SEEING AFTER A BRAIN INJURY

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GOALS

- Define vision beyond 20/20
- Delineate the importance of a neuro-optometric evaluation for patients with traumatic brain injury and stroke
- Explore treatment options and outcomes in a team setting
- Case examples
WHAT IS THE PURPOSE OF HAVING A VISUAL SYSTEM?
THE PURPOSE OF VISION

To determine meaning from light--
CONCRETE VISUAL IMAGES
THE PURPOSE OF VISION

To determine meaning from light--SYMBOLIC VISUAL IMAGES
THE PURPOSE OF VISION

To determine meaning from light--
ABSTRACT LANGUAGE SYMBOLS
THE PURPOSE OF VISION

To guide and direct intelligent movement of the body
VISION, AS A PROCESS, EMERGES

- Move the eyes to look at a target across different distances
- Maintain clarity of the image over time
- Comprehend and process what is seen
- Coordinate the visual information with the hand and body
- Maintain upright and stable body position
- Communicate what is seen and understood
THE VISUAL SYSTEM - AN OVERVIEW

- 2/3rd of all sensory processing in the entire body is directly affected by information coming from the two eyes
- Optic Nerve: 1,000,000 nerve fibers per eye, important pathways where the visual information travels
CRANIAL NERVES INVOLVED WITH VISION

- CN II, Optic Nerve
- CN III, Oculomotor (moves eyes/constrict pupil/accommodate)
- CN IV, Trochlear (moves eye up)
- CN V, Trigeminal (corneal sensitivity, maintaining the tear film)
- CN VI, Abducens (moves eye out)
- CN VII, Facial (closes eyelid)
- CN VIII, Vestibulocochlear (VOR)
- CN XI, Accessory (VOR)
TWO THIRDS OF AFFERENT NERVES ARE FROM OUR EYES

- The sight pathway
- The vestibulo-ocular-reflex
- Oculo-motor pathways
- The Dorsal Stream
- The Ventral Stream
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DORSAL STREAM - WHERE AM I? WHERE IS IT?

- Magnocells respond to large and fast moving stimuli
- More primitive system is present at birth
- Unconscious
- Dorsal stream derives information from the visual system plus information from vestibular and other senses
VENTRAL STREAM- WHAT IS IT?

- The ventral system is associated with the primary visual pathway
- Much slower than the dorsal system
- Mediated by the parvocellular cells
- Cells that react to stationary small targets, detail and color
DORSAL AND VENTRAL SYSTEMS

- Need to work in harmony
- They are not isolated systems
- A disconnect in the dorsal system will cause problems with spatial orientation
  - Symptoms include: balance problems, bumping into things, difficulty navigating
WHAT CAUSES VISION PROBLEMS?

- Disruption of neural pathways
- Damage to structures
  - Brainstem
  - Cortex
  - Cerebellum
- As many as 50% of those with a neurological injury suffer from visual changes (that do not affect the ability to see 20/20)
- Many individuals are not diagnosed
COMMON FINDINGS WITH AN ABI

- Many patients with head injury have characteristic visual sequelae
- These include problems with field of vision loss, difficulty with binocular vision, spatial localization, concentration and difficulty visual motor tasks
- Treating vision must be considered along with PT, OT and ST, if the patient is going to make a good recovery
VISION SIGNS AND SYMPTOMS

- Field Loss
- Light sensitivity
- Reading Disorders
  - a. Accommodative Problems
  - b. Convergence Problems
  - c. Eye Movement Disorders, Fixation, Pursuits
- Double vision- Exotropia, Esotropia and Hypertropia
- Cranial Nerve Paresis / Paralysis III , IV, VI , VII
- Small changes in refractive errors more significant
- Nystagmus
VISION SIGNS AND SYMPTOMS

- Disturbances of spatial relationships
- Right - Left discrimination problems
- Agnosia - difficulty in object recognition
- Apraxia - difficulty in manipulation of objects
- Visual Midline Shift Syndrome
  a. Balance issues, Dizziness
- Memory Loss
- Poor eyelid closure while sleeping
- Dry Eye - Decreased Blink Rate
- Visual Hallucinations
- Frequent Headaches
- Unstable Dorsal Stream processing
- Visual Perceptual Disturbances
POST-TRAUMATIC VISION SYNDROME

- Patients exhibit the following characteristics:
  - Exotropia
  - High exophoria
  - Reduced near point of convergence
  - Accommodative dysfunction
  - Oculomotor dysfunction
POST-TRAUMATIC VISION SYNDROME

- Symptoms:
  - Poor concentration
  - Blurred vision
  - Discomfort with near point work
  - Loses place when reading
  - Gets disoriented in market or malls
  - Bothered by patterned in carpets
  - Photophobia
VISUAL MIDLINE SHIFT SYNDROME

- Mismatch between the perceived egocentric visual midline and the actual physical midline
- Causes an expansion on one side and a contraction on the opposite side
- May be caused by:
  a. Dorsal system dysfunction
  b. Oculomotor imbalance
  c. Spatial shifts caused by unilateral hemispheric damage
SIGNS AND SYMPTOMS OF VISUAL MIDLINE SHIFT SYNDROME

- Floor or walls may appear tilted and appear to shift and move
- Veering during mobility
- Person leans away from the affected side
- Feelings of imbalance or disorientation similar to vertigo
VISUAL FIELD DEFECTS AFTER ABI
WHO CAN BENEFIT FROM A NEURO-OPTOMETRIC EVALUATION?

- Acquired brain injury
- Stroke
- Multiple Sclerosis
- Cerebral Palsy
- Brain Tumor
- Developmental disorders
- Others
THE NEURO-OPTOMETRIC EVALUATION

- Determine the visual problems.
- Determine the visual demands.
- Determine if there is a match.
- Consult with patients and other professionals as to ways to address any mismatch neuro-optometric or otherwise.
THE NEURO-OPTOMETRIC EVALUATION

- Extensive History
- Line Bisection (Visual Neglect)
- Stereopsis (Depth Perception)
- Visual Acuity (distance/near)
- Dynamic Visual Acuity
- Cover test (distance/near)
- Spatial Localization
- Standardized oculomotor testing (DEM or KD Test)
- Sensory fusion (Red lens/Worth 4 Dot)

- Binocular testing
  - Convergence
  - Vergence Ranges
- Visual Midline Shift test
- Posture/Gait evaluation (out of the exam room)
- Assessment of visual information processing abilities and visual motor integration
- Ocular health exam
- Visual Field assessment
- Refraction
ABILITY, SKILL AND ENDURANCE
TREATMENT/ MANAGEMENT OPTIONS
IN CLOSE COLLABORATION WITH OTHER DISCIPLINES

● Modifying the visual input
  ○ Lenses
  ○ Prisms
  ○ Filters
● Vision Rehabilitation
  ○ Binocularity
  ○ Ocular Motility
  ○ Spatial Awareness
MODIFYING THE VISUAL INPUT: LENS AND PRISMS

- Diagnostic
- Compensatory
- Task Specific
- Therapeutic
  - Developmental
  - Stress-Relieving
  - Performance
MODIFYING THE VISUAL INPUT: LENS AND PRISMS

- Change light energy entering the eyes and brain.
- Change the way the brain processes visual input.
- Effects a change in the output of vision and other sensory/motor systems.
- Creates a change in perception.
- Allows for new connections to occur.
- Changes space and time variables.
- Expands periphery.
- Allows for improved attention and awareness.
- Change can be immediate
- Change can be profound.
MEDIAL OCCLUSION

- Used to treat visual midline shift syndrome
- Can cause immediate improvement in depth perception, balance, eyesight, etc
- Reduces car sickness, imbalance, etc
VISUAL MIDLINE SHIFT SYNDROME
VISION THERAPY/REHABILITATION

- Prescribed activities done in a safe, comfortable environment.
- Techniques are designed to develop specific visual skills based on individualized, objective data.
- Therapy creates experiences for learning new skills and rehabilitating visual skills.
- Therapy includes activities which integrate vision with vestibular, auditory and visual motor skills.
WHAT DOES OPTOMETRIC VT USE?

- Therapeutic lenses
- Prisms
- Filters
- 3D Technology
- Virtual Reality
- Balance boards
- A variety of special tools designed for specific and unique vision therapy activities
VISION THERAPY

Brock String
is a vision therapy tool that gives immediate feedback whether a patient is using both eyes when focusing near and far.

Focusing Far → Focusing Near

Vectograms
are used in vision therapy to practice seeing with both eyes while moving them together (converging) and apart (diverging).

Tranaglyphs
are used in vision therapy to practice seeing with both eyes while moving them together (converging) and apart (diverging).

Binocular Flippers
are used in vision therapy to improve focusing and aligning both eyes at once. Combining red/green glasses with an overlay ensures one of the eyes can’t suppress (turn off) and yet the other one does all the work.
CASE EXAMPLE: A.C.

- 58 year old female
- Suffered a venous subarachnoid hemorrhage after a cerebral thrombosis
- “Sensory overload”
- “So many distractions”
- Headaches, poor depth perception, poor spatial judgments

- Currently uses biofeedback to manage stress
- Working with OT and Vestibular PT
- Noted in OT and PT that it was harder to use her vision on the right side more than the left
NEURO-OPTOMETRIC FINDINGS: A.C.

- **Visual acuity**
  - 20/25 OD, OS, OU

- **Stereoacuity Normal**

- **Standardized eye movement assessment, King Devick**
  - Too dizzy and nauseated to complete

- **Pursuits**
  - Appropriate but induces symptoms

- **Sensory fusion and convergence**
  - Double vision at 16 inches
  - Comfort point of convergence at 20 inches
NEURO-OPTOMETRIC FINDINGS: A.C.

- Unable to assess vergence ranges
- Visual Midline Shift
  - Positive for dorsal and ventral processing shifts
  - Shifted to the right
- No visual field loss, no visual neglect
- All ocular health structures within normal limits
NEURO-OPTOMETRIC FINDINGS: A.C.

- Visual acuity
  - 20/20 OD, OS, OU
- Standardized eye movement assessment, King Devick
  - Age appropriate score
- Pursuits
  - Smooth
- Sensory fusion and convergence
  - Fusion at all distances and in all gazes
  - Comfort point of convergence at 4 inches
- Normal vergence ranges at distance and near
- Normal Visual Midline
- Symptom free!
CASE EXAMPLE: K.C.

- 9 year old female
- Suffered 3 concussions back to back
- Headaches everyday since her 3rd accident (“during focusing, school work and reading”)
- “Eyes get tired very fast”
- Double vision when reading
- Light sensitive

- Sound sensitive
- Eyes hurt when looking to the left
- Was also referred to OT and Vestibular PT
NEURO-OPTOMETRIC FINDINGS: K.C.

- **Visual acuity**
  - 20/25 OD, OS, 20/30 OU
- **Stereoacuity Normal**
- **Standardized eye movement assessment, King Devick**
  - Unable to score due to amount of errors
- **Pursuits**
  - Uses head instead of eyes, pain in left gaze

- **Eye alignment/Posture**
  - 4 esophoria with intermittent esotropia
- **Vergence ranges**
  - Unable to assess
- **Sensory fusion and convergence**
  - Double vision at 18 inches
- **Visual Information Processing Assessment**
  - Figure Ground: 7.8 yo
  - Visual-Motor Integration: 4.11
NEURO-OPTOMETRIC FINDINGS: K.C.

- Visual acuity
  - 20/20 OD, OS, OU

- Standardized eye movement assessment, King Devick
  - 14.0 year old age equivalent

- Pursuits
  - Smooth and accurate, no pain

- Eye alignment/Posture
  - 4 exophoria (normal)

- Vergence ranges
  - >40 prism diopters

- Sensory fusion and convergence
  - Fusion to her nose

- Visual Information Processing Assessment
  - Figure Ground: 10.8 yo
  - Visual-Motor Integration: 7.11
FOR MORE INFORMATION...

- Concussionproject.com
- https://visionhelp.wordpress.com/?s=broken&submit=Search
- Noravisionrehab.com
- AOA.org.vrs
- http://adventuresinbraininjury.com/
- COVD.org
  - Handbook for Diagnosis volume 1-A
  - Handbook for Management of Patients with ABI volume 1-B
References


