Myopia Control & Management

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Member AAOMC
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Financial Disclosures

- None

Goals

- Look at myopia in a different light
- Understand different treatments options
- There is no “safe” level of myopia

Overview

- Why we need to treat
- Assess risk factors
- Types of Treatment
  - Do nothing...
  - Glasses
  - Atropine
  - Soft Multifocal, Soft Ortho-k
  - Ortho-k

Incidence in US

Prevalence of Myopia

Incidence of Myopia in US

In 2016 the WHO and the Brien Holden Vision Institute recognized myopia as a public health issue.³
Worldwide Epidemic

USA 42%
Europe 20-30%
China 80-90%
Taiwan 83%
Africa 10%
Chile 20%
India 19%
Aus 20-30%

Myopia, so What

Myopia Classification
- Low myopia < -3.00
- Moderate myopia -3.00 and -6.00
- High myopia > -6.00

Myopic Maculopathy

Pathological

Physiological

Wikipedia...

dis-ease
noun
a disorder of structure or function in a human, animal, or plant, especially one that produces specific signs or symptoms or that affects a specific location and is not simply a direct result of physical injury.

Systolic BP 140-149
Diastolic BP 90

<20 Cigarettes/Day

Why the Big Deal

<table>
<thead>
<tr>
<th>Refraction</th>
<th>PSC Cataract</th>
<th>Glaucoma</th>
<th>Retinal Detachment</th>
<th>Myopic Maculopathy</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.00 to -3.00</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>-3.00 to -6.00</td>
<td>3</td>
<td>3</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>-6.00 to -7.00</td>
<td>5</td>
<td>3</td>
<td>21</td>
<td>41</td>
</tr>
<tr>
<td>&gt; -7.00</td>
<td>44</td>
<td>126</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HTN, Stroke and Myopia

2x risk
2.9x risk
HTN, Stroke and Myopia

Refactive Error vs Disease

The Myopic Fundus

Case 1

Case 2- Pre Myope

Risk Factors

- 6 yo Asian Male
- Current Rx: pl OU
- Cyclo Rx: +0.75 OU
- Ortho @ D, 3 Exo @ N
- MEM: +1.25 (Lag)
- > 2 hours @ near
- < 1 hour outdoors
- Mom: -2.00
- Dad: -4.00
- Brother: -2.50

- 9 yo Asian Male
- -2.50 OU
- > 3 hours @ near
- < 1 hour outdoors
- 'Mom: -2.00
- Dad: -4.00
- 1st Rx: 7 Yo

- Genetics
- Near Work
- Outdoor time
- Education
- Ethnicity
- Age of Onset
  - Current prescription
- Other (prematurity, diet, light exposure)
**Genetics**

- **Children most at risk=**
  - Outdoor time
  - Nearwork

- Children with emmetropia spend 3.7 hours per week more outdoors than those with myopia.

**Environment**

- > 3 hours
  - 2.6x risk

- < 1.5 hours
  - 5-6x risk

**Outdoor Time**

- Outdoor time
- Nearwork

**Get Outside and Play**

- Children with emmetropia spend 3.7 hours per week more outdoors than those with myopia.

**Our Kids Today**

**Outdoor Theories**

- Light level
  - Light towards the UV end of the spectrum slows eye growth and myopia.
Outdoor Theories

- Dioptric field of view
  - Differences in defocus across viewing distances in indoor vs outdoor environments.\( ^{14} \)
- Outside = Dioptric value of 0

Outside = Dioptric value of 0

Light- Dopamine Theory\(^{14} \)

Sugar 

\[ \text{Dopamine} \]

\[ \text{GROW} \]

Dopamine

Outdoor Theories

- Winter Months
  - Progress 3-4x Faster

Risk Factors for Developing Myopia

<table>
<thead>
<tr>
<th>Age</th>
<th>Risk Factors for Developing Myopia</th>
<th>Risk factors for fast progression of Myopia</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 9 years old</td>
<td>Refractive error: Less plus in refraction</td>
<td>≤ -0.50 D per year</td>
</tr>
<tr>
<td>≥ 9 years old</td>
<td>Refractive error: NA</td>
<td>≥ -0.50 D per year</td>
</tr>
<tr>
<td>Parental Myopia</td>
<td>≥ one myopic parent</td>
<td>At least one myopic parent</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>East Asian</td>
<td>East Asian</td>
</tr>
<tr>
<td>Time Spent Outdoors</td>
<td>≤ 1.5 hours per day</td>
<td>NA</td>
</tr>
<tr>
<td>Time Spent on Near work</td>
<td>≥ 2.5 hours per day</td>
<td>NA</td>
</tr>
</tbody>
</table>

The Future of Classrooms?

Risk Assessment
The earlier the onset the higher chance for high myopia

Risk of Glaucoma 67%
Risk of PSC Cataract 74%
Risk of Retinal Detachment 98%
Risk of Myopic Maculopathy 99%

Emmetropia ~ 23-24mm

Axial Length and Visual Impairment

<table>
<thead>
<tr>
<th>Axial Length</th>
<th>Visual Impairment by age 60 (odds ratio)</th>
<th>Prevalence of Visual Impairment by age 75</th>
</tr>
</thead>
<tbody>
<tr>
<td>24-26mm</td>
<td>1 [reference]</td>
<td>4%</td>
</tr>
<tr>
<td>26-29mm</td>
<td>2x</td>
<td>23%</td>
</tr>
<tr>
<td>29-30mm</td>
<td>11x</td>
<td>27%</td>
</tr>
<tr>
<td>30+mm</td>
<td>25x</td>
<td>90%</td>
</tr>
</tbody>
</table>

†0.1mm = 0.25 diopters
††1.0mm = 2.75 diopters
What's Normal AL Growth?

- Up to age 12 ~ 0.1mm per year
- < 12 more than 0.1 is okay (grow faster)
- >12 a little less than 0.1 (grow slower)
- >0.2mm monitor closely, may modify tx

*Dioplers are easy to measure, but myopia control is about axial length control.

Goal

keep myopia below -3.00
and axial length below 26mm

The Myopic Exam

- History (Family history, near work, outdoor time)
- Age of onset, progression (if myopic)
- Visual acuity (uncorrected, best corrected)
- Corneal topography
- Binocular vision (lag, eso/exophoria)
- Axial Length (average of at least 5 readings)
- Objection/subjective cycloplegic refraction
  - 1% Tropicamide 2 drops 5 minutes apart
- Anterior/posterior examination
- IOP

Cycloplegic Refraction

<table>
<thead>
<tr>
<th>Age</th>
<th>Normal</th>
<th>Refractive Error @ Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 years old</td>
<td>+1.75 — +1.50</td>
<td>+0.75 or less</td>
</tr>
<tr>
<td>7 years old</td>
<td>+1.50 — +1.25</td>
<td>+0.50 or less</td>
</tr>
<tr>
<td>8 years old</td>
<td>+1.00</td>
<td>+0.50 or less</td>
</tr>
<tr>
<td>9 years old</td>
<td>+0.75</td>
<td>+0.25 or less</td>
</tr>
<tr>
<td>10 years old</td>
<td>+0.50</td>
<td>0.00 or less</td>
</tr>
<tr>
<td>11 years old</td>
<td>+0.50 — +0.25</td>
<td>0.00 or less</td>
</tr>
</tbody>
</table>

- Tropicamide 1%, 2 drops 5 mins apart
- Follow up every 6 months, sooner if risk factors are high

Pre-Myopes

⇒ +0.75 @ 6-7yo is high risk

- Independent of family history, ethnicity and other optical and environmental factors.
- Fastest change in refraction is year before onset.
- Watch for eso and lag of accommodation

Pre-Myopes

THE 20-20-20 RULE
Reducing eye strain during computer use.

- Every 20 minutes:
  - Take a break for 20 seconds.
  - Look at an object 20 feet away.

Every 24 minutes...
Single Vision Glasses & Contacts
- Single vision glasses & contacts have no effect on slowing progression

Under correction

Spectacles
- Executive Bifocal
  - +1.50 Add
  - +1.50 Add with 3BI
  - 51%
- Bifocals
  - 39%
- Progressives (shorter corridor)
  - 11-33%
  - Esophoria or accommodative lag
    - +2.00, 2BI prism
    - ~40%

Myopia Lens Options

Atropine
- Known to prevent myopia development/progression since 1874
- High doses cause:
  - Blurred near vision
  - Light sensitivity
  - Myopic rebound
- Highly used in Asia

Atropine Mechanism of Action Theories
- A non-specific muscarinic receptor antagonist
- Anticholinergic that binds to M1, M2, M4, and M5 receptors
- May act on one or more muscarinic acetylcholine receptors in the retina or directly on scleral fibroblasts to slow eye growth
- May prevent choroidal thinning due to hyperopic defocus
- Does not work by blocking accommodation
High Dose Atropine 1%-5% Side Effects

- Tachycardia
- Altered mental status
- Dry mouth
- Urinary retention
- Constipation
- Flushing skin

ATOM 1 Study

- Goal: To assess the efficacy of atropine treatment in controlling myopia in children.
- April 1999-2004 (Dir, Seri)
- 400 children
- 6-12 years
- -1 to -6D (Mean:-3.50)

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400 children

6-12 years

-1 to -6D (Mean:-3.50)

Treatment group: 1% atropine in 1 eye, other eye untreated

Control group: Placebo eyedrops in one eye, other eye untreated

All wore photochromatic glasses

3 year study: 2 years of treatment (4 month follow up), 1 wash-out year

Cycloplegic autorefraction, axial length, SLE, fundoscopy, IOP, mfERG in a subset

Over 2 year period: 77% reduction in mean progression of myopia

ATOM 1 Results

<table>
<thead>
<tr>
<th>Year</th>
<th>Control Refraction</th>
<th>Treatment Refraction</th>
<th>Control AL (mm)</th>
<th>Treatment AL (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>-0.76 ± 0.50D</td>
<td>+0.3 ± 0.50D</td>
<td>+0.20 ± 0.30</td>
<td>-0.14 ± 0.28</td>
</tr>
<tr>
<td>Year 2</td>
<td>-1.20 ± 0.69D</td>
<td>-0.25 ± 0.92D</td>
<td>+0.38 ± 0.38</td>
<td>No change</td>
</tr>
<tr>
<td>Year 3</td>
<td>-0.38 ± 0.39D</td>
<td>+0.38 ± 0.39D</td>
<td>+0.52 ± 0.45</td>
<td>+0.29 ± 0.37</td>
</tr>
<tr>
<td>Results</td>
<td>-5.28 ± 1.43D</td>
<td>-4.29 ± 1.67D</td>
<td>+0.52 ± 0.45</td>
<td>+0.29 ± 0.37</td>
</tr>
</tbody>
</table>

ATOM 2 Study

- Goal: To compare safety and efficacy of 3 lower doses of atropine
  - 0.5% (n=161)
  - 0.1% (n=155)
  - 0.01% (n=84) control
- 2006 - 2012
- 400 children
- 6-12 years (slightly older 9.7yo vs 9.2yo)
- ≥ -2D (mean -4.7D)?

Phase 1: 24 months of treatment
Phase 2: 12 month wash-out
Phase 3: Year 4.5: continuing progressors restarted on treatment with one dosage (≥ 0.50D in one → 0.01% one dose
Cycloplegic autorefraction, axial length (AL), mesopic and photopic pupil size, accommodation and distance
**ATOM 2 Results**
- Phase 1:
  - 0.5%: slowed by 75%
  - 0.1%: slowed by 70%
  - 0.01%: slowed by 60%
- Phase 2:
  - Less rebound in 0.01% group
- Phase 3: Treatment Restarted
  - 0.5% Atropine: 68%
  - 0.1% Atropine: 59%
  - 0.01% Atropine: 24%

**ATOM 2 Summary**

<table>
<thead>
<tr>
<th></th>
<th>Refraction</th>
<th>AL</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5%</td>
<td>-1.98 ± 1.10</td>
<td>0.87 ± 0.49mm</td>
</tr>
<tr>
<td>0.1%</td>
<td>-1.83 ± 1.16</td>
<td>0.85 ± 0.53mm</td>
</tr>
<tr>
<td>0.01%</td>
<td>-1.38D ± 0.98</td>
<td>0.75 ± 0.48mm</td>
</tr>
</tbody>
</table>

- 0.01%:
  - Minimal pupil dilation: 0.8mm
  - Minimal loss of accommodation: 2-3 D

**ATOM 3 Study**
- Goal: Study low dose atropine in preventing the onset and progression of myopia in high risk children with pre-myopia or low-myopia
- 570 participants enrolled
- April 2017 - May 2021
- Inclusion criteria:
  - One parent with myopia (<-3D in at least one eye)
  - SE +1.00D to -1.50D
  - Astigmatism ≤1.50D

**LAMP Study**
- Compared concentration of 0.05%, 0.025%, and 0.01% vs placebo over 1 year
- Enrolled 438 children
- 4 to 12 years
- -1.0 D and astigmatism of -2.5 D or less
- Monitored: Cycloplegic refraction, axial length (AL), accommodation amplitude, pupil diameter, BCVA
- 0.05% atropine was most effective in controlling SE progression and AL elongation over a 1 year period

**Atropine in US**
- Level 1 evidence supports use of atropine to prevent myopia progression
- Rebound is minimized by using low dose atropine, especially 0.01%
**Atropine Treatment Protocol**
- 1 drop 0.01% (QHS) daily
- Start in kids 4 to 12 years of age who are at least -0.50 D myopic with:
  - History of at least 0.5 D progression over last 6 months
  - Family history
  - Near work/outdoor time
- Treat for at least 2 years or to 15 years of age

**Atropine Follow up**
- 6 week follow up (make sure they got their drops and are using them)
- 3 month after starting to ensure no side effects/compliance
- Start assessing treatment efficacy at 6 months
- Assess for progression every 6 months
  - VA
  - Binocular vision
  - A-scan
  - Refraction/Topography
  - If >0.50 D of change at 1 year consider changing dosage

**Controlling Peripheral Focus**

**Soft Multifocal Contacts**
- Biofinity D Lens, Proclear D Lens

**Naturalvue MF**
- +4.00 to -12.25 (-0.25)
- One add up to +3.00
MiSight-Coopervision

Soft Multifocal Contacts
- 7 years or older
- Progression >0.50 diopters per year
- Family history
- Near work vs outdoor time

Follow up
- Assess treatment every 3-6 months
  - VA’s
  - Ret (cyclo once yearly)
  - A-scan
- Re-educate on hygiene/care

Soft OK

Astigmatism >1.00
- Extended depth of focus
- Center distance

Ortho-K
- Creates crisp, clear vision all day.
Ortho-k and the Cornea

- NaFL not visible if tear lens is <20 microns

Ortho-K

Ortho-K Candidates
- ~7 or older
- -1.00 to -4.00 (FDA Approved up to -6.00)
- Myopia > Astigmatism
- Cyl < -0.75 WTR central
- K’s between 41-45

Ortho-K Fit
- Central bearing
- Tear Reservoir
- Mid Peripheral bearing
- Edge lift
- Good centration

Fitting Empirically
- Refraction
- HVID
- K’s
- Topography
Multi-site study across USA 267 patients followed for 3 years
Children aged 7-14
Emerald lens design vs PureVision
Empirical fitting of Emerald successful in 80% improving to 95% with one lens change
32% drop out of OK = discomfort
34% drop out of soft lens control = loss of interest
OK group progressed by -0.13D over 3 years, and soft lens wearers by -1.03D

Risk of MK
- Daily disposable:
  > 2 per 10,000 wearers per year
- Silicon hydrogel:
  > 12 per 10,000 wearers per year
- Ortho-k (pediatrics):
  > 13 per 10,000 wearers per year
- Extended wear:
  > 52 per 10,000 wearers per year
- Risk for all contact lens modalities:
  > 1 per 10,000 wearers per year

Case 1
- 9 yo Asian Male
- -2.50 OU
- > 3 hours @ near
- <1 hour outdoors
- Mom: -2.00
- Dad: -4.00
- 1st Rx: 7 Yo
- Patient in Ortho-k ~6 months
Case 2- Pre Myope

- 6 yo Asian Male
- Current Rx: pl OU
- Cyclo Rx: +0.75 OU
- Ortho @ D, 3 Exo @ N
- MEM: +1.25 (Lag)
- > 2 hours @ near
- < 1 hour outdoors
- Mom: -2.00
- Dad: -4.00
- Brother: -2.50

Pre-Myopia

- Plan: Myopia Evaluation 6 months

Public Service Announcements

Screen time Recommendations

Myopia Awareness Coalition

1. Myopia rates, especially childhood myopia, will become a mainstream health care issue and get attention from those outside our industry.
2. FDA will approve devices and/or treatments to stop or slow progression.
3. Asian countries will lead in raising awareness and treatments.
4. Myopia will be recognized and classified as a disease vs. refractive error.
5. The study of genetic markers will help us understand myopia.
6. A “crisis moment” will happen where the legal risk of not treating will force us to be more proactive in treating myopic children.
7. Companies outside eyecare will recognize the opportunity and bring disruption to the product and/or service side of treatment.
8. Screen time for children will become even more controversial.
9. More advanced products will be available for treatment.
10. Childhood eye exams and screening guidelines will be revised and lead to better and earlier vision testing for children to identify myopia.

Online Tools

- Mykidsvision.org
Set realistic expectations for treatment
Atropine, MF contacts, Ortho-k all have around 50%-70% efficacy depending on studies
Children will still likely progress depending on age of onset
Which ever method you choose you are providing evidence based myopia treatment

Do something!
Assess risk factors
Discuss options
- No cookbook approach (yet)
- Decide treatment on patients wants and needs
- Actively manage progression
Enjoy what you do
Don’t dabble in Myopia Management!


18. https://www.opt.uh.edu/onlinecoursematerials/PHOP6241/Berntsen/Fall%202016/Flitcroft%202012%20Review%20Reading%20Assignment.pdf


Thank you
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