Case Example

51 year old, caucasian female presented to our office. CC: Severe headaches and discomfort at near when reading, working, sewing. Additional symptoms include:
- Balance issues - dizzy, runs into things
- Can't walk into grocery stores
- Light sensitivity

Goal: Was able to read 500 page books in 1-2 days before, now it takes her 3-4 weeks to finish one book, be able to get back to work, walk into the grocery store, jump between computer screens (sideways) without blur
Case History

- Ocular Health - hyperopic, astigmatism and presbyopia
- Medical History - Anxiety, bronchitis
- Medications: Singular, Lyrica
- Family Ocular and Medical History - unremarkable
- Allergies: NKDA
- Other Rehabilitation - was in occupational therapy and physical therapy due to accident
  - Did some saccadic and vestibular work at OT

Exam Findings

- Visual Acuities with habitual Pair
  - Distance: OD: 20/25, OS: 20/20-2, OU: 20/20
  - Near: OD: 20/25, OS: 20/20, OU: 20/20
- Pupils: PERRLA (-) APD
- EOMS: Full/ no restrictions OD, OS
- CVF: Full to finger counting OD, OS
- IOP: OD: 13 OS: 12 @ 11:01 AM
- Cover Test:
  - Distance: Ortho
  - Near: 3 xp

- Pursuits: Full and smooth
- Saccades: Full and smooth, no undershoots, no head movements
- VMH: + aversion to OKN
- Near Point Convergence:
  - Breaking: 11 cm
  - Recovery: 17 cm
- Subjective Finding:
  - OD: +1.75-2.75x180 20/20
  - OS: +1.75-3.00x180 20/20
  - Add: +1.75
- Stereo: 40"

In phoropter

- Von Grafe:
  - Distance: 1 xp
  - Near: 9 xp 0.5 L hyper
- Distance Ranges:
  - Bl: X/6/4
  - BD: X/4/2
- Near Ranges:
  - Bl: 16/18/14
  - BD: 6/16/4
  - Supra: 3/1.5
  - Infra: 3/1.5
- FCC: +3.75
Diagnosis

- Post-concussional syndrome
- Convergence Insufficiency
- Vertical Heterophoria
- Dizziness and giddiness
- Unspecified subjective visual disturbances

Definition

- It is an injury to the brain that is not including conditions present at birth or a degenerative diseases
- A specific type of damage to the brain that results when the head:
  - Hits a stationary object
  - Is hit
  - Is penetrated (gunshot wound)
  - Is violently shaken by external force (severe whiplash)
  - Concussion blast injury
- This results in temporary or permanent impairment of cognitive, physical, and psychosocial functions, with an associated diminished or altered state of consciousness

Prevalence

- There are 1.7 million TBI cases diagnosed annually
- 2:1 ratio between men and women
- The leading cause is falls
  - Age 0-17: 50% of TBI related ED visits
  - Age 65+: 81% of TBI related ED visits
TBI: Visual Symptoms

- Binocular vision defects* Most common
  - Convergence insufficiency being the most common
  - Intermittent/ Constant exotropia
  - Vertical deviations
- Accommodative disorders
  - Accommodative insufficiency- more common
- Oculomotor disorders
- Abnormal spatial sense
  - Poor balance, posture, spatial disorientation
- Visual field disorders
- Disease related
  - Corneal abrasions
  - Traumatic cataracts
  - Commotio retinae

---

Convergence Insufficiency

![Convergence Insufficiency Image]
Prevalence

- Wide range 1.75-50%
- Recent study of CITT: 21% in 5-6th graders
- TBI and cerebral vascular accidents: 35%
  - Most common diagnosis
- Women: Men = 3:2

Etiology

- Following causes of CI:
  - Wide interpupillary distance
  - Delayed development
  - Poorly developed accommodation
  - Presbyopia
  - Anxiety neurosis
- Systemic disorders:
  - Head trauma
  - Encephalitis
  - Drug intoxication
- Anoxia
- Heavy tobacco use

Where in the Brain?!

- Cohen et Al.: vergence anomalies associated with brain injury
  - Mesencephalic (midbrain) and cortical brain structures
- Holden et Al.: CI and cognitive impairment in Parkinson’s
  - “Impaired subcortical and/or cortical function beyond the midbrain”
  - Superior cortical and frontal cortical regions

Lateral Geniculate Nucleus

- Magno cells- sensitive to high temporal and low spatial frequencies
  - Movement
  - Periphery
- Parvo cells- respond to low temporal and high spatial frequencies
  - Central information
  - Fine details
- Studies of cerebral control of vergence have implicated dorsal area MT - which suggests magnocellular involvement
  - Vergence is mediated via magnocellular pathways
Visual Motion Hypersensitivity

- Magnocellular and Parvocellular discrepancy when trying to process external stimuli
- Symptoms include:
  - Dizziness
  - Nausea
  - Imbalance
  - Fatigue
- Noted in 60% athletes after sports related concussion
- Noted with:
  - Patterns
  - Grocery stores
  - Visually overwhelming environments

The Convergence Insufficiency Neuro-mechanism in Adult Population Study (CINAPS)

- Why?
  - This study used a functional magnetic resonance imaging (fMRI) to see which areas are activated in the brain during convergence
    - Frontal eye fields
    - Parietal eye fields
    - Cerebellum
    - Primary visual cortex

CINAPS Results

- Shows efferent metabolic activity of cortical and subcortical regions
- Limitations of this study: eye movement recording is monocular

Characteristics

- Exophoria (N>D)
- Receded near point convergence (NPC)
- Decreased positive fusional vergence
- Asthenopia at near
**Signs/ Symptoms**

- Diplopia
- Eye strain
- Headaches
- Major discomfort after reading or computer work
- Frontal headache
- TBI specific:
  - Intense aversion to having things close to their face

**Testing Protocol**

- CISS/ BVISS survey
- Phoria
- NPC
- Fusional convergence
- Near point analysis
- Accomodation
- Sensory fusion
- Visual motion hypersensitivity testing

**CISS**

- Lowest score is: 0
- Highest score: 60
- Symptomatic CI
  - Children: >16
  - Adults: >21
Visual Motion Hypersensitivity

Positive Fusional Vergence
- Requires patient to converge to maintain the bifoveal fixation and maintain accommodation at a given level
- The Values
  - Blur/Break/Recovery

Phoria & NPC
- Requires patient to converge to maintain the bifoveal fixation and maintain accommodation at a given level
- The Values
  - Blur/Break/Recovery

The Convergence Insufficiency Neuro-mechanism in Adult Population Study (CINAPS)
- Significant differences are observed between CI and binocularly normal cohorts at their baseline measurements for NPC, PVF, difference in phoria from far to near, amplitude of accommodation and CISS
- 26% comorbidity with AI
Treatment Protocol

- Low plus reading glasses
- Prism
- Bi-Nasals
- Neuro-optometric rehabilitation
- Surgery!

Low Plus Readers

- Helps with accommodative component
- Helps stimulate motion (parvocellular pathway)
- Some studies show that low plus can improve the dizziness symptoms often felt with

Base In Prism

- Decreases vergence demand
- Decrease the noise/shifts emphasis on near space and shift outward
- Concern of prism adaptation
- How to prescribe:
  - Sheard’s VS Prism Bar
    - Fusional reserve should be 2 times the demand
    - Prism needed= ⅔(demand) - ⅓(reserve)

Back To Case # 1
Let’s Remember Goals:

- Able to read at her original pace - a book per day
- Get back to work
- Walk in the grocery store
- Jump between computer screens (sideways)

Plan

- Prescribed two pairs of glasses with BI prism and vertical prism, FL-41 10% tint. Recommended 10 session of vision therapy focused on binocularity, visual motion hypersensitivity, and periphery.

Programming Sequence

- Monocular
  - Saccadic work
    - Doorway saccades while walking
    - Hart Chart fixations
  - Periphery
    - Space Fixator
    - Bean bag toss
    - Gaze stabilization
    - Chair swings
    - Four corner hart charts with metronome and spins

Gross Convergence
Smooth Convergence

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- Cover Test:
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Aperture Rule

Let’s Remember Exam Findings

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  - Infra: 3/1.5
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Progress Evaluation #1
Goals:

- Able to read at her original pace - a book per day (MET)
- Get back to work (MET)
- Walk in the grocery store (MET)
- Jump between computer screens (sideways) (improving)

Clinical Pearls

- CI may have more peripheral issues associated with it
- Base in prism is a great alternative choice for patients over 45
- Vision therapy is a great tool for TBI patients
- Don’t be afraid to go back to basic activities

References

- Cooper J, Jamal M. Convergence insufficiency—a major review. Optometry (St. Louis, Mo.). 2012 Apr;83(4):135-133.
Thank you for your time
Questions?
Contact: drmariam@doctorbruce.net
A CHANGE IN PERSPECTIVE: VISUAL MIDLINE SHIFT SYNDROME IN TBI PATIENTS
Sydney Kapp, OD

Disclosures
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- Seen 1 month after motor vehicle accident (MVA)
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- CC:
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  - Feels "crooked"
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  - Intermittent double vision
  - Difficulty reading
  - Blurred vision

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- Aka: Abnormal Egocentric Localization
  - Altered perception of self in space
  - “the ambient visual process changes its orientation to concept of the midline”
  - Mismatch between visual and spatial information processes in the brain
- Seen in persons with neurological dysfunctions
  - Cerebrovascular accidents (CVA)
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  - Other neuromuscular disorders (multiple sclerosis, cerebral palsy, etc)
Not to be confused with Midline Shift

- Midline Shift
  - Brain shifts past its center
- Serious and structurally based neurologic condition
  - Associated with brain stem distortion
  - Associated with high intracranial pressure
- Often caused by:
  - TBI; Stroke; Hematoma; Birth deformity
- Symptoms include:
  - Abnormal posture
  - Unresponsive pupils

Identifying patients with VMSS

- Start with a thorough case history
  - Details regarding accident
- Can you tell what area of the brain suffered damage?
- VMSS common symptoms
  - Floors appear tilted
  - Floors and/or walls can appear to shift or move
  - Dizziness and/or nausea
  - Patient leans away from affected side
  - Poor balance
  - Abnormal posture or gait

Brain Injury Vision Symptom Survey (BIVSS)

- Useful in ‘triaging’ brain injury patients
- Categories: Eyesight Clarity, Visual Comfort, Doubling, Light Sensitivity, Dry Eyes, Depth Perception, Peripheral Vision, Reading

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Ambient and Focal Processing

- Aka: magnocellular and parvocellular processing
- Magno ganglion cells
  - “where”
  - Periphery; movement, gross details
  - Information regarding balance, movement, coordination, posture
- Parvo ganglion cells
  - “what”
  - Central; fine details
  - Information in fixating on an object; derived from the macula
- The two systems work in tandem; keep focus on the object in question while still being aware of spatial relations of the surrounding environment

Structurally speaking...

- Ambient process begins in the peripheral retina
  - This peripheral retinal nerve fibers are delivered to the midbrain
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Ambient Processing Dysfunctions

- “where you are in space and essentially where you are looking before you process information about what you are looking at”
- After a neurological dysfunction...
  - Ambient process loses ability to match spatial information
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Testing for VMSS

- Padula’s Method:
  - Wand held 16in from patient’s eyes
  - Move wand from patient’s left to right field
    - Watching just with eyes, head held still
    - Ask patient to stop examiner when wand appears in front of nose
    - Note where patient stops wand
  - Repeat moving from right field to left field
  - Hold wand horizontally, start above eye level and bring downwards
  - Repeat, starting below eye level and bring upwards

- Examiner should not stand directly in front of patient!
Testing for VMSS

- **Finger Touch Test**
  - Hold your finger in front of the patient
  - Have patient reach out and touch your finger
  - Have patient reset and close eyes and repeat
    - Notice if patient is able to touch your finger or if they are off
  - Repeat in multiple gazes

- Can do all 9 gazes
- In exam setting, typically the four corners and central positions
- Aids in better understanding of the patient’s spatial localization
- Patient also gains proprioceptive cues

Treatments: Yoked Prism

- Padula recommends placing base opposite of shift or same direction as ‘paretic side’

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<td>Right</td>
<td>Base Left</td>
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<td>Base Down</td>
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- Begin with .5° to 1° trial in office
- This method produces a neuro-motor shift back to midline
  - Paradoxical: placing base same direction of shift – sensory shift
- Goal: Help the brain learn re-organized space to bring midline back to true center
  - Ultimately, want to remove prisms

What was seen with MT?

- Stopped lateral path to the right of center
- Stopped vertical path below her eyelid

- Angular orientation of prism
  - Base up and base left
  - OD: 1.5° BU, 0.75° BU
  - OS: 1.5° BG, 0.75° BU
Yoked Prism

- "Bends towards the base, appears toward the apex"
- Spatial perceptions with prism
  - Base: compresses space
  - Apex: expands space
- Angular orientation
  - Base down and right
  - Base up and left

This patient suffered right brain damage

Treatments: Neuro-optometric Rehabilitation

- Space Fixator
- Peripheral Awareness Training
- Yoked Prism
- Line Bisection/Line Cancellation

Where is MT now?

- Wearing prism glasses full-time
  - Re-evaluate visual midline at next progress exam, hope to reduce prismatic value in specs
- Currently enrolled in vision rehabilitation
  - Spatial localization activities
    - Fixations
    - Peripheral awareness tasks (Lora’s Card, Nielsen circles)
- Awareness in space (space fixator, space matching)
  - Returning to work soon as symptoms have improved
    - Decreased hours with special allowances

Clinical Pearls

- Listen to your patient! Case history can tell you everything
- Prisms can be a very effective form of treatment
- Trial in office – paradoxical VMSS can exist

Sources

- "Modifying Postural Adaptation Following a CVA through Prismatic Shift of Visuospatial Egocenter." Padula Institute, padulainstitute.com/education/articles/modifying-postural-adaptation-following-a-cva-through-prismatic-shift-of-egocenter/
- "Visual Midline Shift Test.” Padula Institute, padulainstitute.com/education/articles/post-trauma-vision-syndrome/.
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<tr>
<th>Visual Midline Shift</th>
<th>Direction of Prism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>Base Left</td>
</tr>
<tr>
<td>Left</td>
<td>Base Right</td>
</tr>
<tr>
<td>Anterior</td>
<td>Base Down</td>
</tr>
<tr>
<td>Posterior</td>
<td>Base Up</td>
</tr>
</tbody>
</table>

- Begin with .5° to 1°, trial in office
- This method produces a neuro-motor shift back to midline
  - Paradoxical: placing base same direction of shift – sensory shift
- Goal: Help the brain learn re-organized space to bring midline back to true center
  - Ultimately, want to remove prisms

What was seen with MT?

- Stopped lateral path to the right of center
- Stopped vertical path below her eyeline

- Angular orientation of prism
  - OD: 1.5° BL, 0.75° BU
  - OS: 1.5° BG, 0.75° BU
Yoked Prism

- "Bends towards the base, appears toward the apex"
- Spatial perceptions with prism
  - Base: compresses space
  - Apex: expands space
- Angular orientation
  - Base down and right
  - Base up and left

Treatments: Neuro-optometric Rehabilitation

- Space Fixator
- Peripheral Awareness Training
- Yoked Prism
- Line Bisection/Line Cancellation

Where is MT now?

- Wearing prism glasses full-time
  - Re-evaluate visual midline at next progress exam, hope to reduce prismatic value in specs
- Currently enrolled in vision rehabilitation
  - Spatial localization activities
    - Fixations
    - Peripheral awareness tasks (Lora's Card, Nielsen circles)
    - Awareness in space (space fixator, space matching)
- Returning to work soon as symptoms have improved
  - Decreased hours with special allowances

Clinical Pearls

- Listen to your patient! Case history can tell you everything
- Prisms can be a very effective form of treatment
- Trial in office – paradoxical VMSS can exist

Sources

- “Modifying Postural Adaptation Following a CVA through Prismatic Shift of Visuospatial Egocenter.” Padula Institute, padulainstitute.com/education/articles/modifying-postural-adaptation-following-comparative-
  - Psychomotor Rehabilitation through Prismatic Shift of Visuospatial Egocenter.
- “Visual Midline Shift Test.”
Course Outline:

I. Introduction
   A. Learning Outcomes
   B. Prevalence of Esotropia
   C. Pathophysiology
      1. Proposed mechanisms of origins of strabismus and loss of binocular vision
   D. Classification of Esotropia
   E. Optometric Examination
   F. Treatment Options
   G. The Importance of Motion Processing
   H. Case Studies

II. Pathophysiology
   A. Normal binocular visual development
      1. Expected norms: stereopsis, oculomotor skills, vergence skills, accommodative skills, visual acuity.
   B. How is esotropia developed?
      1. Proposed mechanisms: genetics, environmental, traumatic

III. Classifications of esotropia
   A. Infantile esotropia
   B. Acquired esotropia
      1. Accommodative
      2. Partially-accommodative
      3. Nonaccommodative
      4. Acute
      5. Mechanical
   C. Secondary esotropia
      1. Sensory
      2. Consecutive
   D. Microesotropia or Monofixation Syndrome

IV. Optometric Examination Components
   A. Key examination components related to esotropia
      1. Visual acuity
      2. Cover test
      3. Refractive status
      4. Stereopsis
      5. Worth-4-Dot
      6. Status of accommodation – MEM, NRA/PRA
      7. Monocular pursuits
      8. Monocular OKN response nasal-temporal and temporal-nasal
MOTION PROCESSING IN ESOTROPIA EVALUATIONS

Presenter: Kimber M. Kenzli, O.D.

B. Clinical associations with essential infantile esotropia
   1. Typical onset: 2-4 months of age
   2. Family history of infantile esotropia
   3. Large angle and constant typical
   4. Cross-fixation
   5. Low to moderate hyperopia
   6. Amblyopia
   7. Abduction deficit
   8. Inferior oblique overaction
   9. Latent nystagmus
  10. Dissociated vertical deviation (DVD)
  11. Monocular nasotemporal-pursuit optomotor nystagmus (OKN) asymmetry

C. Important Differential Diagnoses: early onset esotropia, Duane syndrome, congenital abducens nerve palsy, lateral rectus nerve palsy, Moebius’ syndrome, sensory esotropia, accommodative esotropia

V. Treatment options
   Treatment options may vary depending on clinical findings and goals of the patient
   A. Spectacle prescription
      1. Will a bifocal be required?
      2. Will prism correction be required?
   B. Binasal occlusion
   C. Optometric vision therapy
   D. Strabismus surgery
   E. Patching?

VI. The importance of motion processing - Monocular naso-temporal pursuit dysfunction
   A. What does this mean?
      1. Impaired naso-temporal tracking compared to temporal-nasal tracking
      2. Proposed mechanism of evaluation: compare performance of strabismic with non-strabismic eye with pursuits or OKN drum and scale 1-4
      3. Helps in diagnosis if patient has borderline findings accommodative vs. nonaccommodative
      4. Patient history is important to narrow down the onset of strabismus
      5. Making realistic goals based on findings about improving visual skills and binocular vision
   B. Making treatment decisions
      1. Will my patient benefit from vision therapy?
      2. Is strabismus surgery alone sufficient for functional vision?
      3. What are my patient goals?

VII. Case Studies
   A. JF: An 8-year-old white male presented for a binocular vision evaluation sent from his primary care optometrist. CLET since early childhood, current spectacle prescription +1.00 DS OD, OS. BCVA OD: 20/20, OS: 20/200. CT: 35PD CLET at distance and near, Stereopsis: (-) global or local with Randot, W4D: OS suppression, OKN G3+
      1. How can we help?
      2. What are the patient’s goals?
      3. What did this patient and his family choose and what are the results thus far?
MOTION PROCESSING IN ESOTROPIA EVALUATIONS

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B. LG: A 5-year-old Hispanic female presented for a progress evaluation post-strabismus surgery for further treatment and management. The patient had completed almost 2 years of monthly vision therapy and passive therapy with binasal occlusion with poor compliance to home therapy activities. Large angle (>40PD) CAET noted since early childhood, current spectacle prescription: +0.50 DS OD, OS. CT at today’s appointment: 10PD CAET at distance and near, Stereopsis: (-) global or local with Randot, W4D: Alternating suppression, OKN G3+ OD, OS post-optometric vision therapy.

1. How can we help?
2. What is our responsibility in optometric care?
3. What did this patient and her family choose and what are the results thus far?