

Challenging cases in myopia management: you make the call!

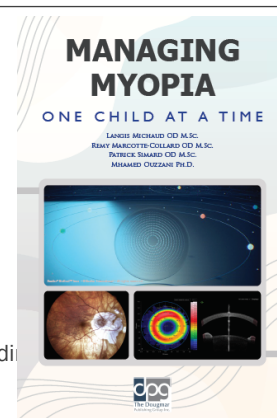
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PROFESSOR



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Disclosures - LM

- Honorarium received /Research grants
 - Cooper Vision
 - Bausch and lomb
 - Johnson and johnson
 - Alcon
 - Novartis
- First author : myopia management book
- Co-owner: PCT Medical device for the control of Axial lenght (patent pending)



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World Council of Optometry Resolution
The Standard of Care For Myopia Management by Optometrists

A new standard of care defined

Now, therefore, be it resolved, that the World Council of Optometry, on behalf of its members:

1. Defines the evidence-based standard of care as comprising of three main components:

- Mitigation — optometrists educating and counseling parents and children, during early and regular eye exams, on lifestyle/dietary/other factors to prevent/ delay onset of myopia
- Measurement — optometrists evaluating the status of a patient during regular comprehensive vision and eye health exams, (e.g. 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; and

2. Advises optometrists to incorporate the standard of care for myopia management within their practice that shifts from not only correcting vision but includes public education and early and frequent discussions with parents that explains:

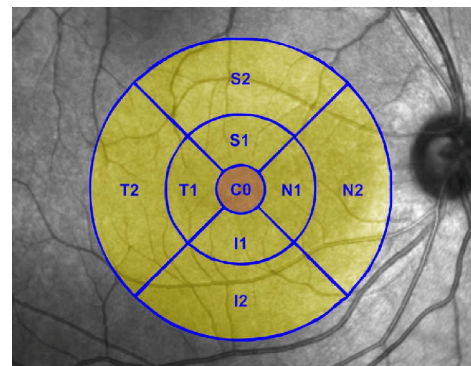
- what myopia is
- lifestyle factors that may impact myopia
- the increased risks to long-term ocular health that myopia brings
- the available approaches that can be used to manage myopia and slow its progression.

Mr. Paul Folkesson, President, Sweden

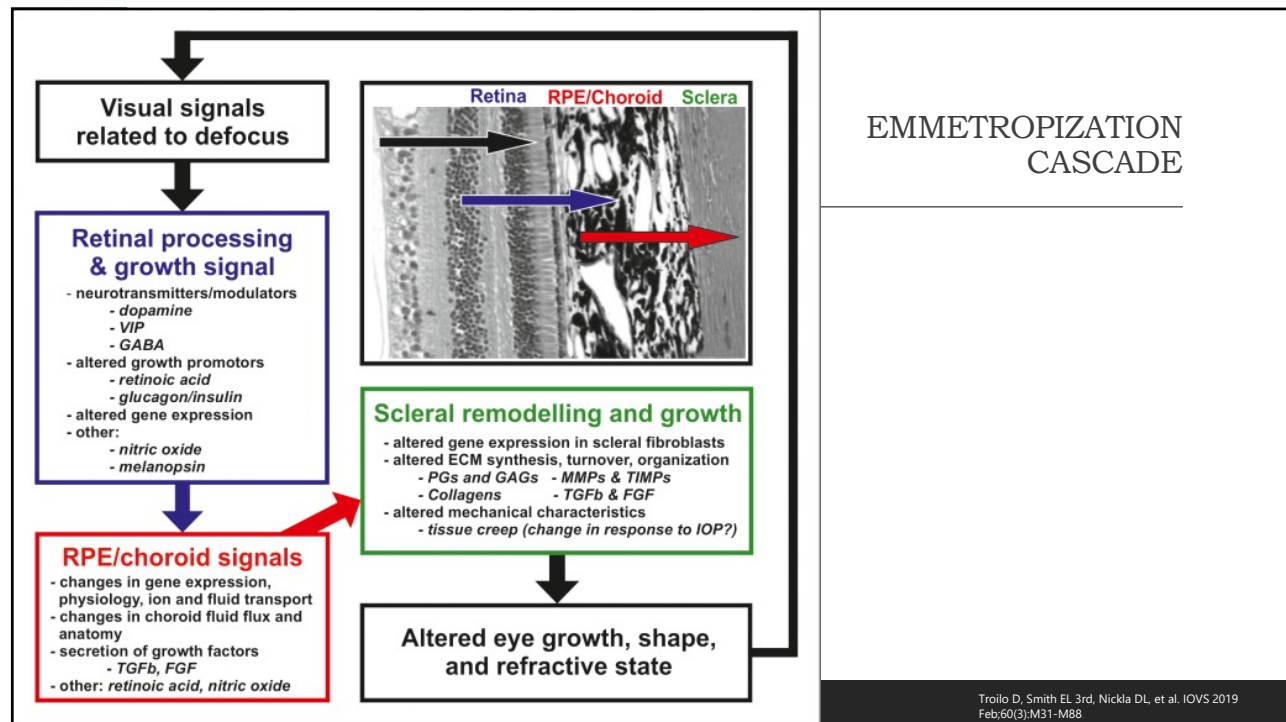
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What do we know

- Quality of the optical signal dictates the ocular response
- Ocular response is local
 - Mostly modulated by peripheral retina
 - 12-20 deg surrounding the macula
 - Proportional to the area of impact
 - Intensity is driven by a dose-response phenomenon
 - Quadrant specific
- Optical devices can generate 2 types of stimuli
 - Hyperopic and myopic defocus
 - Retina can handle both at the same time
 - Emmetropization occurs when both are at equilibrium



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<https://2020tulsa.com/when-should-your-child-have-a-first-eye-exam>

MYOPIA MUST BE THEN DEFINED AS A FAILURE IN THE EMMETROPIZATION PROCESS

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Boote

•August 2019
 •Progress in Retinal and Eye Research 74(S1359-6446-1):100773

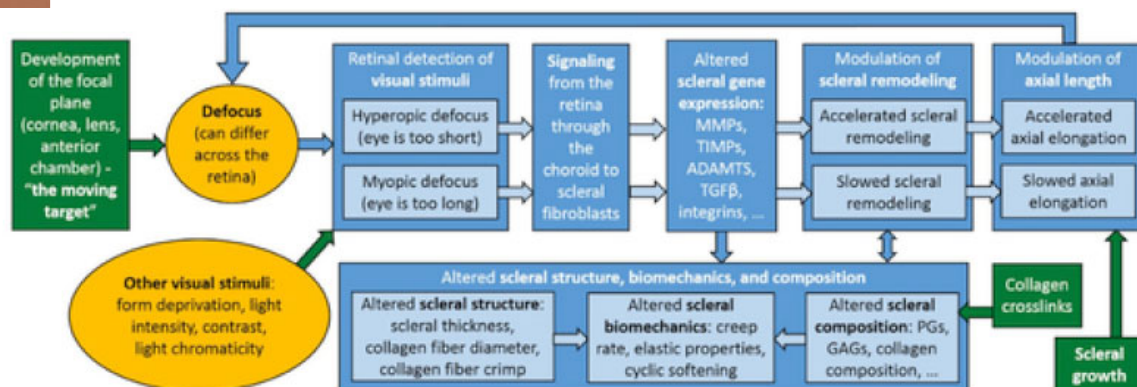
- Changes in scleral composition and structure of myopic eyes
 - Lower hyaluronan and sulfated GAG levels
 - Upregulated enzymatic degradation
 - Downregulated collagen Type I synthesis
 - Downregulation of aggrecan
 - Significant diameter thinning of the scleral collagen fibrils / change in fibrils alignment
- Accelerated tissue growth is NOT the cause of myopia
 - Scleral volume increases 0-2 years and then remain stable
 - Sclera can become thinner with eye elongation
- SCLERAL REMODELING underlies axial elongation in myopia

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Boote – Key points

•Boote August 2019
 •Progress in Retinal and Eye Research 74(S1359-6446-1):100773

- The emmetropization process involves a vision-guided feedback mechanism that alters scleral remodelling to match the axial length of the eye to its optical system.
- Accelerated scleral remodelling, and not scleral growth, underlies myopia development.
- Scleral composition, structure and biomechanics are changed during myopia development.



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SCLERAL REMODELING

- Mechanism involving the rearrangement of existing material due to micro-deformations that are (nearly) volume-conserving at the tissue-scale,
- Scleral growth is a mechanism that changes the amount (volume) of the sclera.
- Microdeformation reduces the scleral strain (resistance to deformation)
 - Vicious circle as myopia evolves: the sclera resist less and less to stretching forces
- THERE IS A TIGHT CONNECTION BETWEEN CHANGES IN TISSUE COMPOSITION, STRUCTURE, BIOMECHANICS, AND SCLERAL REMODELING

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Clinical translation

- Quality of the visual signal is key
 - No undercorrection
 - Peripheral stimulation is crucial
- Optical devices / Pharma/ Chromatic interventions
 - Must influence scleral remodeling
 - May take weeks/months to happen (rabbits: 2 weeks, threesheeps: 3 months; humans ??)
- Any intervention must be evaluated through the choroidal/scleral response
 - Is this becoming the new metrics for myopia evolution /management ?

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What is the best strategy then?

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THE ONE WHO WILL INFLUENCE THE QUALITY OF THE VISUAL SIGNAL
ENOUGH TO ALTER THE AXIAL LENGTH ELONGATION STIMULATION

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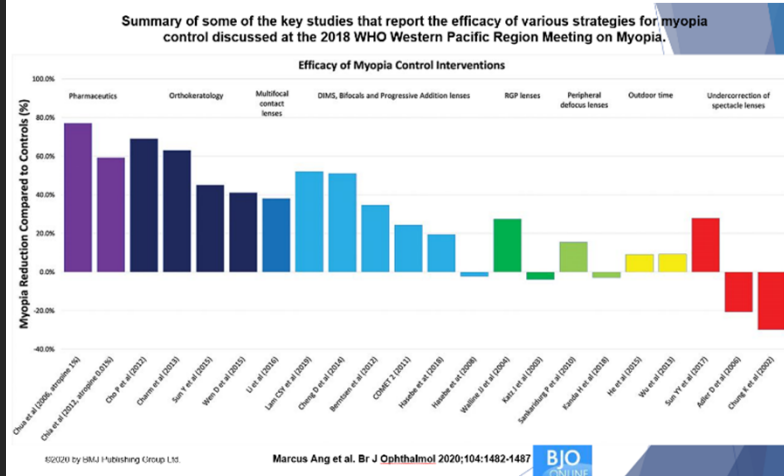
Factors to consider

- The response to visual signal is individual (Tepelus, 2010)
 - Threshold is different from one patient to another
 - Refractive error, age, genetics, etc. are also variable among individuals
- There is a dose response mechanism in place
 - Animal model (Tse 2011)
 - +3.50D defocus is minimal- and response is proportional
 - BLINK study (Walline 2020)
 - Low-dose atropine (0.05% vs 0.01%) (Yam, 2021)
 - OK - higher efficacy with higher correction (+ defocus) (Cho, 2005)
 - Importance to calibrate the dose vs individual case (risk factors)

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The best strategy ?

- There is no single method that will fit everybody
- Results are averaged
The kid in your chair is not « the Average »
- Customization is the key



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DEFINING THE best strategy ?

• FACTORS TO CONSIDER

- Age at myopia onset
- Genetics (ethnic origin, family ocular history)
- Binocular vision status
- Presence of a dose -response (Blink Study)
- Patient's related factors (maturity, compliance, budget)

MORE INTENSIVE STRATEGY

Onset < 10 years old

2 parents/1 highly myopic

Eso at near, CI, NRA/PRA

Myopia predicted > 6D
AL 26 and higher

LESS INTENSIVE STRATEGY

Onset > 10 years old

Limited background myopic

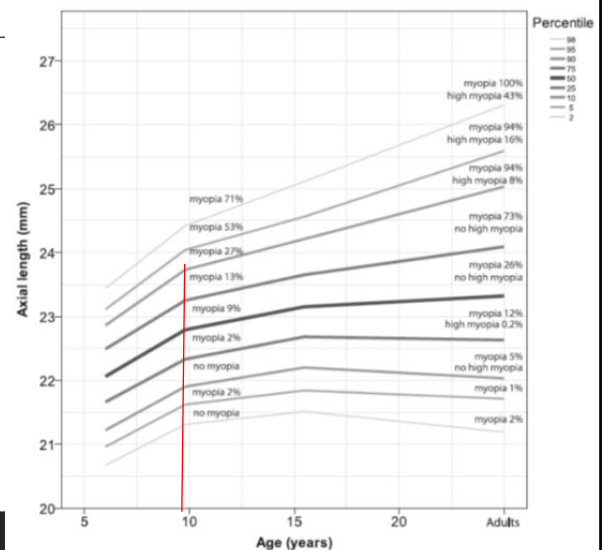
Normal condition

Myopia predicted < 6D
AL < 26 mm

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Risk factors dictate intensity of the treatment

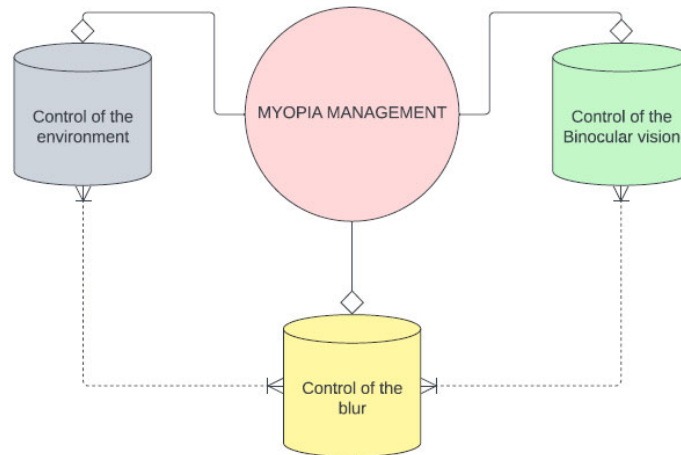
- Intervention needed : 50% percentile and over
- Bold line
- Intensive strategy : > 75 percentile
- May suggest combined therapy



<https://onlinelibrary.wiley.com/doi/full/10.1111/aos.13603>

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Three pillars of Myopia management




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Control of the environment



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Binocular vision

- 1 Vergence
- 2 Accommodation

Courtesy Dr Ganivet OD

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CONTROL OF THE BLUR

TAKE HOME

- Undercorrection should never be recommended
- Control of the blur means more frequent F/U
- Equilibrate Near/distance zones for optimal results

- Factors promoting myopia and its evolution
 - genesis of retinal blur in the presence of accommodative lag, exposure to certain spatial frequencies at near, and close reading distance seem to be the factors that impact myopia (Logan, IIMI white paper, 2021)
- Central blur
 - = undercorrection
 - = form deprivation (Wallman, 1978)
- Peripheral blur
 - Hyperopic defocus > myopic defocus
- High myopic defocus may be associated with blur at distance
 - Depends on the proportion of near/distance zones

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TOOLS IN OUR HANDS

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Glasses

TAKE HOME

- Single vision lenses must not be prescribed anymore to any myopic kid /young adults who is evolving
- Newest designs can be considered as a valid option

Single vision lenses do not work

- Hyperopic defocus
- Associated with fast progression in younger kids
- Corneal rigid lenses = the same

Progressive and bifocal glasses are habitually considered less effective for Myopia management

Newest designs seems to be as effective as contact lenses

- Not available yet in the US.

There are conditions where glasses can still be considered a valid option

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When glasses are considered a valid option

- Progressive lenses
 - Eso at near combined with High lag ($>1D$)
 - Add value = lag or higher than lag
 - Short corridor, centration middle of the pupil
- Prismatic bifocals
 - High Exo at near and normal Lag
 - CL induce exo shift
 - Add power = lag -0.50D
 - Centration: with lower pupil edge
- Calibrate vs reading distance
- Selection of the frame is crucial
- Educate the patient where to look.



This IS NOT effective !!

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Contact lenses

TAKE HOME

- Need for customized designs to improve myopia management efficacy
- Dose/response
- Center-Distance designs work better

Soft MF

Myopic kids and young adults are not presbyopic

- Pupil diameter
- Reading behaviour
- Accommodation is still present
- MF add vs bV dysfunctions

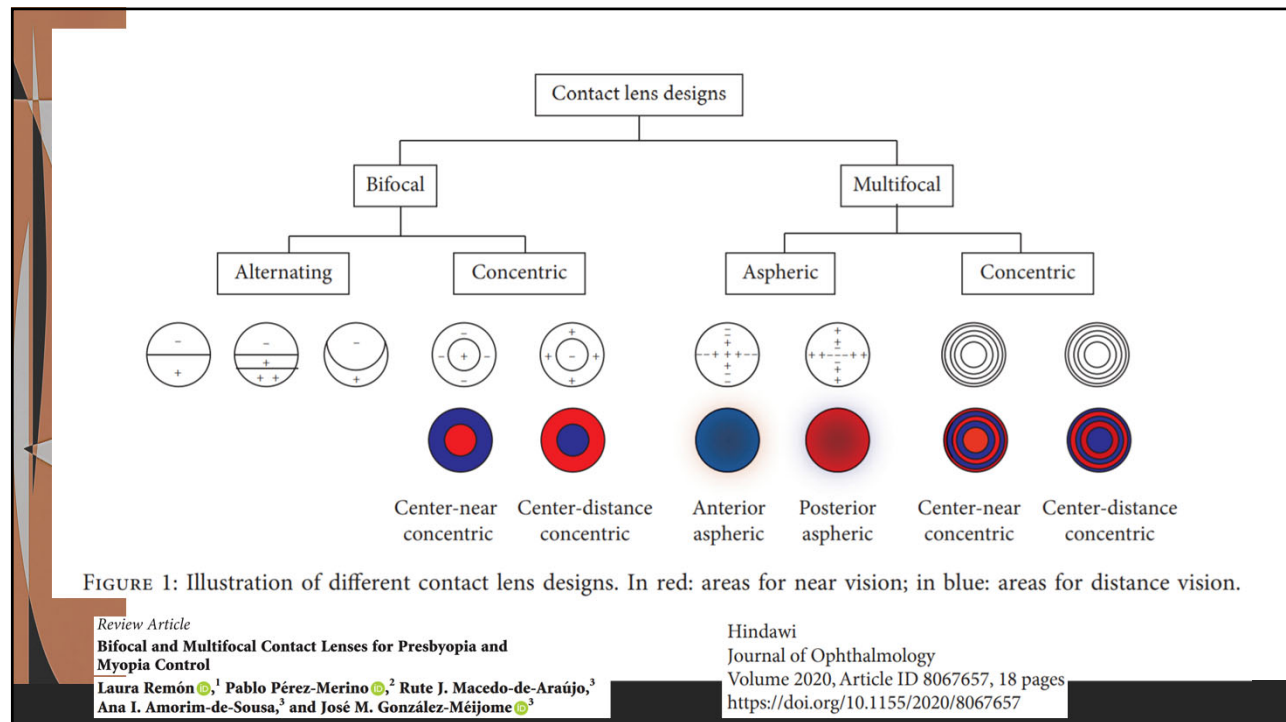
CL need

- To generate higher myopic vs hyperopic defocus
- Bifocals or multifocals
- To generate higher + spherical aberrations
- Higher add
- Proportional to level of myopia

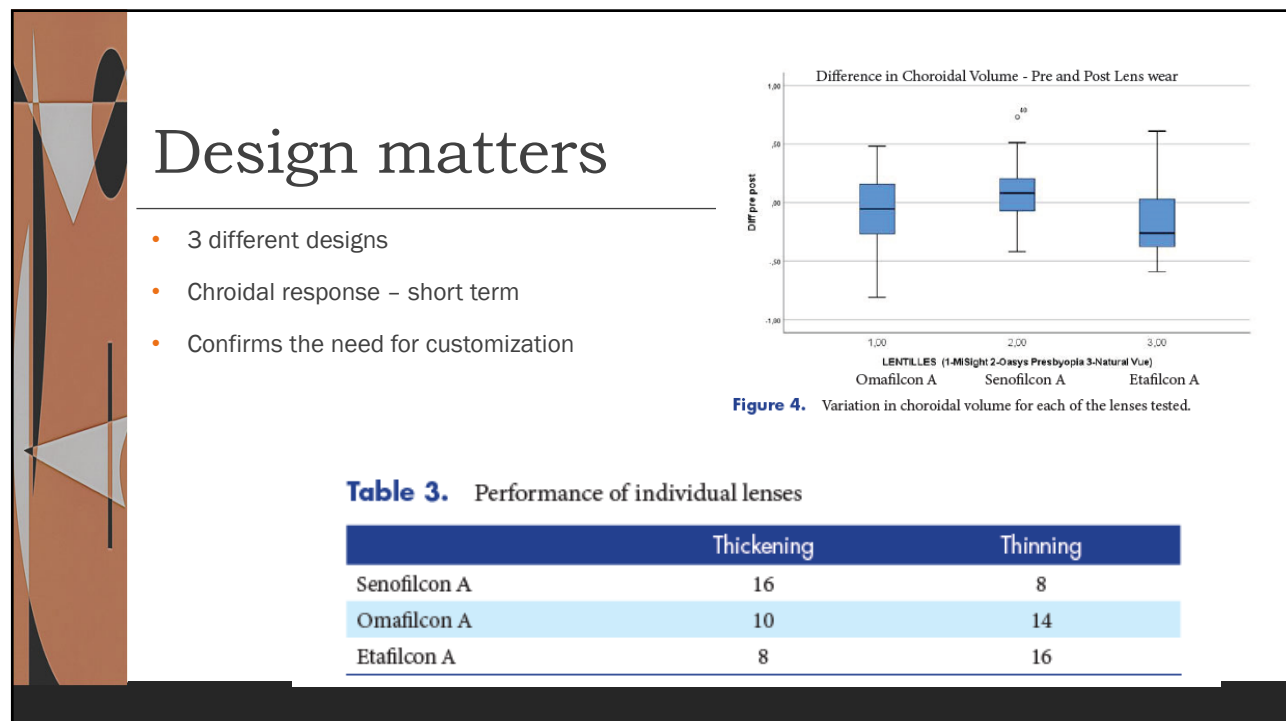
Design matters

- We need designs made for myopia management

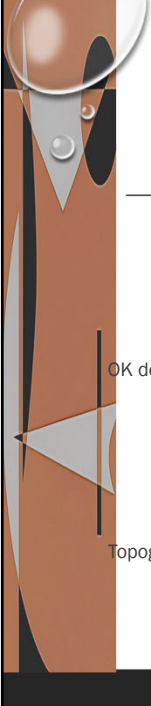
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Ortho K

Take Home


OK design for Myopia management is different vs myopia correction

Customization is key in most cases

Topography analysis reveal real lens behaviour (not Slit lamp)

	Differences between Lens Designs	
	Myopia Management	Myopia Correction
Jessen Factor	Habitually higher (superior to 1.00 and inferior to 3.00).	Lower (1.00 or less); 0.75 in general.
#Curves	5 or more.	4–5 in general.
Diameter	Larger diameter. Must cover 90–95% of the visible cornea (HVID).	80–90% of the visible cornea.
Central zone diameter	Smaller (5.0–6.0 mm in general). Proportional to the pupil area. Aim to enhance peripheral defocus and positive spherical aberration [64].	Larger (6.0 mm in general). Aim to alleviate haloes.
Back surface positive asphericity	Higher (>1.0) to generate a deeper reservoir. Jessen factor must be modified accordingly (higher as well).	Rarely used.
Reservoir (reverse curve)	Customizable to enhance corneal molding, especially in low myopes (going over 1:1 ratio).	Fixed versus refractive error (1:1 ratio—myopia corrected versus +power-generated).
Landing zone	Toric/quadrant-specific to enhance centration. Steeper than OK.	Toric to enhance centration. On K, or flatter than K.
Peripheral curves	Steeper to enhance seal-off effect.	Flatter to allow tear exchange.
Overall lens sag	Higher	Lower
Lens movement (slit lamp)	Reduced, fluorescein exchange almost stagnant.	Regular—fluorescein exchange as habitually seen with RC lenses

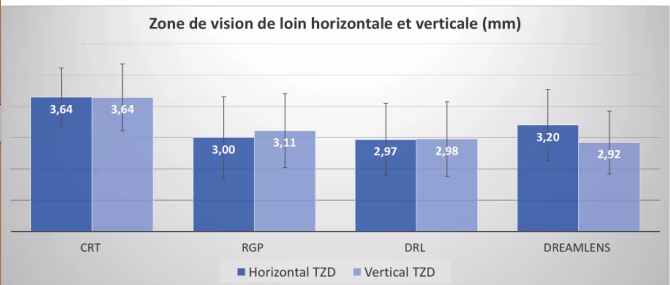
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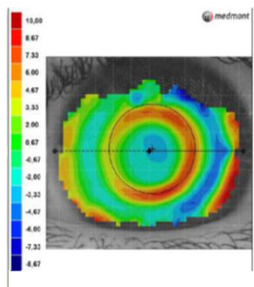
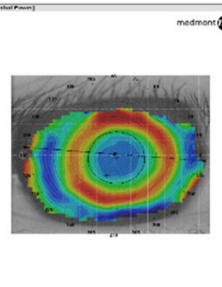
Treatment zone diameters compared

Analyse du changement topographique cornéen

Zone de vision de loin horizontale et verticale (mm)



Lens Design	Horizontal TZD (mm)	Vertical TZD (mm)
CRT	3.64	3.64
RGP	3.00	3.11
DRL	2.97	2.98
DREAMLENS	3.20	2.92

ARTICLE

Analysis of Two Orthokeratology Lens Designs and Comparison of Their Optical Effects on the Cornea

Remy Marcotte-Collard, O.D., Patrick Simard, O.D., M.Sc., M.B.A., and Langis Michaud, O.D., M.Sc.

Courtesy: Dr Remy Marcotte-Collard

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Pupil vs treatment zone

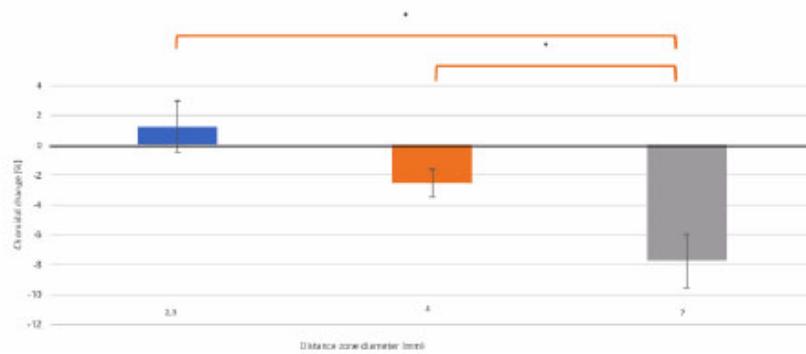


Figure 5. Variation in choroidal volume as a function of the treatment area (central) of a high addition multifocal lens.

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PHARMACOLOGICAL APPROACH

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Atropine efficacy

Atropine – Wonder Or Weak Treatment?

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

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The Netherlands experience

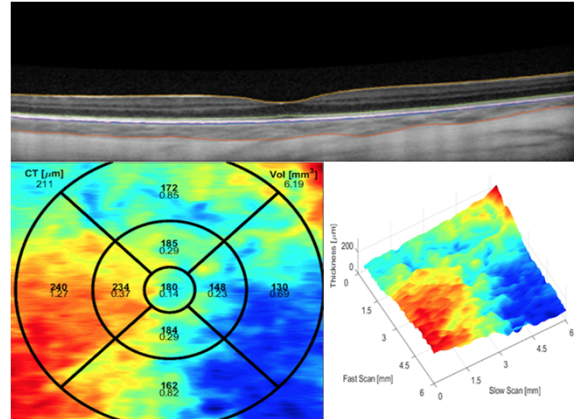


- They suggest 0.5% for those over 75 percentile (growth chart)
- Photochromic +3D add Progressive lenses provided
- 0.05% for those under
- Dosage increased (if evolution is still present) or decreased (side effects vs efficacy)
- Treatment maintained up to 15 years
- Tapering after
 - If AL is stable (0.1 mm or less /year) : then concentration is reduced over time
 - Cessation of the treatment when elongation is 0.05mm or less/year

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Metrics to assess evolution

- Diopters
- Axial length
- Choroidal /Scleral response
 - Short vs long term



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Challenging cases

NO.1

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CR#1



- 6 years old, Caucasian male
- Referral infos:
 - OD -6.25 -1.25 x 34 OS -3.00 -0.25 x 172
 - Acc Lag +1.25 (MEM) 12 exo @ 40 cm
 - Is wearing single vision glasses
- Is looking for myopia management
- What other information do we need ?

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Info missing

Case history

Genetic background

Birth hx + child physical development

CONSIDER POTENTIAL FOR
NEUROLOGICAL SYNDROME (high
myopia at a young age)

Evolution

Reading /school/ outdoors/ screen time

Myopia management initiatives

Expectations

Factors who may influence compliance



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Clinical testing

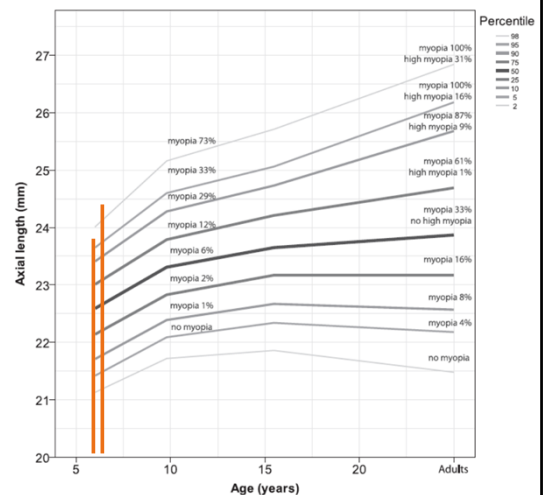


- Emphasis on binocular vision / amblyopia
 - OD 20/25 NIPH OS 20/20
- High exo at near (CI) vs myopia evolution vs CL wear (exo shift)
 - VT recommended
 - Anisomyopia vs monocular accommodation
 - No difference
- Refraction
 - Cycloplegic – for anisomyopia - Cyclopentolate 1%
- Topography : high cyl / Posterior cornea profile /
 - Normal
- Biomechanical aspects
 - Normal
- Vitreo-retinal assessment
 - Normal
- AXIAL LENGTH !!!
 - OD 24.9 mm OS 23.6 mm
 - > 95 percentile

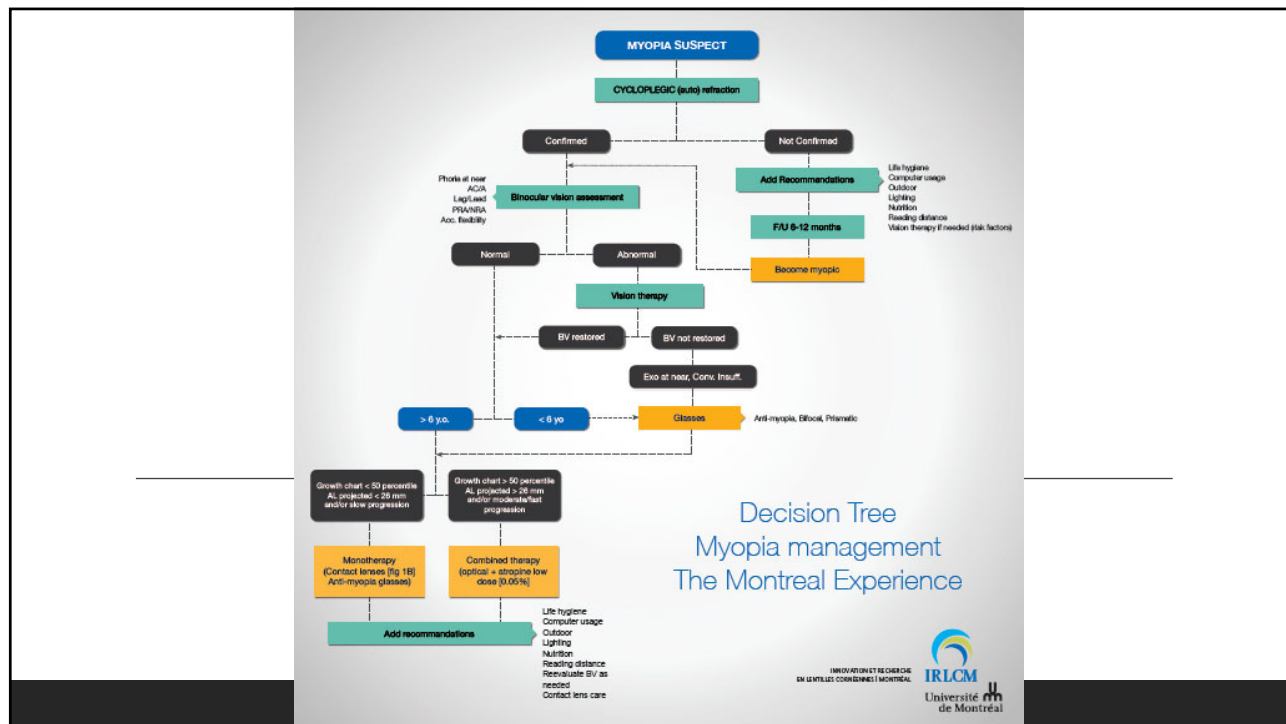
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Management options

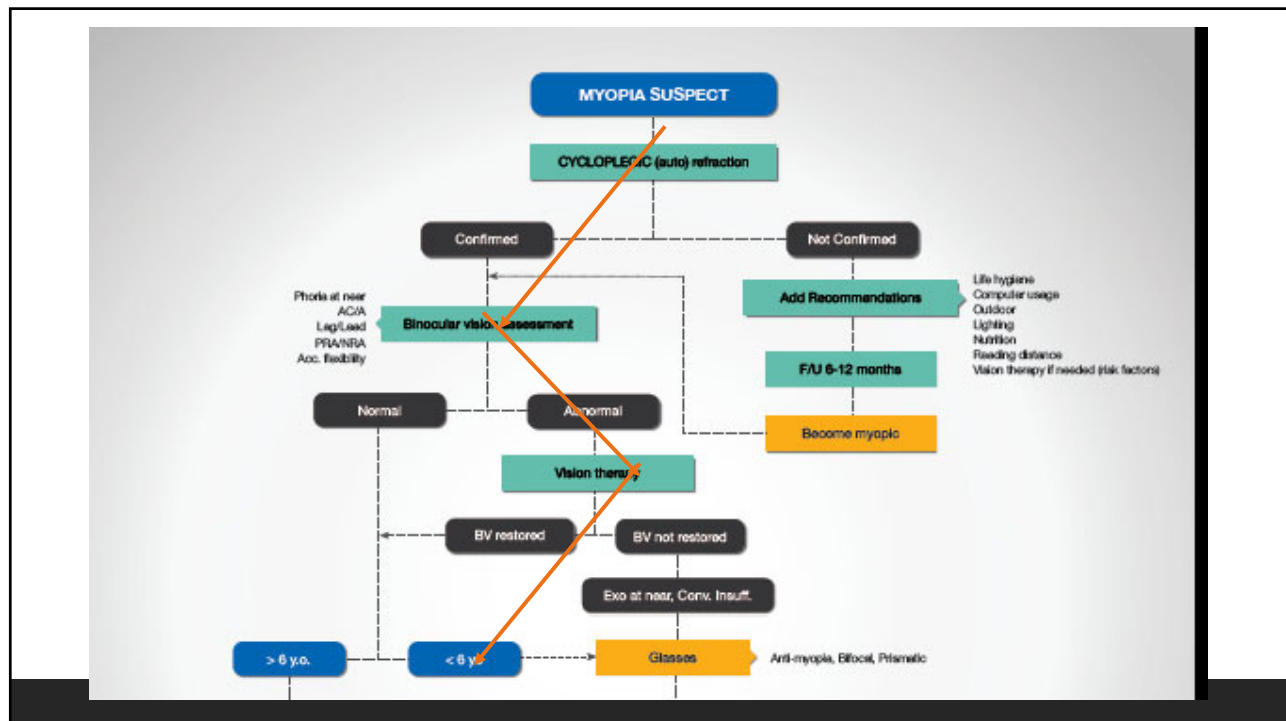
- 1) To consider
 - Need for intensive management
 - Combined therapy ?
 - High myopia
 - OK safer if < 4-5D
 - With Astigmatism
 - Age
 - Is 6 y.o. too young for CL wear ?
- Cost /budget



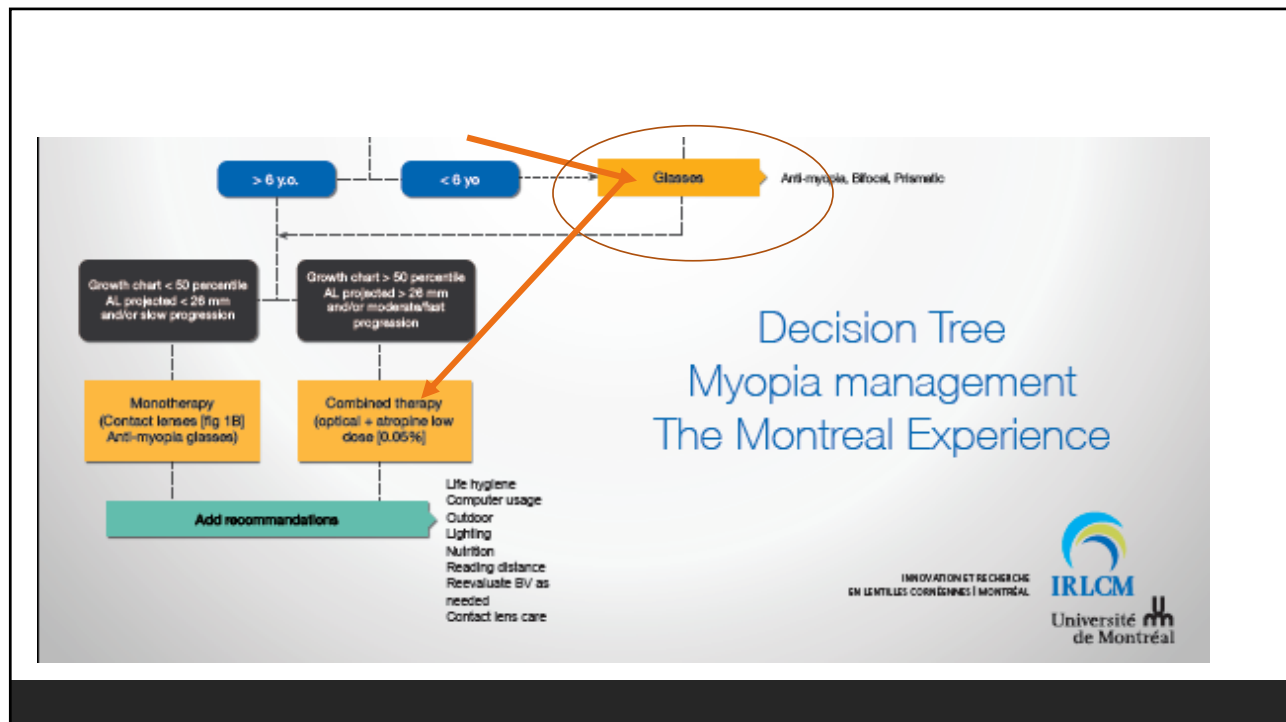
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CL options.... If

- Soft MF (distance centered) + regular SV glasses for astigmatism
 - Make sure to keep some myopia in the glasses to enhance compliance to wear them
- Partial OK
 - Residual refractive error corrected with regular glasses during the day
- GP – front aspheric lenses
 - Mimics OK optics

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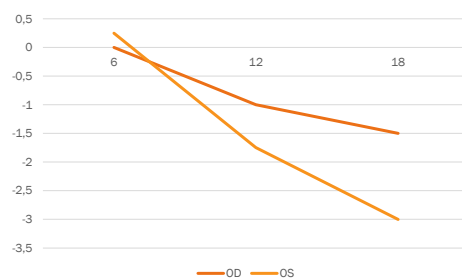
Challenging cases

NO.2

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CR #2

- 9 years old, Asian female
- Refraction



- Not corrected so far
 - Parents believe that glasses will make eyes « lazy »
 - Vs kids complaint: would consider glasses but no more than 1D
 - May agree to OK if they are in full control
- + genetic background
 - 1 parent highly myopic
 - No outdoors
 - Tutoring and intensive school work 7days/wk
- AL : 23 mm OU
- WHAT WOULD YOU DO ?

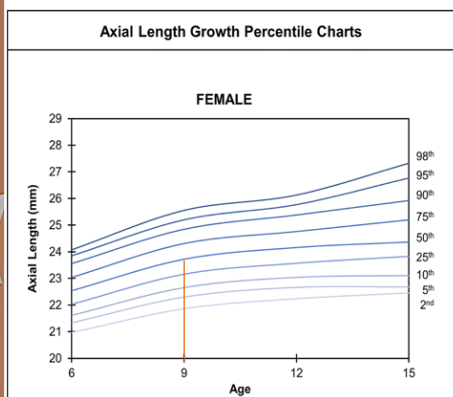
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Éléments to discuss

- Parents and kid behaviours
 - We must respect them
 - Provide valid and accurate information
 - Explain with calm the goal and the strategies
 - Establish trust and a positive relationship
 - Put them « in charge » / this becomes their decision to manage
- No correction/ undercorrection
- Genetics vs epigenetics
 - Reading distance / screen time / tutoring – studies

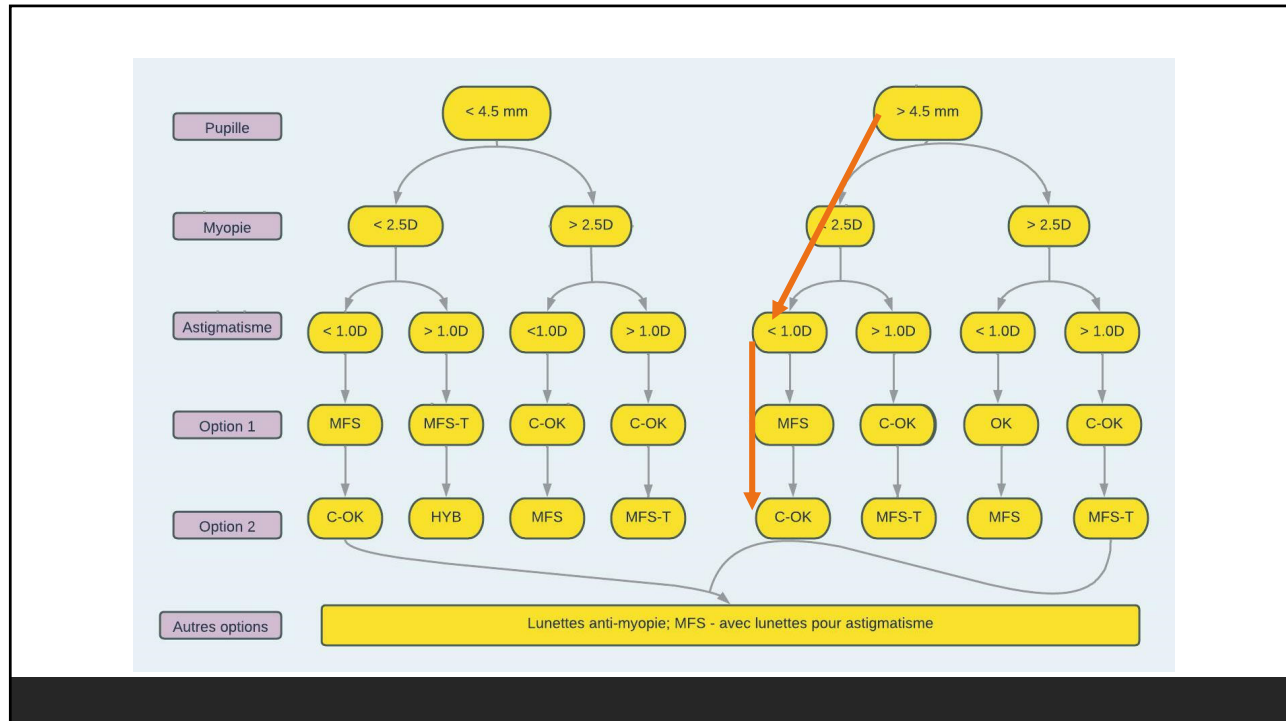
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Options

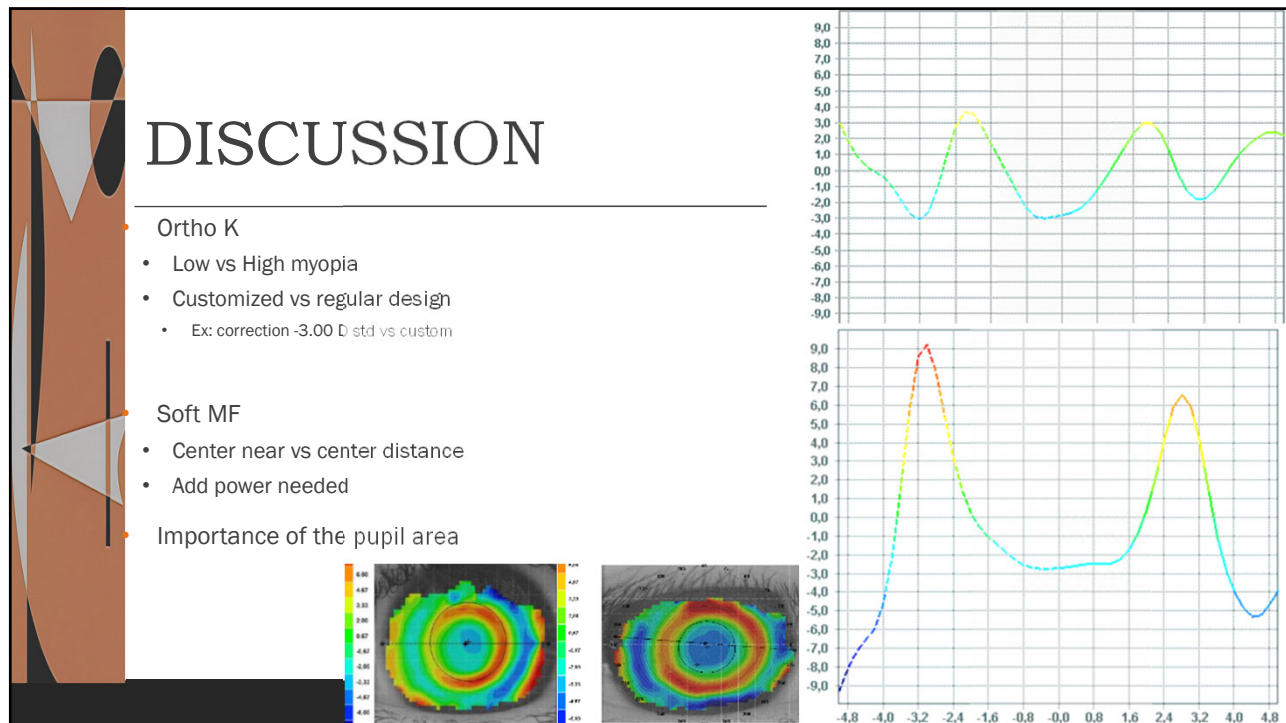


- Other factors
 - Girl, Asian, myopia onset < 10 years
 - Suggest fast progression
- Growth chart (San Diez- Asian)
 - 50% percentile
 - Suggests: Moderate intervention
- Decision tree
 - Monotherapy
 - Contact lenses

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Challenging cases

NO.3

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CR#3

- 13 y.o. Caucasian male

Age	Myopia	Intervention
10	-1.25	First diagnosis / Single vision glasses
11	-2.25	Fitted in soft MF high add (center distance) – monthly disp.
12	-2.75	Does not wear CL often – blur and dryness . Rx anti-myopia glasses
13	-4.25/ -4.75	Reports to do not wear his glasses for TV, screen time (2-8h/day). Just for school.

- AL is now 24.9/25.1 mm OU
- Does not report blurred vision – patient is comfortable at all distances

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Elements to discuss




Why interventions don't work

Nutrition and myopia evolution

Outdoors impact

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OUTDOORS VS SCREEN TIME



- 20 minutes of continuous usage of smartphones increases myopia risk and progression in teenagers
- Negative effect canceled if outdoors exposure of > 14 hrs per week
- Takes in account seasonal variations
 - Myopia tends to progress more in the winter time (more school, less outdoors)

Eppenger LS, Sturm Clin Ophthalmol 2020; 14:1875-1890

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What to do

- Education of kids and parents is crucial
 - To develop a common understanding of the situation
- In cases of non compliance
 - OK + atropine may be the best option here
 - Glasses: need 10h of wear (minimum)
 - Soft MF : comfort issue
 - Pharma- stand alone: higher percentage needed – may generate non compliance vs side effects

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Challenging cases

NO.4

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CR#4

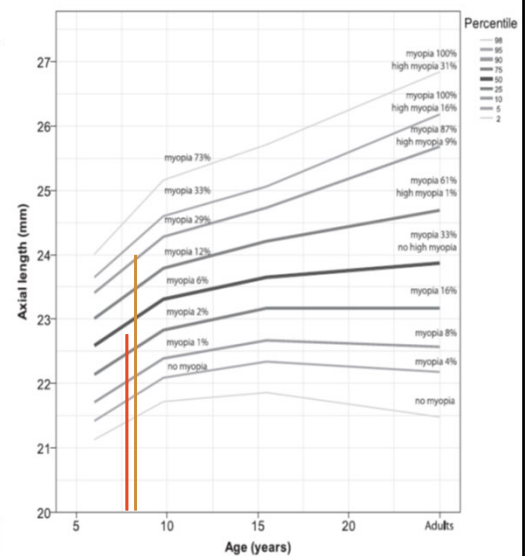
- Dizygotic twins , 8 y.o., South-American origin
 - Twin #1 : -1.50 D OU - evolution 0.50D /year /AI 22.50 mm
 - Twin #2 : -1.75 D OU - evolution 0.62 D /year / AL 23.60 mm
- Normal BV
- Outdoors: 3h/ day, 4 times a week (soccer league)
 - Limited screen time
- 1 parent – low myopia; second is hyperopic
 - 1 other brother : +0.50D @ 6 y.o.
- CL are considered for sport activities
 - Ks : average = 43.75D TW1 ; 42.50 TW2
 - Ecc: 0.6 = highest
 - Pupil: 4.7 mm for both



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Management

- Twin 1 : < 50 percentile, no risk for high myopia
 - Observation ? Low intervention ?
- Twin 2: 90 percentile, 9% risk high myopia
 - Needs intensive management
- Decision tree
 - Contact lenses
 - TW1 : soft MF = preferred / OK as an option
 - TW2 : OK – custom (despite flatter K and limited ecc, low myopia)
 - Atropine
 - Not for the moment (TW1 and 2 not projected > 26 mm)



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DISCUSSION

- Cost
 - Parents were not able to afford DD soft MF for TW1 and custom OK TW2
- Options:
 - OK for both
 - Monthly disposable soft MF for TW1 - is this safe ?
- Will affect compliance
- Discussion about partial vs constant lens wear
 - Dose needed
 - If CL not worn, then anti-myopia glasses and/or atropine (cost still involved)

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Conclusion

- Myopia management must be prescribed one child at a time.
- Many options exist – Do nothing is no longer acceptable
- Combined treatment may be needed on those evolving fast or at high risk
- Regular follow-up is mandatory to achieve the best outcome

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