Concussion – Look into the Eyes

Dr. Cathy Stern, OD, FCOVD, FCSO, FNORA
Behavioral, Developmental and Neuro-Optometry

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Concussion

The American Academy of Neurology defines concussion as “a pathophysiological disturbance in neurological function characterized by clinical symptoms induced by biomechanical forces”.

Concussions are a type of traumatic brain injury.

They deserve the same attention and care throughout the rehabilitative process.

75% of TBI is mTBI

Those most likely to sustain a TBI are:
- younger than age 4
- age 15-19
- older than 65

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Neuro-Optometric Rehabilitation
Models of Vision

Medical/Optical Model

Detection of eye disease and visual acuity

Behavioral Model

Vision guides movement and directs action

Vision is learned

Visual skills can be improved with neuro-optometric rehabilitation

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Neuro-Optometric Rehabilitation
Models of Vision

Ocular Visual Impairment
rooted in the eyeball

Cerebral Visual Impairment (CVI)
in the visual pathways/connections through the brain and connecting with the rest of the body
Models of Vision

Vision Involves Two Mechanisms

focal: identification, eyesight
ambient: spatial orientation & localization in space

Visual acuity is to vision as the alphabet is to reading

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Neuro-Optometric Rehabilitation
The Visual Process

To enhance vision for both:

- visual input (sensory) and visual output (motor)

Optimal visual processing leads to:

- better sustained attention
- faster processing speed
- superior comprehension/perception
Why Evaluate Vision after Closed Head Injury

Routine vision evaluation detects eyesight ability and eye disease damage.

*Neuro-Optometric Vision Evaluation* assesses visual efficiency and visual processing critical for reading, using your cell phone, computer use, activities of daily living, recreation, driving and mobility.
Why Evaluate Vision after Closed Head Injury

Vision plays a significant role for abilities that require sustained visual attention or judgment of direction, distance and space.

Vision skill plays an important role for the success of activities being addressed in therapies including occupational, physical, speech and cognitive rehab.

Vision is also a critical skill for balance, walking and driving.
Visual Dysfunction in Concussion

Increased vulnerability

50% of the brain is involved in visual information processing
Common Visual Symptoms after Closed Head Injury

- Blurry Vision
- Double Vision
- Reading Difficulty
- Headaches
- Dizziness or Nausea
Common Visual Symptoms after Closed Head Injury

Attention Deficit

Hemispatial Inattention (Visual Neglect)

Light Sensitivity

Low Blink Rate

Spatial Disorientation
direction/distance
Double Vision is extremely disruptive to reading. It often gets worse as the day wears on, or as reading extends beyond a few minutes. Many children block the vision of one eye in
Double vision is extremely disruptive to reading.
Functional Vision Changes associated With Closed Head Injury

Oculomotor Dysfunction (eye tracking)
Convergence Insufficiency
Accommodative (focusing) Deficit
Depth Perception Deficiency
Functional Vision Changes associated With Closed Head Injury

Visual Field Loss
Hemispatial Inattention (Visual Neglect)
Strabismus (eye turn)
Functional Vision Changes associated With Closed Head Injury

Visual Midline Shift Syndrome (balance and posture)
Visual Memory and Visual Perceptual
Visual Motor Integration

Decreased Blink Rate
Visual Acuity (eyesight) Loss
POST TRAUMA VISION SYNDROME

The **Characteristics** of the PTVS include:

- Exotropia or High Exophoria
- Convergence Insufficiency
- Accommodative Insufficiency
- Spatial Disorientation
- Unstable Peripheral Vision
POST TRAUMA VISION SYNDROME

The **Symptoms** of the PTVS include:

- Possible Diplopia
- Poor Concentration and Attention
- Objects Appear to Move
- Asthenopic Symptoms
Vision Evaluation

What You Often Get

History

Visual Acuity (eyesight)

Eye Health

Refractive Status
Neuro-Optometric Vision Evaluation

What Should You Expect

Oculomotor (visual tracking)

Pursuits - smooth tracking movements

Saccades - visual fixations from one point to another point

Binocular Eye Coordination – how the two eyes work together

Strabismus or high phoria ("tendency” for the eye to turn)

Suppression is the "ignoring or turning off vision" of an eye

Double vision is the inability to ignore a second image

a dark patch should not be used to treat diplopia
Neuro-Optometric Vision Evaluation

What Should You Expect

Vergence Facility or stamina of the ability to converge/ diverge

Accommodation or focus flexibility
  hold focus at near
  shift focus from distance to near and back

Depth Perception or Stereopsis
Visual Acuity and Refractive Status

50% of ABI patients in one study required a prescription for spectacles

These patients included:
- those who needed glasses for the first time.
- those who needed a replacement for lost eyeglasses.
- those requiring a change in their prescription.

Progressive no-line bifocals may exacerbate symptoms.
Neuro-Optometric Vision Evaluation

Visual Field – affects mobility and attention

Types of visual field assessment

1. confrontation
2. automated perimetry (better for disease)
3. kinetic perimetry (more sensitive)
4. line bisection or letter cancellation for unilateral spatial inattention (neglect)
5. observation of performance during daily activities
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Neuro-Optometric Rehabilitation
Neuro-Optometric Vision Evaluation

Balance and Postural Status

Visual Midline Shift Syndrome (VMSS)

The examiner moves a wand laterally in front of the person and asks the person to state when the wand appears to be directly in front of the person's nose. This indicates the position of the midline as either centered or with a lateral shift. When the wand is passed vertically in front of the person's face, the person then must respond when the wand appears to be at eye level. This indicates the anterior-posterior relationship of the visual midline. This is the objective analysis to evaluate for Visual Midline Shift Syndrome (VMSS).
Visual Midline Shift Syndrome (VMSS)

The patient is leaning away from the affected side, complaining that the floor looks tilted, and that the wall or floor may be appearing to shift or move.
**DO YOU CURRENTLY EXPERIENCE ANY OF THE FOLLOWING:**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Yes</th>
<th>No</th>
<th>Prior to Injury?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eyes ache</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Difficulty moving or turning eyes</td>
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<td>☐</td>
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<tr>
<td>Pain with movement of eyes</td>
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<tr>
<td>Eyes twitch</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Pain in or around eyes</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Eye redness</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Burning eyes</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Watery eyes</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Itchy eyes</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Brightness is bothersome</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Motion sickness / car sickness</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Headaches</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Blurred vision</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Difficulty changing focus far to near</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Double vision</td>
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</tbody>
</table>
**DO YOU CURRENTLY EXPERIENCE ANY OF THE FOLLOWING:**

<table>
<thead>
<tr>
<th>Prior to Injury?</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>• One eye turns in, out, up or down</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>• Squinting, covering or closing one eye</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>• Movement of objects in the environment is bothersome</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>• Fluorescent light is bothersome</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>• Lose place often when reading</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>• Words jump or move around when reading</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>• Short attention span for reading or writing</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>• Skip words frequently when reading</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>• Discomfort when reading</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
Do you currently experience any of the following:

<table>
<thead>
<tr>
<th>Prior to Injury?</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of interest/concentration when doing close work</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Orient writing/drawing poorly on page</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Squinting, covering or closing one eye</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Head tilts during desk work</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Hold books too close</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Avoid reading or writing</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Difficulty with peripheral vision</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Objects jump in and out of field of view</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Reduced depth perception</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Tunnel vision / Loss of visual field</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Flashes of light</td>
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</tbody>
</table>
Neuro-Optometric Rehabilitation vs. Low Vision Rehabilitation

Neuro Rehabilitation is relatively new and practiced primarily by optometrists with more specialized training (FNORA).

Visual processing may be affected even when eyesight is good and it can interfere with the rehabilitative process.

It affects a person’s ability to integrate visual, kinesthetic, proprioceptive and vestibular input and therefore affects output - walking, reading, writing, driving.

Low Vision management is directed to sight improvement or environmental accommodations – larger print, magnifiers, hand-held telescopes.

Some patients will need both services.

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Neuro-Optometric Rehabilitation
Vision Screening

Stereopsis – depth perception

Worth 4 dot test - a test for suppression
Randot Stereo Test  
Stereo Fly, Stereo Animals and Wirt Circles
Worth Four Dot Test (W4D)
Vision Screening

Visual Tracking and Locating

Convergence Ability (convergence insufficiency)

Eye Teaming – accurate, stamina, stability
NSUCO Maples Oculomotor Test

**Pursuits**

Have the patient stand (if possible) with their arms at their sides and instruct them to follow a fixation target with their eyes. Hold the target approximately 16 inches from the patient and trace a circle with an 8 inch radius from primary gaze at least two times in a clockwise direction and two times in the counter-clockwise direction. Monitor and record the patient’s ability to complete each rotation, to maintain fixation of the target, and any head or body movements made during the testing.
NSUCO Maples Oculomotor Test

**Saccades**

Have the patient stand (if possible) with their arms at their sides and feet at shoulder’s width. The procedure involves two targets. Hold the two fixation targets 16 inches from the patient with a target positioned horizontally 4 inches from the right and left of the midline, respectively. Have the patient fixate one target and then instruct them to quickly look at the other target. Repeat each cycle four more times.[It is reasonable to test saccades in vertical and diagonal orientations if more data is desired]. Monitor and record any over- or under-shooting of fixation, the ability to complete the task, and any head or body movements.
4+ System for Evaluating Oculomotility

**Pursuit ability:** test binocularly

- 4+ Smooth and accurate
- 3+ One fixation loss
- 2+ Two fixation losses
- 1+ More than two fixation losses or any uncontrolled head movements

**Saccadic ability:** test binocularly

- 4+ Smooth and accurate
- 3+ Some slight undershooting
- 2+ Gross undershooting or overshooting or increased latency
- 1+ Inability to do task or any uncontrolled head movement
- Normal latency of initiating a saccade is 120 to 180 milliseconds
Assessing Convergence

A good screening test is **Near Point of Convergence**.

This provides quantitative and qualitative information.

- Quantitative or inches fusion breaks from the nose.
- Qualitative or the ease, comfort and stability with which the patient holds fusion.
Nearpoint of Convergence (NPC)

Requires a small near picture target

Ask the student to look at the target as you move it toward his/her nose

Record the distance in inches from the nose an eye drifts outward and/or the student reports seeing two images. This should be no greater than 3 inches

Reverse direction and record the distance in inches from the nose when the student regains fusion of the eyes. This should be no greater than 6 inches
Brock String

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Neuro-Optometric Rehabilitation
Important Visual Factors

Fixation / Visual Tracking / Locating
Focus Flexibility
Near Point of Convergence and Eye Teaming
Visual – Vestibular

These skills lead to sustained visual attention over time and faster processing speed
Cognitive Load

1. basic pursuit – follow the tip of my pen

2. now ask the person to repeat the task while spelling or trying simple math problems

   *this is more representative of performance in the real world*
TIC-TAC-TOE FLASH

Start with 10 flash cards of tic-tac-toe boards each with one letter X and one letter O. Flash each card quickly and have try to reproduce the image on a page of blank tic-tac-toe grids.

Allow the person to compare the images and point out any mismatches.

For higher level visualization, number the tic-tac-toe board 1-9 from upper left to lower right. Play tic-tac-toe by having each player say the number of the square they wish to place their X or O. See if the child or adult can tell if and when there is a winner.
Treatment Alternatives

Visual field expanding devices
- Prism expansion system
- Yoked prisms
- Vision therapy for fixation and scanning

Optical and non-optical aids for Low Vision
- Reading - markers ("L")
- Turn book 90 degrees
- Watch sizing/ spacing of print and lighting

Management or monitoring of eye disease
Treatment Alternatives

**Neuro-Optometric Vision Rehabilitation** - an individualized treatment

The goal is the treatment of visual processing and the enhancement of visual performance to meet the needs of each individual.

Neuro-Optometric Vision Rehabilitation should be the recommended treatment for visual conditions that include ocular motor and binocular vision dysfunctions, amblyopia, strabismus and visual motor/visual perceptual/visual processing disorders.

The use of lenses, prisms, filters and tints along with active neuro-optometric vision rehabilitation is integral to treating post-concussion. The goal of the treatment is to alleviate symptoms, achieve desired visual outcomes, meet the patient’s needs and improve the patient’s quality of life.
1. How soon after my brain injury is diagnosed should I seek a vision evaluation?

2. What type of vision examination is necessary?

3. Will all eye doctors give the same examination?

4. How long will vision rehabilitation take?

5. What is Neuro-Optometric Vision Rehabilitation?

6. How do you find an optometrist specializing in neuro-optometric vision rehabilitation?
Web Sites

Neuro Optometric Rehabilitation Association - www.nora.cc

College of Optometrists in Vision Development - www.covd.org

Optometric Extension Program Foundation - www.oepf.org

College of Syntonic Optometry - www.syntonicphototherapy.com

American Optometric Association - www.aoa.org

Dr. Cathy Stern, OD, FCSO, FCOVD - www.MyVisionDoc.com