IS THERE A PLACE FOR OCT IN AMBLYOPIA?

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WHAT WE KNOW

► DEVELOPMENT OF THE EYE:

► AT 16-17 WEEKS OPTIC NERVE HAS APPROX 3.7 MILLION AXONS
  ► DEGENERATE TO APPROX 1.1 MILLION IN ADULTHOOD

► AT 18-30 WEEKS RETINA HAS 2-2.5 MILLION GANGLION CELLS
  ► DEGENERATE TO APPROX 1.5-1.7 AT 40 WEEKS

WHAT WE KNOW

- Amblyopia effects various areas of visual system

- 1950–1960’s: Rausch and Chow:
  - Animal models demonstrated
    - Interplexiform layer thinning
    - Nucleolar volume diminution in ganglion cells
  - Mammals reared in darkness vs light

WHAT WE KNOW

- 1970’s - Von Noorden and others showed histopathologic changes in lateral geniculate nucleus (LGN) in *Macaca mulatta* with unilateral lid sutured closed
  - Arrest in the LGN development (worse in the LGN that received crossed fibers)
  - Decrease in size/density of parafoveal retinal ganglion cells

Remember:
- Ipsilateral eye sends information to 2, 3, and 5
- Contralateral eye sends information to 1, 4, and 6

WHAT WE KNOW

- Wiesel and Hubel: micro-electrode recordings of single neurons in visual system (specifically striate cortex)
  - Extracellular recordings from striate neurons
    - Kittens with unilateral lid closure – decimation of cells receiving input from amblyopic eye

- Human PET scans (Deemer, 1998)
  - Reduction in cortical blood flow and glucose metabolism during visual stimulation of amblyopic eye vs. normal eye

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FINDINGS IN THE EYE?

- ERG with patterned stimuli in humans
  - Various types of amblyopic patients tested
  - All had significant reduction

- Visual appearance is unaltered in the amblyopic eye


OCT

Interferometry using near-infrared light. Long wavelength can obtain deeper tissue images.

Current uses of OCT:

- **Anterior segment:**
  - Cornea
  - Angle structure
  - Iris abnormalities

- **Posterior segment:**
  - Macular edema
  - Drusen
  - ERM/VMT
  - Optic nerve elevation
  - RNFL dropout
  - Specific retinal layer findings in macular area.
## REVIEW OF CURRENT LITERATURE

<table>
<thead>
<tr>
<th>Change in Thickness</th>
<th>No Change in Thickness</th>
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<tbody>
<tr>
<td>May-Yung (2004)*</td>
<td>Colen et al. (2000)*</td>
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<td>Dickmann (2009)Å♦</td>
<td>Kee et al. (2006)*</td>
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<td>Repka (2009)Å</td>
<td>Miki (2010)*</td>
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<td>Alotaibi (2011)*</td>
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<td>Wang (2012)*</td>
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<td>Landa (2012)Å</td>
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<td>Wu (2012) *Å</td>
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- Repka et al (2006) found better seeing eye had an increase in RNFL thickness

Δ Looking at macular thickness,
* Looking at RNFL
♦ Statistically significant for strabismic amblyopia
▪ Statistically significant for anisometropic amblyopia
✖ Looking at Ganglion Cell Count
HYPOTHESIS

- By taking an in depth look at ganglion cell count via OCT, we may be able to detect changes between the amblyopic eye and the normal eye.
METHODS

- **Inclusion Criteria**
  - >4 y.o.
  - Able to read the Snellen Linear Acuity Chart
  - Greater than 2 lines different between eyes either on current visit or documented in chart

- **Exclusion Criteria**
  - Any retinal problem
  - Any brain/orbital tumor/mass
  - Unable to cooperate perform test
METHODS

- Two OCT scans per child on the day of the visit
  - Amblyopic eye
  - Control eye

- No repeat OCTs at future visits regardless of treatment

- Ganglion cell analysis calculated by Cirrus OCT Software
  - Average GCL + IPL thickness was recorded on Microsoft Excel for both the amblyopic and control eye
DATA

- Total Patients: 15
  - Strabismic eyes: 10
  - Anisometropic eyes: 5

- Average GCL + IPL Normal eye: 79.67μm
- Average GCL + IPL Amblyopic eye: 81.33μm

- This was not statistically significant.
DATA

- What about different types of amblyopia?
- Strabismic Eyes: 10

- Average GCL + IPL Normal Strabismic eyes: 79.9μm
- Average GCL + IPL Amblyopic Strabismic eyes: 82.8μm

- Not statistically significant
What about different types of amblyopia?

- Anisometropic eyes: 5

- Average GCL + IPL Normal Anisometropic eyes: 79.2μm
- Average GCL + IPL Amblyopic Anisometropic eyes: 78.4μm

- Not statistically significant
PITFALLS

- OCT in children is a challenge in itself
- OCT was conducted by various individuals
- No minimum signal strength was required
- Small sample size
DIRECTIONS FOR THE FUTURE

- Larger sample size
- Strict OCT guidelines
- Examine various layers of the retina