

The Visual Experience of the Young Hyperope: Emmetropization and Accommodation
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Course description

Young hyperopes are at risk for strabismus and amblyopia. Their retinal image quality and visual experience are dependent on their accommodative performance. This course reviews the evidence regarding normal and abnormal emmetropization and accommodative performance in infants and young children in the context of clinical assessment and care.

Course objectives

- I. To provide an understanding of normal and abnormal emmetropization during infancy and early childhood.
- II. To provide an understanding of normal and abnormal accommodative performance during infancy and early childhood.
- III. To provide expectations for clinical assessment of young hyperopic patients who might be at risk for amblyopia and strabismus.

I. Emmetropization during infancy and early childhood

- A. The optics of the eye at birth & postnatal optical development
 1. The axial length of the eye increases from approximately 17mm at birth to approximately 24mm in adulthood.
 2. The overall power of the optical components reduces as the eye grows.
 3. Typically, the optical power is too weak at birth resulting in hyperopia, with a mean value of approximately 2D and a standard deviation of approximately 2D. Therefore 70% of the typical newborn population should have spherical Rx's between plano and +4D of hyperopia.
 4. Anisometropia and astigmatism are also common in infancy. Astigmatism is typically corneal.
 5. Most of the growth of the eye occurs during the first two to three postnatal years. Refractive error also tends to emmetropize during this time, in terms of the spherical component, astigmatism and anisometropia. It is not common for patients to undergo dramatic emmetropization after this time.
- B. The role of visual experience in emmetropization
 1. Vision-dependent control of ocular growth.
 - Animal models
 - Manipulations of visual experience including development of myopia after form deprivation, and emmetropization to imposed defocus.
 - Current interest in peripheral refraction.
 - Human parallels
 - Form deprivation and anisometropia
 - Currently no model of bilateral emmetropization
 2. Retinal image quality dependent on accommodative performance in isoametropia.

II. Accommodative performance during during infancy and early childhood

- A. Accommodative performance of typically-developing infants and young children.
 - 1. Accuracy. Lags are measured to be less than a diopter at typical near viewing distances by approximately three months of age.
 - 2. Dynamics. By this age many infants have accommodative latencies of less than half a second and are able to track targets moving at different velocities.
 - 3. Sensory vs Motor immaturities. Immaturities prior to three months of age are chiefly thought to result from sensory immaturities in blur sensitivity.
- B. Clinical assessment
 - 1. Target selection. Decision to measure maximum performance (small target) or habitual performance (more typical object found in the environment)
 - 2. Techniques: Retinoscopy (Nott vs MEM), Autorefractor/Photorefractor
 - 3. Patients with low levels of refractive error, at any age beyond 3 months, should be accommodating to within a diopter of a target at a typical near viewing distance.

III. The accommodative performance of young hyperopic patients.

- A. A series of studies over the last 20 years have suggested that:
 - 1. Infants and young children with refractive errors greater than approximately 4D of hyperopia can have significantly larger accommodative lags.
 - 2. The individuals who do not accommodate well are the individuals who do not emmetropize and who are more likely to go on to develop strabismus and/or amblyopia.
 - 3. This is inconsistent with the animal models, which suggest that an eye should grow to compensate for the blur that it is experiencing.
- B. Clinical implications:
 - 1. A patient over three years of age with a significant amount of hyperopia is unlikely to undergo dramatic emmetropization at that point.
 - 2. Performing near retinoscopy, or another technique to assess accommodative accuracy, may help identify individuals at the most risk for further abnormality.
 - 3. Current data from trials of preventative spectacle correction suggest that the prevalence of severe amblyopia may be reduced, but the data regarding prevention of strabismus are ambiguous.