Vision Problems After Brain Injury

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Disclosures

Dr. Houston: None

Dr. Eli Peli and Schepens/Mass Eye and Ear holds the patent for the Peripheral Prism Glasses (P-prisms)
Objectives

1. Recognize Symptoms of Vision Disturbance
2. Recognize the Most Common Vision Problems
3. Recognize Available Treatments for Vision Problems
Outline

• Double Vision (Strabismus)
  – Patching

• Homonymous hemianopia ("Field Cuts")

• Hemispatial neglect

• Basic optics and types of prisms
Prevalence of Visual Disturbance

- Brahm and Goodrich 2009
- Service members with TBI
- Polytrauma Rehabilitation Center (PRC), n=68
- Polytrauma Network Site (PNS), n=124
- Received comprehensive visual examination
- 75% had visual complaints
- 25% had strabismus
- 26% had homonymous visual field loss
Prevalence of Visual Disturbances in ABI

• Hines VA Study, 2009
• n=103
• TBI
• 76% reported visual symptoms
• Reading problem 50%
Prevalence of oculomotor palsies in civilian stroke population

• Rowe et al 2011
• 20 Hospital sites in UK
• 54% with oculomotility disorders
  – Nystagmus
  – Oculomotor palsy
Homonymous Field Defects in the Civilian Stroke Population

• Townend 2007, Rowe 2009, Gilhotra 2002
• 29-50% of strokes
• Based on this data estimate 1 million living with HFD (over 50 years old)
What can you observe?
CN III (Oculomotor Nerve)

From Volpe and Prasad
CN VI
CN IV (Trochlear Nerve)

From Volpe and Prassad
Nerve Palsies: Basics

• CN III
  – Lid down, pupil affected, eye down and out

• CN IV
  – Head tilt, blurred vision, worse on down-gaze, balance

• CN VI
  – Worse at distance, cross eyed, head turn

• INO
  – Eye cannot ADduct
Strabismus Assessment Pearls

• The amount of strabismus can be very small
• It may not be noticeable
• Patient may not report double vision
What is it like to have strabismus?

Normal View
Exotropia = double vision & visual confusion
Illustration of Vertical Strabismus
Two sets of feet and stairs
Strabismus Associated with Increased Falls

- JAMA Ophthal, August 2014
- 10 year retrospective Medicare Beneficiaries
- n~2 million
- 4.5% had strabismus*
- 27% higher risk of falls/injury in elderly patients with strabismus*
  - Controlled for confounders

*includes other binocular vision disorders as well as strabismus
What are tell-tale symptoms of Strabismus?
• Clues that your patient has strab
  – Reports Blurry Vision
  – Closes one eye
  – Dizziness and Imbalance
  – Avoids Participating
  – Tilting/turning head
So what can we do?
White Patch or Tape on Glasses
Black Tape or Patch on Glasses
Complete Occlusion (aka pirate patch)
Disadvantages of Patching

- Appearance
- ~20 degrees of peripheral vision loss
- May discourage recovery
- Patients are often not satisfied with this approach
- Anonymous Patient Quotes:
  - “it’s better than squinting an eye closed, but no I don’t like it”
  - “If there is something you can do with my lenses, then do it!”
What about head posturing?
Left CN VI palsy

• Which way should cue patient to turn head?
Other Treatments

• Vision Therapy
• Prisms
• Therapy + Prisms
• Surgery
If you are like me this is what you think of:

A mystical optical element splits light into component colors?
Ophthalmic Prisms Shift light instead of focusing, color dispersion is minimal

Light  Image  Apex  Base  Direction of image shift
If you look through a prism
Image shifted towards apex (thin side)

3.5 deg
base down
Designs of Prisms: Standard Prism vs. Fresnel

- **Standard Prism**
- **Fresnel Prism**

**Direction of shift**

Photo illustration next slide
20 diopter standard vs. 40 diopter Fresnel

The Fresnel = an important advance for clinical application of prisms
Up to 30 degrees (57 prism diopters)
Press-on Fresnel Fit for Strabismus
Application for Strabismus

• Fit over entire lens of one eye to optically align the images seen by the two misaligned eyes.

Base Out

Base In

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Prisms Facilitate Fusional Convergence
Prisms for Strabismus

- Reduce the amount of fusional vergence needed
- Fit over entire lens of one eye to optically align the images seen by the two misaligned eyes.

*Prisms for strabismus well accepted in mainstream Ophthalmology/Optometry*
Important to be aware of side effects

• All prisms cause chromatic aberration and distortion
• Press-on prisms cause additional blur (filmy vision)
• Lessened angle of strabismus is sometimes more bothersome
  – harder to ignore double image
  – This is monitored closely
Disadvantages of Fresnel

• Reduced contrast

• Light scatter at prism edges
Actual Photo Through a 10 degree Press-on Fresnel

Prism View

Actual View

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What about vision therapy?

• Binoc vision therapy
  – Activities to improve vergence ranges

• Training fusion ranges supported by multicenter placebo-controlled RCT
  – showing significant effects in non-brain injured patients. (Schiemann et al, 2008)

• Convergence Insufficiency Treatment Trial
Vergence training in the brain-injured

• Evidence for vergence training in brain-injured limited to case series/reports
  – Vision rehab service does minimal vision therapy:
    1) educate patient on fusional vergence using alternate cover
    2) compensatory head posturing
  • Patient is advised to practice daily for 2 weeks
  • OT monitors and reinforces instructions. Attempts to help patient transfer any useful strategies for ADLs
Head Rotations

• Fixation target ~5 feet away
• Find head posture where double images closest together
• Without closing an eye, try to focus and fuse images
• Rotate/tilt slowly until double
• Turn/tilt back until single
• Repeat 30-50 times 1-2x per day, 3 weeks
• Avoid if history of neck or vertebral artery problems
Alternate Cover

- Head in neutral position
- Fixation target ~5 feet away
- Cover right eye
- Cue patient to look at target
- Switch cover to left eye
- Repeat 30-50 times 1-2x per day, 3 weeks
I don’t get it.....
Hemianopia
Primary Visual Pathway
Homonymous Field Defects

Loss of part or all of the visual field on the same side in both eyes resulting from damage to the post-chiasmal visual pathway

- 29-50% of strokes
- Prevalence of 1 million in individuals over 50

Negatively impacts mobility

• compromise safe walking (Yates 2002; Bowers 2008; Chen 2009)
• compromise safe driving (Bowers 2009; Bowers 2012)
• reduce quality of life (Chen 2009; Papageorgiou 2007)
Visual Field Testing

• Confrontation

• Finger counting

*Pearl: *Test one eye at a time and Move target from behind patient*
Humphrey Computerized Visual Field
(Central 30 degrees)
Is this what people with HH see?
What is it like to have HH? (Right)

Motion sensors

Mobile eye tracker
Will My Vision **Improve**?


  *Natural history of homonymous hemianopia.*

Probability of Improvement

Zhang X et al. Neurology 2006;66:901-905
Will I Be Able to Drive?
Are there some exercises I can do to help my vision recover?

- Vision Restoration Training
- Detecting Lights at Border of Field loss
- May restore up to 5 degrees of vision
- Difficult to prove recovery vs. noise
Visual Restoration Therapy (VRT)

36 year old, right PCA stroke 2 years prior
Data: N. Mehta • NovaVision

Novavision Inc
www.novavision.com
Compensatory Treatments

- Visual Scanning Therapy (VST)
  - Cueing during ADL’s (very practical, inexpensive)
  - Light Boards (no evidence)
    - Dynavision
    - Wayne Saccadic Fixator
  - Neuro-vision trainer (some evidence)

Are there some glasses to correct my vision?
Other older hemianopic prism designs
Peripheral Prisms (p-prisms)
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Vision Problems After Brain Injury

Binocular Goldmann Bowl Visual Field

Left Hemianopia
Same Patient with 57 oblique p-prisms
Evidence Base

• Multicenter randomized controlled trial
  – Real preferred over sham ($p = 0.001$)
  – Helpful when walking (questionnaire)

• On-road driving study
  – Reactions to blind side hazards better with real prisms
  – Masked rater in back seat

Bowers, Tant and Peli (2012) Stroke Research and Treatment
Limits to Field Expansion

Clinician

1m

Patient
My Hemianopia Rehab Protocol

See: Houston, KE. Vision Care for the Brain-Injured Patient. Review of Optometry, 2013. 150(3): p73-83

• **Awareness Training**

• **Eccentric Viewing Training**

• **Visual Scanning Training Using Cueing during ADLs**

• **Mobility training: Anchoring, sighted guide**

• **Fitting and training with peripheral prisms**

• **Reading Rehab: Adaptive tech, line guides, tilt/turn page**
Hemispatial Neglect
The condition where the left side of the world doesn’t exist

Spontaneous drawing:
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http://statisticallysignificantscience.wordpress.com/2010/09/03/barley-mow/

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Important not to Neglect

- **LHSN is common!** ~50% of right brain strokes (Buxbaum, 2004)

- Longer hospital stays, more falls, independent predictor of poor outcomes (Feigenson, 1977; Wade, 1983; Katz, 1999)

- R neglect possible, but L neglect 4x’s more common, more severe, more chronic (Beis, 2004)
  
  - Thought due to right hemisphere specialization for spatial functions
Infarct takes out optic radiations and overlying cortex. Attentional, sensory, and motor corticies affected.
Diagnosed with Paper and Pencil Tests
Stickman: Notice Face Drawn on Table (Neglect is not just a vision loss)
Prisms for Left Hemispatial Neglect
Yoked Prisms

- Prism over entire lens
- Shift entire field 10 degrees to right
- Causes misreaching to the right
Left Hemispatial Neglect

- Based on egocentric shift hypothesis of neglect, Chokron 2003

- Based on Yoked prism adaptation studies
  - Judgments shifted leftward (aftereffects) (Kornheiser, 1976)
Rossetti et al 1998 attempted to apply this to hemispatial neglect

Scene the patients were instructed to draw
Baseline drawings with severe left neglect

Patient 1

Patient’s Baseline Drawing

Patient 2


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5 minutes of yoked prism adaptation


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Drawings immediately improved

Immediately after removal of prisms

Unexpectedly, drawings were even better 2 hours later.

Evidence for Prism Adaptation Therapy

• >500 articles since 1998

• improvements in all types of neglect

• transfer to ADL’s such as wheel chair driving, standing balance (Newport 2012, review)
Evidence as a Treatment

• A multicenter, double-masked, RCT (Mizuno et al., 2011)
• Significant improvement in FIM
• Significant improvement on Behavioral Inattention Test
Summary Hemineglect

- Yoked Prisms improve hemispatial neglect
- They do not cure neglect
- Effects generalize to ADLs
- Effect occurs after the prism training session, not when the prisms are on
- Simple, inexpensive, low risk
Conclusions, Vision Problems after ABI

• High prevalence
• Strabismus, Homonymous Field Defects, Hemineglect
• Negatively affect function long term
• Treatable/manageable in early post acute phase
• Evidence building for use of Prisms, therapy
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