Vision Impairments Following Trauma to the Brain

Julie Dyken, M.Ed.
Course Objectives

• To become familiar with common vision impairments following injury to the brain.
• To learn key elements of a vision screen.
• To identify key areas of ocular anatomy and the visual pathway.
• To identify how to implement treatment memos to improve vision function in the living environment.
About Julie Dyken, M.Ed.

- BS from Slippery Rock State College
- M.Ed. From University of Texas at Austin
- Low Vision Teaching Certification
- Employment Specialist
- ACBIS
Career Positions

• NeuroRestorative
• Core Healthcare
• Mentis Neuro Health
• St. David’s Rehabilitation Hospital
• The Cognitive Clinic
• Texas Rehabilitation Commission
• The Rehab Hospital
• Director of Cognitive Rehabilitation of Brown Schools Healthcare Rehabilitation Center (currently Texas Neuro-rehab. Center)
• Master Teacher and Vision/Cognitive Consultant for Region XIII
• Private Practice
About Julie Dyken, M.Ed.

New Hope of Indiana Residential Treatment Center
Individual Vision Therapy

- Provides screened assessments of impairment and recommendations for therapy
- Exercises for convergence, ocular motility, accommodation, visual scanning, ptosis, awareness of deficits, visual perception disorders
- Refer for consultation with ocular specialists in the community.
- Attend community appointments with specialists as requested
What Is Vision?

Vision is the process of deriving meaning from what is seen. The main purpose of the visual process is to arrive at an appropriate motor, and/or cognitive response.

(Politzer, 5/2016)
Vision Impairment and Brain Injury/Stroke

Research shows that 50 to 80% of individuals incurring CVA or Traumatic Brain Injury experience some vision impairment.
Vision Impairment and Brain Injury/Stroke

Up to two thirds of people experience some changes to their vision after a stroke.

National Stroke Association, 2018
Vision Impairment and Brain Injury

Current research indicates that approximately 80% of patients that suffer from a traumatic brain injury are struggling with vision deficits which are a direct result of their injury.
Vision Impairment and Brain Injury

Table 1. (Scheiman, 2013)

<table>
<thead>
<tr>
<th>VISION DEFICIT</th>
<th>ABI POPULATION STUDIED</th>
<th>GENERAL ADULT POPULATION (EXPECTED)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye teaming</td>
<td>42%</td>
<td>10%</td>
</tr>
<tr>
<td>Eye movement</td>
<td>40%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Focusing</td>
<td>10%</td>
<td>2-3%</td>
</tr>
<tr>
<td>Visual field deficits</td>
<td>32%</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>
Vision Impairment and Brain Injury

There are a myriad of types of brain injuries that can result in visual disturbances including:

- strokes
- motor vehicle accidents
- concussions/whiplash injuries
- status-post neurosurgery for tumor resection or aneurism repairs
Vision Deficits and Neurological Illness

Vision deficits are also extremely common in individuals struggling with Parkinson’s disease, myasthenia gravis and multiple sclerosis.

http://www.visiontherapysuccess.com/headtrauma.php
Vision deficits have been so prevalent among service members diagnosed with TBI, that in 2007 the U.S. Department of Veterans Administration (VA) modified its standard of care to include vision assessment for everyone with a TBI.

(Scheiman, 2013)
Processing Visual Information

The processing of visual information—through the eyes, interpreted by various brain centers, and translated into visual images—has been estimated to involve as much as 40 percent of the brain.
Vision Impairment and Brain Injury

It is common for families to be told that a survivor should wait 6 months before evaluating or confronting vision impairments.
The Anatomy of the Eye

Eye Anatomy

- Vitreous Gel (body)
- Choroid
- Optic Nerve
- Macula
- Forea
- Retina
- Superior Rectus Muscle
- Iris
- Anterior Chamber
- Cornea
- Pupil
- Lens
- Ciliary Body and Muscle
- Inferior Rectus Muscle
Vision and the Brain

The occipital lobe at the back of the brain is our primary vision center, but all of the brain lobes receive visual information.

“Almost every major area receives Input from vision.”

- Dr. Carl Garbus, an optometrist at the Neuro Vision Rehabilitation Institute in Santa Clarita, Calif., and president of the Neuro-Optometric Rehabilitation Association, or NORA
Eye Muscles

- Lateral Rectus - Abduction
- Medial Rectus - Adduction
- Superior Oblique
- Inferior Oblique
- Superior Rectus
- Inferior Rectus
Extra Ocular Movements

• Elevation (pupil directed upwards)
• Depression (pupil directed downwards)
• Abduction (pupil directed laterally)
• Adduction (pupil directed medially)
• Extorsion (top of eye rotating away from the nose)
• Intorsion (top of eye rotating towards the nose)
Cranial Nerves
Cranial 4 (Trochlear) innervates the superior oblique.
Cranial Nerve 6 (Abducens) innervates the lateral rectus.
Cranial Nerve 3 (Oculomotor): innervates medial rectus, inferior oblique, superior rectus and inferior rectus.
Cranial Nerve 3

Cranial Nerve 3: pupils and eyelids
Ptosis

Cranial Nerve 3
Dry Eye Syndrome
Common Impairments Following Trauma
Reduced Visual Acuity
Myopia

Nearsightedness
Hyperopia

Farsightedness
Normal vision: light is focused on the retina, not in front of it or behind it.

Nearsightedness: the image is focused in front of the retina.

Farsightedness: the image is focused behind the retina.
Presbyopia
Presbyopia

In a normal eye, images are focused on the retina, enabling good vision close up.

Presbyopia is age-related farsightedness as a result of the lens aging and stiffening. Images are formed behind the retina, resulting in blurry vision up close.
Accommodative Disorders
Cross section of Human Eye

- Iris
- Retina
- Inverted Image of object
- Object
- Lens
Visual Field Loss
Scotoma

Scotoma is a blind spot occurring in any part of the visual field.
Hemianopsia
Homonymous Hemianopsia
Quadranopsia
Central Field Loss
Neglect
Hemianopsia

May lose one half of their side vision to the right or left.
Homonymous Hemianopsia

The right half or the left half of your vision is missing from each eye.
Homonymous Hemianopsia

Homonymous hemianopsia on admission is linked to poor early survival and conversely around 10% [30] experience full spontaneous recovery within the first 2 weeks.
Visual Field Defects Following Stroke

Visual field defects seriously impact on functional ability and quality of life following stroke [31]. Patients with visual field defects have an increased risk of falling, impaired ability to read, poor mood, and higher levels of institutionalisation.
Impacts of Visual Field Loss

Visual field loss impacts on a patient’s ability to participate in rehabilitation, may ultimately result in poor long term recovery, and can lead to loss of independence, social isolation, and depression.
Quadranopsia

Incomplete hemianopsia, referring to a quarter of the schematic "pie" of visual field loss.
SUPERIOR QUADRANOPHIA FROM PARIETAL STROKE
Central Field Loss

Loss may be central/foveal (e.g., an optic disc or nerve problem).
Management of Field Loss

1. Let the person’s partner walk on the affected side and have the patient take their arm.

2. Encourage eye and head movements to the affected side – environmental scanning. This will require significant practice to develop an ongoing habit.

3. Visual scanning can include timed intervals via “clickers” for rhythmic scanning.
Neglect

Neglect is the inattention to or lack of awareness of visual space to the right or left and is most often associated with a hemianopsia.
Neglect

Neglect is almost always for the left hemifield. This is explained by the left hemisphere monitoring the right hemispace, while the right hemisphere monitors both hemispaces. A left hemisphere lesion will still allow the right hemisphere to survey the entire visual field, hence neglect does not occur. By contrast, with a right hemisphere lesion, the left hemisphere monitors only the right hemispace; therefore, because of the lack of monitoring the left hemispace, left sided neglect occurs.
Visual Motor Abilities
Alignment

This refers to eye posture (position, e.g. straight and aligned, versus abnormal alignments).
Fixation Pursuits, Saccades, Accommodation, Convergence
Diplopia

“Double Vision”
Monocular Diplopia

More than one image of the object of regard is formed in the retinae of one or both eyes.

- Irregular astigmatism (corneal scars, haze, corneal distortion)
- Subluxated clear lenses
- Poorly fitting contact lenses
- Early cataract
- Macular disorders – edema, CNVM, etc.
Double/Blurry Vision

Monocular Double Vision/Blurry Vision
Overlapping images with blurring

Horizontal Binocular Double Vision
Two identical images side by side

Vertical Binocular Double Vision
Two identical images on top of one another

Oblique Binocular Double Vision
Two identical images at an angle to one another
Monocular Double Vision/Blurry Vision

Horizontal Binocular Double Vision

Vertical Binocular Double Vision

Oblique Binocular Double Vision
Convergence Insufficiency
Convergence Insufficiency

Convergence Insufficiency (CI) is the leading cause of eyestrain, blurred vision, double vision and/or headaches.¹

Scientific research by the National Eye Institute has proven that office-based vision therapy is the most successful treatment.⁸
Suppression

Suppression of vision in one eye causes loss of binocular (two-eyed) vision and depth perception.

Poor binocular vision can have a negative impact on many areas of life, such as coordination, sports, judgment of distances, eye contact, motion sickness, etc.
Cranial Nerve Paresis/Paralysis
Ocular Motility Disorders
Fixation
Saccades
Smooth Pursuits
Vergence
Vestibulo-Oculomotor
Fixation

Fixation is the act of maintaining visual attention on one point in space.
Saccades

Saccades are rapid, ballistic movements of the eyes that abruptly change the point of fixation such as reading or room scan.
Smooth Pursuits

Slower tracking movements of the eyes designed to keep a moving stimulus on the fovea.
Vergence

Convergence or divergence of the lines of sight of each eye to see an object that is nearer or farther away.
Vestibulo-ocular movements stabilize the eyes relative to the external world, thus compensating for head movements. These reflex responses prevent visual images from “slipping” on the surface of the retina as head position varies.
Nerve Fiber Interaction

Approximately 20% of the nerve fibers from the eyes interact with the vestibular system.
Nystagmus is a vision condition in which the eyes make repetitive, uncontrolled movements. These movements often result in reduced vision and depth perception and can affect balance and coordination.
Strabismus

- Vertical skew deviation
- Horizontal skew deviation
- Eso-tropia
- Exo-tropia
- Hyper-tropia
- Fatigue causing temporary tropias
Strabismus
Photophobia
Apraxia

Oculomotor apraxia: Difficulty moving the eye, especially with saccade movements that direct the gaze to targets.
Prosopagnosia

Prosopagnosia, also called face blindness, is a cognitive disorder of face perception where the ability to recognize familiar faces, including one's own face (self-recognition), is impaired.

Damage in right occipital temporal cortex and fusiform gyrus.

Prosopagnosia

It’s estimated to affect about 2 percent of the general population.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3904192/
Visual Perceptual Disturbances
Visual Midline Shift (VMSS)

A person with a condition called visual midline shift may think the floor is tilted. The walls will also appear tilted, and the survivor will tilt his or her body to compensate. The visual system is telling this person that the world is at an angle, and the brain is making adjustments.
Visual Information Processing
Evaluation and Management of Vision Disorders
Screening and Assessment

- Vision Screen by Vision Specialist
- Annual Optometric Exam with Escort
- Extended Sensori-motor Evaluation
- Higher cerebral function assessment of visual processing (visual memory, speed and span of recognition, form perception, etc)
- Vestibular Testing
Definition of Vision Impairment
Division for Blind Services

- A visual acuity of 20/70 or less in the better eye, with best correction
- A visual field of 30 degrees or less in the better eye
- A combination of both.
Social Security Act

Defines blindness as central visual acuity of 20/200 or less in the better eye with the use of a correcting lens.

A visual field limitation such that the widest diameter of the visual field subtends an angle no greater than 20 degrees as having a central visual acuity of 20/200 or less.
Treatment and Management of Visual Disorders
Orthoptics

Emphasis on binocular vision and eye movements
Eye Movement Control
Near/Far Accommodation
Binocular Alignment
Central Vision (Visual Acuity)
Depth Awareness
Reading Fatigue
Behavioral Vision Therapy
Non Strabismic Therapy
1. Accommodation
2. Vergence disorders
3. The underachieving child
4. Prisms for near binocular disorders and for producing postural change
5. Near point stress and low-plus – the use of special lenses to adjust near-field vision, even for people who would not normally need glasses. Use of low-plus lenses at near to slow the progression of myopia
6. Therapy to reduce myopia
7. Behavioural approaches to the treatment of strabismus and amblyopia
8. Training central and peripheral awareness and syntonics
9. Sports vision therapy
10. Neurological disorders and neurorehabilitation after trauma/stroke
Behavioral Management Approaches

“A large majority of behavioural management approaches are not evidence-based, and thus cannot be advocated.”

-BT Barrett, UK, 2009
“Although there are areas where the available evidence is consistent with claims made by behavioural optometrists (most notably in relation to the treatment of convergence insufficiency, the use of yoked prisms in neurological patients, and in vision rehabilitation after brain disease/injury.”

-BT Barrett, UK, 2009
Non-strabismic Visual Therapy and Learning

The American Optometric Association, the American Academy of Optometry, the College of Optometrists in Vision Development, and the Optometric Extension Program, support the assertion that non-strabismic visual therapy does not directly treat learning disorders, but rather addresses underlying visual problems which are claimed to affect learning potential.
Individual Vision Therapy

• Provides screened assessments of impairment and recommendations for therapy
• Exercises for convergence, ocular motility, accommodation, visual scanning, ptosis, awareness of deficits, visual perception disorders
• Refer for consultation with ocular specialists in the community.
• Attend community appointments with specialists as requested
• Presentation of room or home settings
• Use of prosthetics such as patching, lenses, prisms
• Unit programs or daily homework
• Vision exercises
• Recommendations for specialists in the community
• Recommendations for further exams (vestibular, visual perception)
• Counseling and education of client, family or caregiver of visual problems, functional implication, goals, prognosis, and strategies
Vision Screen
<table>
<thead>
<tr>
<th>Personal Account</th>
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</table>
| **Double Vision**
Bumping into things on R/L
Out of focus
Eye infections
Difficulty reading
Glaucoma |
| **Halos**
Watery eyes
Itchy eyes
Dry eyes
Flashes of light
Use eyedrops |
| **Headaches**
Diabetes
Thyroid
Floaters
Photophobic
Cataracts |
Treatments for Vision Impairments

Glasses: Bifocals, lined or progressive

Readers: Tint

Eye injuries

Eye surgeries:
- Cataract?
- Glaucoma?
Personal Presentation
Pupil Size and Constriction
Pupil Alignment
Pursuits

- OS
- OD
- Binocular
Evidence of Strabismus

OS: hyper hypo exophoric exotropicle esophoric esotropicle wnl

OD: hyper hypo exophoric exotropicle esophoric esotropicle wnl
Fixation

Gaze in affected eye for __________ seconds
• Convergence: breaks at ________ inches
• Eye wanders at break:
• OS OD alternates wnl
Confrontation

Sees stimuli ___ degrees left of OD midline
___ degrees right of OD midline

Sees stimuli ___ degrees left of OS midline
___ degrees right of OS midline
Acuity

Distance of Ten Feet Acuity
OS: 20/___  OD: 20/___  Bi: 20/____

Near Distance Acuity w/o Glasses
OS: 20/___  OD: 20/___  Bi: 20/____

Near Distance Acuity with Glasses
OS: 20/___  OD: 20/___  Bi: 20/______
Nystagmus

OS: Horizontal    vertical
     Only outer extremes in pursuits    wnl

OD: Horizontal    vertical
     Only outer extremes in pursuits    wnl
Room Scan

Systematic search  Random search

Slow scan  Misses more on  L  R
Visual Processing Speed

Delayed:

Severe   Mod   Min   Shadow   WNL
Visual Cancellation

- Random scan  Slow Scan
- Misses more on  L / R
- Systematic scan
12 Point Font at Near Distance Reading

- Inches held from eyes OS _____ OD _____
- Laborious reading
- Skips lines
- Neglects R L
- No problems noted ________________
Community Store Scan/Search

Search of aisles: random systematic

# of distractions: _______

Use of signs: yes no

# found on left: _____/10

# found on right: _____/10

Total time: ____________
Driving Search

Items found on left

Items found on right

Number of omissions
Recommendations for Further Exams

Vestibular, visual perception
Recommendations for Specialists in the Community
Vision Exercises
Unit Programs or Daily Homework
Use of prosthetics such as patching, lenses, prisms
Presentation of Room or Home Settings
Counseling and education of client, family or caregiver of visual problems, functional implication, goals, prognosis, and strategies
References

http://www.strokeassociation.org/STROKEORG/LifeAfterStroke/RegainingIndependence/PhysicalChallenges/Vision-Disturbances-After-

http://www.stroke.org/we-can-help/survivors/stroke-recovery/post-stroke-conditions/physical/vision

http://www.visiontherapysuccess.com/headtrauma.php

theatlantic.com/health/archive/2013/09/living-with-face-blindness/279898/

http://dx.doi.org/10A Prospective Profile of Visual Field Loss following Stroke: Prevalence, Type, Rehabilitation, and Outcome.1155/2013/719096
