Practical Myopia Management for the Busy Optometrist

Maria K. Walker, OD, MS, FAAO


96.5% myopia at age 19
>80% myopia at age 18

Current worldwide prevalence: 22%
Est. prevalence in 2050: 44%

Pathologic or Degenerative Myopia
- Axial length >26.5 (26) mm or myopia >6 D
- Associated with several pathologies
  - Glaucoma, cataracts, retinal tears/ detachments, CNV, macular atrophy, choroidal degeneration, and more
- 2% worldwide currently
- Est. to be 10% worldwide in 2050 (~1 billion people)

United States:
~45% prevalence

5 Billion people with myopia
1 Billion people with PATHOLOGIC myopia

2050 Projection:
Retinal Detachment
Glaucoma
Myopic Retinal Degeneration


Choroidal Neovascularization
Cataract
Myopic CNV

Pan, C.-W. et al. 'Myopia and Age-Related Cataract: A Systematic Review and Meta-analysis'.

Theories of Myopic Progression

- 5x increased risk with myopic parents
- Over 20 genes identified
- Near work
- Lack of "horizon" viewing
- Light levels
- Undercorrection
- Late at-home

Hormones
- Protective Hormones
  - Dopamine
  - Vitamin D

Visual Feedback
- Near work
- Image shift in specs

Detect Treat Manage Educate

Full Circle Myopia Management

- Refraction shift
- Axial Length
- Progression risk

- Myopic栎uity
- Myopic栎uity in kids
- Myopic栎uity

Pediatric Norms:
Infants: approx +2.00D
3-5 yo: emmetropization
May have +1 D at 5 y o
6-16 yo: slight myopic shift

Normative Data

Full Circle Myopia Management

- Monitor tx efficacy
- Modify and add treatments

Detect

Pediatric Norms:
時期 mean ±2.00D
>5 yo: emmetropization
May have +1 D at 5 y o
6-16 yo: slight myopic shift
**Normative Data**

**Pediatric Norms:**
- Infants: 19–21 mm
- 3-5 yo: 21–22 mm
- 6 yo: 22 – 22.75 mm

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**What about light levels?**
- Associated with reducing myopia incidence (even those with high amount of near work)
- Physical activity not necessary
- Direct sunlight also not necessary
- Recommend 8-15 hours of outdoor activity per week
- Does not protect against progression

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**What about near work?**
- Greater near work may influence development and progression of myopia (36,37,39 in IMI)
- Close reading (less than 20cm)
- Continuous reading (greater than 45 min)
- None: great amount of outdoor activity and high levels of near work → reduced incidence

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**Clinical Guidelines**

**IMI – Clinical Management Guidelines Report**

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**Standard Procedure for Myopia Exam**

- History
  - Age, sex, ocular health, surgery, general health and FHx
  - History of myopia, history of myopic progression, prior treatments
  - Refraction
    - Cycloplegic – recommended dosage is two drops 1% tropicamide or cyclopentolate, 5 minutes apart. Perform refraction after 30 mins.
  - Anterior ocular health examination
  - Fundus examination
    - Appearance of choroidal abnormality, macula, PISA, static discs

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**Standard Procedure for Myopia Exam**

- Specialized refraction
- Binocular vision testing
- Corneal topography
- Axial length
Refraction

- Wet vs. dry
- Wet refraction =Rx?
- Be careful: do not solely rely on refraction!

Axial Length Measurements

What are we actually measuring?
How accurate is it?

The “true” Axial Length

Don’t fall subject to the ASSUMPTIONS of sound and light

Enucleation
MRI

Clearly not practical techniques (not necessary)

Precision and Accuracy

- Precision (repeatability): How close is measurement "a" to measurement "b"?
- Accuracy / Validity: Is the device giving an accurate (correct, true) measurement?
- Correlation: How well can we predict the measurement of one instrument by knowing another?

A precise and repeatable instrument is needed for myopia management

Axial Length:
Primary Outcome for monitoring myopic progression

<table>
<thead>
<tr>
<th>R.E. change</th>
<th>Predicted AL Change (mm)</th>
<th>Actual AL Change (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.50 - 0.37 x 005</td>
<td>0.45 mm</td>
<td>0.22 mm</td>
</tr>
<tr>
<td>-2.25 - 0.82 x 185</td>
<td>1.15 mm</td>
<td>0.12 mm</td>
</tr>
</tbody>
</table>

Patient 1

<table>
<thead>
<tr>
<th>R.E. change</th>
<th>Predicted AL Change (mm)</th>
<th>Actual AL Change (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>+0.37 - 0.87 x 180</td>
<td>0 mm</td>
<td>0.18 mm</td>
</tr>
<tr>
<td>+0.35 - 0.82 x 005</td>
<td>0 mm</td>
<td>0.18 mm</td>
</tr>
</tbody>
</table>

Patient 2

<table>
<thead>
<tr>
<th>R.E. change</th>
<th>Predicted AL Change (mm)</th>
<th>Actual AL Change (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.50 - 1.50 x 013</td>
<td>0.37 mm</td>
<td>0.85 mm</td>
</tr>
<tr>
<td>-0.50 - 1.00 x 170</td>
<td>0.30 mm</td>
<td>0.91 mm</td>
</tr>
</tbody>
</table>

Patient 3

Ultrasound

- Highly repeatable & precise
- Somewhat dependent on eye position
- Longer acquisition time
- Practically not always best for kids
- Contact
- Longer acquisition time
Interferometry

- Lenstar (Haag-Streit)
- IOL Master 500 & 700 (Zeiss)
- Pentacam AXL (Oculus)
- OA2000 (Tomey)
- AL-Scan (Nidek)
- OCT-B

Interferometry vs. Ultrasound

- Ultrasound consistently measures shorter than interferometry
- No change in MAGNITUDE of difference in normal eyes or high myopia

<table>
<thead>
<tr>
<th>Devices</th>
<th>Axial length (mm)</th>
<th>Axial length (mm)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lenstar</td>
<td>23.17 ± 0.78</td>
<td>26.74 ± 2.04</td>
<td>0.000</td>
</tr>
<tr>
<td>IOL Master</td>
<td>23.18 ± 0.77</td>
<td>26.73 ± 2.05</td>
<td>0.000</td>
</tr>
<tr>
<td>Ultrasound</td>
<td>22.94 ± 0.24</td>
<td>23.96 ± 1.98</td>
<td>0.000</td>
</tr>
</tbody>
</table>

0.24mm shorter

P values from independent sample t-tests.

Technology Alert:

- Tomey OA 2000
  - Pupillometer
  - Keratometer
  - Biometer (axial length)
  - Pachymeter

Technology Alert:

- Pentacam AXL
  - Tomography & all features
  - Axial length

Technology Alert:

- Myopia Master
  - Axial length
  - Refraction (pupil diameter)
  - Corneal Curvature
  - Calculates risk of myopia & has customizable "take home" report
Comparing New Technology with Established Technology

• IOL Master 500 vs. 700: mean difference of 0.008 mm
• IOL Master 500 vs. Pentacam AXL: difference of 0.026 mm
• Similar repeatability between all of them

Take home: compare instrument to standard instruments prior to purchase

The Choroid Effect

• Temporal thickening of choroids artificially “shorter” measurements
• All myopia control methods can cause acute choroidal thickening
• Choroid has diurnal variation in thickness

Tip: Take consistent time of day measurements
Develop a consistent protocol for measuring AL

Accommodation Effect

• Greater accommodation leads to greater AL measurement

Binocular Vision Assessment: Accommodation

Table 1. Accommodation Function Tests Used in Clinical Studies

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Clinical Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accommodative accuracy (lag or lead)</td>
<td>Operative autorefractors (Kowa B, LCA 9000, Grand Siko 150, Grand Siko WB-3500)</td>
</tr>
<tr>
<td>Accommodative amplitude</td>
<td>Phoropter, distance and near, pretest and posttest, Worth 4-dot test, push-up test</td>
</tr>
<tr>
<td>Accommodative facility</td>
<td>Distance Bjerrum + 2.00 D (Hoffer, 1988), Near + 1.25 D (Hoffer, 1988)</td>
</tr>
</tbody>
</table>

Binocular Vision Assessment: Versions

Table 2. Vergence Function Tests Used in Clinical Studies

<table>
<thead>
<tr>
<th>Vergence Assessment</th>
<th>Clinical Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance and near heterophorias</td>
<td>Risky prien and Maddox rod, Von Graefe method, Alternating cover test</td>
</tr>
<tr>
<td>Near fixation disparity</td>
<td>Saladin near point balance, Saladin near point balance, Saladin near point balance</td>
</tr>
<tr>
<td>AGA test</td>
<td>Calculated method, Gradient technique</td>
</tr>
</tbody>
</table>

Take home: use the methodology that best fits your practice, and use it consistently

Is that it? Do we need to consider anything else?
Ancillary Technology for Myopia Management

Aberrometry

Role in myopia progression?
Role in CL management?

Calculating Risk

• Age of onset
  • Independence of sex, ethnicity, school, reading time, parents
  • So early myopes are high risk regardless
• Parents (2 w/2 parents)
• Outdoor time, close reading distance
• Ethnicity
  • Asians > European & African descent

Parents (3x w/2 parents)

Impact of family history of high myopia on level and onset of myopia. IOVS. 2004;45(10):3446-52.

PARENT EDUCATION:
GLOBAL MYOPIA CENTER

https://globalmyopiacentre.org/

Full Circle Myopia Management

Contact lenses
Spectacles
Therapeutics
Treat

Scleral lens
Accommodative prisms
Eye exercises
Laser treatment
Medication
Orthokeratology
Pharmacology
Plano contact lens
Prosthetic lenses
Relief of symptoms
Surgery
Treatments
Contact Lenses
Contact lens trends for MC in 2018

THE BIRTH OF THE MC THEORY

PERIPHERAL REFRACtion

Optical Designs of Myopia Management contact lenses
- Concentric ring (bifocal) designs
- Progressive power (peripheral add) designs
- Orthokeratology designs
**Soft CL for Myopia**

**CUSTOM SOFT MF**
- Optic Zone Size
- Optic Zone Centration

**Fitting Ortho-K**
- Beware of asymmetric treatment zones due to toricity.
- Mix of toric/dual-axis ortho-k lenses for max treatment
- 20um difference in refractions between major meridians: think dual axis

**Spherical vs. Toric**
- Spherical Ortho-K
- Toric Ortho-K

**SOFT CONTACT LENSES:**

<table>
<thead>
<tr>
<th>Lens Brand</th>
<th>Contact Design</th>
<th>Replacement</th>
<th>Disadvantages</th>
<th>Advantages</th>
<th>HIGHEST ADD Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naturalvue (Visioneering)</td>
<td>Progressive power</td>
<td>Daily</td>
<td>CornealVision</td>
<td>Discontinue</td>
<td>Highest commercially available ADD: +4.00</td>
</tr>
<tr>
<td>Naturalvue (Visioneering)</td>
<td>Quarterly</td>
<td>Disposable</td>
<td>Highly customizable</td>
<td>Not commercially available</td>
<td></td>
</tr>
<tr>
<td>Specialeyes MF (Specialeyes)</td>
<td>Center distance (Concentric ring)</td>
<td>Monthly</td>
<td>Transcend</td>
<td>Availability</td>
<td></td>
</tr>
<tr>
<td>Biofinity D MF (CooperVision)</td>
<td>Monthly</td>
<td>Transcend</td>
<td>Available Toric Available</td>
<td>Monthly Replacement Availability</td>
<td></td>
</tr>
<tr>
<td>Proclear D MF (CooperVision)</td>
<td>Monthly</td>
<td>Transcend</td>
<td>Transcend</td>
<td>Monthly Replacement Availability</td>
<td></td>
</tr>
<tr>
<td>MiSight (CooperVision)</td>
<td>Daily</td>
<td>Transcend</td>
<td>Transcend</td>
<td>FDA Approved Disposable</td>
<td></td>
</tr>
</tbody>
</table>
Spectacles: MyoVision

- 203 Japanese children
- 2 years
- -1.43D with MyoVision
- -1.39 with SV control

Study could not verify treatment effect

Spectacles: DIMS lens

Defocus Incorporated Multiple Segments

- 160 Chinese children
- 2 years
- -0.41D in DIMS
- -0.85 with SV

Atropine

- Atropine 0.025 or 0.05%
  - Minimal side effects compared with 1% atropine
  - Dosed 1gtt OU at night before bed
  - Minimal mydriasis and near complaints
  - LAMP study

- Atropine 0.01%
  - Only if adjunctive therapy

Combined therapy?


Several factors will affect treatment decision

Choosing a Modality

What would you choose?

<table>
<thead>
<tr>
<th>Spectacle Rx</th>
<th>Orthokeratology</th>
<th>Soft Multifocal</th>
<th>Daily wear GP</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.00 DS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.50-1.00x180</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>0.00 DS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.00-3.75x110</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>0.50-2.00x180</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>4.00 DS</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Educate

- Contact lenses
- Spectacles
- Therapeutic

Full Circle Myopia Management

- Reduce risks
- Protective
Eyeglasses
Nearsightedness
Vision
Contact Lenses
Bifocals
Myopia Control

Simplified Parent Education
Myopia is genetic
• Risk increases with 1 or 2 myopic parents
• Darwinian theory

Environmental Risks
• Less time outdoors
• More near work demands
• Refractive correction

Parent & Patient Education
Use of Electronic Devices

PATIENT EDUCATION
• Starts in the waiting room
• Videos
• Literature (pamphlets)
• Posters
• Identification of candidates and distribution of educational materials by the doctor

Kids Education
Design colorful, fun
directional information

Educate children and
parents differently

Make it FUN!

Myopia Swag
Eyecare “Goody Bag”
CL/Glasses solutions &
cases
Do’s and Don’t worksheet
Replacement schedule
stickers
Contact Lens safety in children

Bottom line: minimal adverse events...
But always use caution and provide verbal and written instruction


The Patient + Family Experience

Dent Estet 4 Kids
România

Ramp up your webpage

http://videre-eyecare.com/siapour-services/myopia-management/

Patient Information Checklist

- Videos, Posters, Interactive Models
- Patient, Myopia education materials
- Written instructions + contracts
- Patient “goodie bags”
- Parent resource sheet

Full Circle Myopia Management

- Manage
- Monitor eyewear
- Modify treatments
- Progression risk
- Axial Length
Meaningful Progression?

Full Circle Myopia Management

Sequence of Exams

Materials

Stay connected
Clinicaltrials.gov
563 registered clinical trials on myopia
- 10+ studies on Atropine
- 10+ studies on soft CL
- 10+ studies on Ortho-K
- 10+ studies on spectacles
Observational, environmental (lighting), genetic, surgical studies...

Summary of Myopia Management
Know the science
Educate
Treat
Keep it simple & fun

The Future
- COVID-19: where does the myopia management patient stand?
- Telemedicine and myopia management?
  - Axial length measurements – at home?
  - Telemedicine is already here
- Activity monitoring
- Risk assessment

"If nothing is done, myopia will become the major cause of blindness around the world" - Brian Holden

Thank you!