Refractive Errors in Children

Marilyn T. Miller, MD
Professor of Ophthalmology
Department of Ophthalmology and Visual Sciences
University of Illinois at Chicago

(I have no financial interest or other relationship with any manufacturer/s of any commercial product/s which may be discussed at the symposium)
**Refractive Error**

**Definition:** Distant objects do not focus on the retina.

\[
\therefore \text{ one’s refraction is the lens (glasses) necessary to make the object fall on the retina }
\]
Emmetropia – No refractive error

- Parallel rays focus on retina when lens in non-accommodative state (must use cycloplegic in children).

- With accommodation (for distance and near) image moves on retina
Myopia

Symptom: distant objects blurred (nearsightedness)

- Image focused in vitreous
e.g., -3 D child

- With Concave lens in glasses
Hyperopia

- Parallel rays focus behind retina $\rightarrow$ blurred image

- With accommodation (for distance and near) image moves on retina
Astigmatism

- Two major meridians with different focal points
Refractive Error

Measurement of refractive state in “diopters” (D)

- +1 D (convex lens) bends light to focus at 1 meter; +2 D bends to ½ meter

e.g., 1 D hyperopic child

\[ \bar{c} +1.0 \text{ lens} \]
Refractive Error

Accommodation

- Accommodation measured in diopters
  \[ \therefore \text{ at } \frac{1}{3} \text{ m, need 3 D accommodation} \]

- Presbyopia: A reduced ability to focus on near objects caused by loss of elasticity of the crystalline lens. It is a normal aging process and usually symptoms start in early to mid 40’s.
Amplitude of Accommodation with Age
(Duane 1923)
Myopia

\[ \therefore \text{ near images often in focus at some distant so can read with glasses if not high myopia.} \]

e.g., -3 D child focus in at 1/3 meter with no accommodation
## Examples of Eye Glass Prescription

<table>
<thead>
<tr>
<th>Rx</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. OD: -3.00</strong>&lt;br&gt;<strong>OS: -2.75</strong></td>
<td>Myopia corrected by -3 D concave lens in right eye (OD) and -2.75D lens in left eye (OS)</td>
</tr>
<tr>
<td><strong>2. OD: +2.00</strong>&lt;br&gt;<strong>OS: +2.00</strong></td>
<td>Hyperopia corrected fully (or partially) +2D convex lens in both eyes (OU) or reading correction emmetropia (50s)</td>
</tr>
<tr>
<td><strong>3. OD: -3.00±2.00×90°</strong>&lt;br&gt;<strong>OS: -2.75±2.00×90°</strong></td>
<td>Astigmatism with designation of strength and axis of astigmatism</td>
</tr>
</tbody>
</table>
Refraction Issues in Children

Natural History

• Mean refraction in infants about +2.00 (Banks 1980)

• Hyperopia increases for 5-7 years (Banks 1938)

• Myopia increases 8-13 years

• Myopia/astigmatism and anisometropia more frequent in premature infants
Cycloplegic Refraction

- Always some systemic absorption and possible systemic reaction
- Premature babies need careful monitoring and weaker drops (cyclomydril)
- Cycloplegic has 2 effects:
  1) prevent accommodation
  2) dilate
- Mydriacyl (tropicamide) fast, short acting; good for primary care physicians
Refraction Issues in Children

Accommodation

• Infants near 16 D
• 8-year-old about 14 D (Duane 1922)
• Therefore, small to moderate degrees of isolated hyperopia may not require glasses
Refraction in Children

Symptoms

1. Hyperopia – often have none unless high amount then reading problems primarily

2. Myopia – difficulty with distant objects; holds things close, “squints”

3. Astigmatism – “squints” eyes when looking at things, fatigue problems
Goals of Therapy in Prescribing

- Improved visual acuity and function
- Treatment of strabismus
- Treatment of amblyopia
- Relief of visual symptoms (rare in children)
Visual Acuity Screening by Pediatricians?

Initially (early infancy)

• Good, symmetric red reflex
  → may require 1 drop tropicamide (mydryacil)

• Looking for cataracts, retinoblastoma, asymmetry
  (may be due to anisometropia: difference in refraction between two eyes)
Visual Acuity Screening by Pediatricians

Pre-school

• To identify amblyopia or significant refractive error
Visual Acuity Screening by Pediatricians:

Grade School

• Identify child who has become myopic for referral and glasses
Thank you for your attention!