educated
- 2. Broaden scope

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Knowledge Centre Program

- Myopia Management Q&A with Mark Bullimore
- 1.00pm



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