Strabismus and Sensory Adaptations

Timothy Hug, OD, FAAO
Assistant Professor – Ophthalmology
University of Missouri-Kansas City School of Medicine
Children’s Mercy Hospital
Kansas City, MO
thug@cmh.edu

Strabismus

- Esotropia
- Congenital / Infantile
- Accommodative
Esotropia – Congenital (Infantile)

- Onset: age 6 – 18 months of age
- Angle of Deviation 30° - 40° or greater
  - Helveston (1983) - found mean average of 40°
  - Von Noorden (1985) - found mean of 50° - 60°
- Refractive errors tend to be same as age matched non strabismic (+1.00 - +2.00)

Esotropia – Infantile

- Monitor
  - Spontaneous resolution in 27 % for patients with onset less than 20 weeks (Congenital Esotropia Observational Study – AJO, 2002 Jan 109-118)

Esotropia – Infantile

- Binocularity “turns on”...suddenly...between 3 - 5 months of life - Reflex
  - So what happens in presence of an anti binoculogenic factor
    - Think similar to amblyogenic factor during the amblyogenic time period
    - Hubel and Wessel...strabismic cat during first 12 weeks of life (cat’s binoculogenic time period)
      - more cells develop that are not binocularly driven

Esotropia Infantile Management

- Surgery
  - Timing of Intervention
    - Surgery by 6 – 24 months of age (CEOS)
    - Surgery within 2 – 4 months of misalignment
  - What is sensory adaptation to the misalignment?
Marshall Parks – facultative suppression (foveal vs extrafoveal)

ARC – as described by Marshall Parks

After surgery for the misalignment...the peripheral binocular system takes over and allows development of peripheral fusion with a microtropic alignment status.

Animal models suggest the length of the horizontal axon connections corresponds to the misalignment of 4 – 8 prism diopters

Parks M A, Sensory Adaptations in Strabismus; Harley’s Pediatric Ophthalmology, 5th Edition; Nelson, Olistsky; Lippincott Williams & Wilkins, Philadelphia: 137 – 142


Or not!

No surgery/ delayed surgery

Animal models suggest decay of the interocular cortical connections

Lack of proper binocular cortical development prevents future binocularity improvement...

If not microtrope ...no fusion...no fusion potential

No chance of “restoring” something that is not there

Why?

Infantile Esotropia Summary

Age of Onset – 4 -12 months

Angle of Deviation – Greater than 30 prism diopters

Surgical re-alignment goal: within 2 months of onset

Refractive Evaluation – normal for age

Amblyopia treatment

Best stereo outcome requires intervention 2 – 6 months after onset of deviation


Esotropia – Accommodative

Refractive

Onset 18 – 36 months

Associated uncorrected hyperopic refractive error :

+4.00 average

Angle of Deviation : 20 - 30 prism diopters at distance

Amblyopia possible – depending on time of decompensation and treatment

50% of accommodative ET with High AC/A ratio decompensate into non accommodative

Esotropia – Accommodative

Refractive - management

Cycloplegic refraction

Prescribe full cycloplegic both eyes

Prescribe less than full plus

1 Basic and Clinical Science – Pediatric Ophthalmology and Strabismus 2008-2009
2 Eye Care for Infants and Children – Bruce Moore, OD
3 AOA – Optometric Clinical Practice Guidelines
Esotropia – Accommodative

- Parent Preparation
  - Full time wear of spectacles
  - Angle may appear worse with out glasses, after adaptation
  - Follow up refraction every 4-6 months for 1 – 2 years (depending on age)
  - If controlled with spectacles – surgery not an option

  - 79% of patients reviewed had orthophoria or esotropia of 10 prism diopters or less
  - 1% had decompensation

  - Fair and poor compliance with spectacle use greatly increases risk of poor sensory and motor outcomes in children with pure refractive accommodative esotropia

- Fair and poor compliance with spectacle use greatly increases risk of poor sensory and motor outcomes in children with pure refractive accommodative esotropia

  - 79% had orthophoria or microtropia

So imagine the 30 ET, who is 5 year old with refraction of +5.50 OU

- Will they be aligned in glasses?
- Is it too late for stereopsis?
Exotropia
- Exotropia
  - Congenital
  - Intermittent
  - Convergence Insufficiency
  - Divergence Excess

Exotropia - Congenital
- Onset 6 – 12 months of age (Harley’s Pediatric Ophthalmology and Strabismus)
- Rare – 1.0% occurrence (Cohen 1985)
- Angle of 35 prism diopters (average)
- Treatment:
  - Manage amblyopia if exists
  - Manage refractive conditions if outside age matched normative
  - Surgery within 2-6 months of onset
    - Similar to congenital esotropia – allows potential for restoration of binocularity

Exotropia - Intermittent
- Onset – between 6 months and 4 years of age
- Most common form of exotropia
- May break down to constant deviation (unknown percentage – Nelson; Harley’s Pediatric Ophthalmology and Strabismus, 2005,158-162)
- If late enough onset from intermittent to constant, then binocular development can/will be normal...
- Sensory adaptation is suppression (for intermittent)
  - Facultative (Parks) vs Absolute
  - Suppression for constant

Imagine though the binocular cortical cells are developed...intact and mature...now just “dormant”
- Awaiting binocular stimulation via orthoptics or surgery,
  - Poof! stereopsis

Strabismus Surgery
- Form vs Function
- Pediatric vs Adult
Strabismus Surgery

- Form vs Function

  - Pediatric
    - Misalignment of eyes results in compromise of binocular cortical regions (Hubel and Weisel)
  
  - Realignment of eyes may result in recovery of some binocular cortical function

  - Studies indicate best chance within 2 – 4 months of misalignment for congenital esotropia

  - Does critical window exist for this benefit?

  - Adult
    - Can adult strabismics ever recover some binocular cortical function?

  - May depend on status of binocularity at age of "binocular maturation"

  - Kushner B, The Benefits, Risks and Efficacy of Strabismus Surgery in Adults; OVS, vol91 (5), May 2014

- Traits evaluated

  - Honesty
  - Humor
  - Intelligence
  - Leadership Ability
  - Organizational Skills
  - Sincerity
Overall, the strabismic faces were judged significantly more negatively, across 11 descriptive characteristics, than the non-strabismic face.

CONCLUSIONS: Psychosocial difficulties are a problem for teenagers and adults. Correction of strabismus in the older teenager or adult may offer them improvement in psychosocial functioning.