Low Vision, Visual Dysfunction and TBI – Treatment, Considerations, Adaptations

Andrea Hubbard, OTD, OTR/L, LDE
Objectives

In this course, participants will:

1. Learn about interventions involving specialized equipment to adapt an environment for clients with low vision.
2. Learn about the most typical low vision presentations/conditions.
3. Gain increased knowledge of eye anatomy and the visual pathway.
Overview of TBI

Leading Causes of TBI

- Falls, 40.5%
- Struck by/against, 15.5%
- Unknown/Other, 19.0%
- Motor vehicle traffic, 14.3%
- Assaults, 10.7%

Reference: Centers for Disease Control and Prevention
Overview of TBI

Risk Factors for TBI

Among non-fatal TBI-related injuries for 2006–2010:

- Men had higher rates of TBI hospitalizations and ED visits than women.
- Hospitalization rates were highest among persons aged 65 years and older.
- Rates of ED visits were highest for children aged 0-4 years.
- **Falls were the leading cause of TBI-related ED visits for all but one age group.**
  - Assaults were the leading cause of TBI-related ED visits for persons 15 to 24 years of age.
- The leading cause of TBI-related hospitalizations varied by age:
  - Falls were the leading cause among children ages 0-14 and adults 45 years and older.
  - Motor vehicle crashes were the leading cause of hospitalizations for adolescents and persons ages 15-44 years.

Reference: Centers for Disease Control and Prevention
Overview of TBI

Risk Factors for TBI

Among TBI-related deaths in 2006–2010:

- Men were nearly three times as likely to die as women.
- Rates were highest for persons 65 years and older.
- The leading cause of TBI-related death varied by age.
  - Falls were the leading cause of death for persons 65 years or older.
  - Motor vehicle crashes were the leading cause for children and young adults ages 5-24 years.
  - Assaults were the leading cause for children ages 0-4.

Reference: Centers for Disease Control and Prevention
Why Vision Is Important

- A significant portion of sensory input is visual; it is the primary sense used to acquire information about the environment.
- 1/3 – 1/2 of brain is devoted to visual processing pathways
- Individuals with visual impairments seek static environments leading to decreased participation
- Vision allows for quick information processing in environment (safety, judgement, reasoning)

When the visual system is impaired, the impact can be broad across our daily living activities (e.g., reading, driving, school, employment, etc).
Different visual problems occur depending on where the damage is. The black bars (labeled 1-5) indicate where damage may occur and the chart to the right of the pathway indicates the resulting “blind” area (gray shading of visual field).
Visual Pathways

(Image Credit: Retrieved from Bing.com 10/1/2016)
Basic Anatomy Of The Eye
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)

• The process of vision can be broken down into three general categories; 1) visual acuity and visual field, 2) visual motor abilities and 3) visual perceptual. (Politzer, 5/2016)
What Is Vision?

- Visual acuity: refers to clarity of sight, commonly measured using the Snellen chart.
- Visual field: complete central and peripheral range of vision.
- Visual motor abilities: Alignment – this refers to eye posture (position, e.g. straight and aligned, versus abnormal alignments).
  - Fixation, pursuits, saccades, accommodation, convergence, binocularity, stereopsis
What Is Vision?

- Visual perception: visual-motor integration, visual-auditory integration, visual memory, visual closure, spatial relationships, figure-ground discrimination
Common Visual Problems After TBI

- Field loss
- Hemianopsia (loss of half of the field of view to the left or right)
- Quadranopsias
- Central loss, sector loss, peripheral loss
- Total loss of visual field
- Photophobia
- Reading disorders
- Diplopia – exotropia, esotropia, hypertropia
- Cranial nerve paresis/paralysis III, IV, VI, VII
- Small changes in refractive errors more significant
- Nystagmus
- Dry eye – decreased blink rate
Common Visual Problems After TBI

- Visual hallucinations
- Formed – objects
- Unformed – stars, lightning bolts, floaters
- Anisocoria
- Accommodative problems
- Convergence problems
- Eye movement disorders, fixation, pursuits
- Unstable ambient vision
- Visual perceptual disturbances
- Disturbances in body image
Common Visual Problems After TBI

• Disturbances of spatial relationships
• Right – left discrimination problems
• Agnosia – difficulty in object recognition
• Apraxia – difficulty in manipulation of objects
• Psychological problems (withdrawal, depression)
The three most devastating visual problems resulting from TBI are considered to be visual field loss (homonymous hemianopsia), double vision (diplopia), and visual balance disorders. (Politzer, 5/2016)

These three conditions will be briefly discussed, but are beyond the scope or time limits of this webinar as each condition is highly involved with varying degrees of severity.
Homonymous Hemianopsia

• Homonymous hemianopsia refers to the absence of vision towards one side of the visual field in each eye. The damage is not in the eye itself, but in the brain.

• Common symptoms include:
  – Frequently bumping into objects such as door frames or people to affected side
  – Difficulty and uneasiness moving about in crowded areas
  – Tripping/stumbling
  – Startling easily by moving objects or people appearing suddenly
  – Losing place while reading/frustration with reading
  – Struggles to find or misjudges the start or end of a line of print in reading, withdraws from most reading
  – Frequently spills drinks when eating
  – Unsteady balance, may report dizziness
  – Difficulty finding objects on desktop, in closets, etc.
  – May get around well at home, but avoids outside activities (learned boundaries)
Homonymous Hemianopsia

- Attempts to show what a person sees with a homonymous hemianopsia often involve showing a picture, leaving the affected half blank or missing. In reality, to a person with a homonymous hemianopsia, that missing half of the world simply does not exist resulting in a sensation that can not be replicated with a half drawn picture.
Homonymous Hemianopsia

• Example of text as seen with left side hemianopsia:
Homonymous Hemianopsia Treatment/Adaptations

- Reading may be improved through several adaptive strategies, including use of additional senses (touch) to aid in start/stop point, such as raised edges along right and left boundary.
- In particular, reading is more difficulty for those with a right side hemianopsia when reading a language that is read left to right because he or she is reading into the visual field loss. Patients receiving optokinetic therapy read text that moves from right to left on a computer screen for 400 minutes during a four-week period. This forces patients to engage in saccadic movement to the right. Patients enjoyed increased reading speeds compared with baseline and following placebo random saccadic training. Free moving text programs can be accessed at readright.ucl.ac.uk
- Another technique used is holding text at a 90 degree angle to the normal direction so that it is read vertically.
  - Those with left hemianopsia should read from the bottom up, while those with right hemianopsia should read from the top down.
Homonymous Hemianopsia Treatment/Adaptations

• Moving through the environment can be challenging, and dangerous, when one with a homonymous hemianopsia is only seeing half of the visual field. Techniques to minimize risk of falls or injury include:
  – Letting the person’s partner walk on the affected side and have the patient take their arm.
  – Encourage eye and head movements to the affected side – environmental scanning. This will require significant practice to develop an ongoing habit.
  – Visual scanning can include timed intervals via “clickers” for rhythmic scanning.
Homonymous hemianopsia will absolutely present difficulties during ADLs. Again, scanning the environment is going to be a crucial aspect and one of the simplest adaptations made to overcome this deficit. During mealtimes, place spillable items such as drinks to the unaffected side or well within visual field. Encourage scanning. Within the home, keep walkways clear and furniture changes to a minimum. When there are changes, encourage relearning, because it is likely that scanning is going to take place less in a well known environment such as home. If there is a stair case or steps that must be negotiated, ensure there is a railing up on either side to avoid falls.
Double Vision (diplopia)

- Double vision is a very troublesome visual disorder leading to severe and frustrating deficits. Double vision may be constant or intermittent.

- Our eyes must point precisely at the same point in space to prevent diplopia or double vision. Each eye has six external muscles that move the eyes together as a team. If control is impaired to one or more muscles, the eyes cannot maintain alignment in all positions of gaze. This may occur due to damage to the control centers for the III, IV and VI cranial nerves. Double vision may be constant or intermittent. The patient may experience normal single vision in the straight ahead position, but suddenly have double vision on looking to one side.
Double Vision (diplopia)

• Symptoms are as obvious as the name sounds. However, if the patient is unable to state what the problem is, you may notice things such as covering one eye, missing “targets” when reaching for things, difficulty going up or down steps (depth perception issues). Again, the double vision may be a constant problem, or may come and go.

• The degree of severity may also vary in intensity. This may be related to physical fatigue throughout the day, exposure to light, illness, or eye strain from reading, tv watching/computer screens.
Double Vision (diplopia)
Double vision makes it difficult to read and comprehend.
Double Vision (diplopia)

Treatment Options

- **Prisms**: A prism is a wedge-shaped piece of glass or plastic that bends the light that shines though it. Special prisms called Fresnel (pronounced "frennel") prisms can be attached to your glasses, and are an effective way of treating double vision. Fresnel prisms are thin, see-through sheets of plastic. One side sticks to the lens of your glasses and the other side has special grooves in it that change the way the light enters your eye. You may need to wear prisms for several months. The strength can be adjusted to suit your eyes. If the Fresnel prisms are successful, glasses can be made with the prisms built in.

- **Patches**: With brain injury, typically double vision is binocular in nature (occurring with both eyes open). Patching one eye eliminates the double vision but creates a new problem – monocular vision which reduces depth perception as well as creates a loss of peripheral vision and decreased range of visual field on side patched. Other deficits as a result of monocular vision are eye hand coordination, impaired balance and general mobility issues as a result of these.

- **Partial Patching/Spot Patching**: A relatively new technique, partial patching, or spot patching consists of placing an opaque, round or oval patch made of dermacil, 3M blurring film (or other tape). It is placed on the inside of the lenses of glasses and directly in the line of sight contributing to the diplopia. The size of the patch is generally about 1cm in diameter, but may vary per individual needs determined on testing.
Visual Balance Disorders

• The visual system is an significant part of our balance, contributing to our righting reflex as well as awareness in space. With visual deficits, balance can and usually does become impaired. This significantly impairs safety, increasing risk of falls and creates social barriers as patients limit their outings.

• Approximately 20% of the nerve fibers from the eyes interact with the vestibular system.
Visual Midline Shift Syndrome (VMSS)

- Visual balance disorders can be caused by a Visual Midline Shift Syndrome (VMSS), oculo-motor dysfunction in fixations, nystagmus, and disruptions of central and peripheral visual processing.
- VMSS is caused by distortions of the spatial system causing the individual to misperceive their position in their environment (lack of spatial awareness). Visual field loss following a TBI can influence a shift in visual midline causing a VMSS. A homonymous hemianopsia frequently occurs following a CVA. When a homonymous hemianopsia occurs after a TBI, the bilateral field loss causes the visual concept of the midline to become centered in the remaining portion of the visual field.
- Symptoms noted include the patient leaning to one side, forward and/or backward.
• When the visual midline shifts, it causes the person to unconsciously think that the body center is shifted in the direction of the visual midline. In turn, the person will lean toward the midline shift. This can cause problems with balance, center of gravity, weight bearing, transfer, or ambulation (walking).

• For example, if a hemiparesis or hemiplegia has occurred with the brain injury, a lateral shift in visual midline may cause the patient to posture laterally away from the affected side. Some patients may have an anterior visual midline shift, causing a forward lean (flexion), or a posterior midline shift, causing a backward lean (extension). When a patient develops a visual midline shift, physical therapy or occupational therapy treatments for balance, transfer, or ambulation may plateau.
VMSS Treatment Techniques

- Yoked prism glasses are prescribed by optometrists skilled in neuro-optometric rehab for patients with midline shift. Yoked prisms alter a patient’s perception of visual space and increase the patient’s ability to transfer their weight to achieve better posture and balance. Glasses are not worn constantly, but rather worn for intervals during occupational or physical therapy sessions. The therapist keeps the prescribing optometric physician informed about the patient’s response to the prescribed yoked prism during therapy sessions.
Visual Balance Disorders
Eye Movement Disorders

- Eye movement disorders may present as instability of gaze (nystagmus), eye tracking (pursuits), or visual scanning (saccades).
- With an acute onset of nystagmus, the brain interprets that the world and objects in it are moving. This is referred to as oscillopsia and will frequently cause dizziness and balance problems. If there is diplopia present with the nystagmus, prism and/or partial selective occlusion may reduce symptoms. Head position and direction of gaze may help compensate for the oscillopsia by finding a null point where the nystagmus is decreased.
- Tracking and scanning exercises may be completed during therapy sessions or as a prescribed home exercise program.

Reference: Centers for Disease Control and Prevention
Example Of Saccade Exercise

- Download and print this worksheet. **FOUR SQUARE SACCADES**
- Cut the worksheet up into four squares and tape the squares on a wall, each 3-4 feet apart.
- Stand 10-15 feet away.
- Read the first letter on the first line from each square, then second letter from each square, etc., working all the way through every letter on all four squares until you reach the end.
- Remember to move only your eyes and not your head.
- Bring it Home: Add a motor demand. Perform the task while walking forward heel-to-toe toward the squares and then walking backwards toe-to-heel while reading the letters.

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V S X P E  O E A N C
E A N C B  G D B K E
D B K E P  P S M A R
S M A R D  U A X S O
A X S O G  S N C T K
F N P V D  N C B K F
B A K O E  K E P M A
T H W F M  A R D L G
X F R T O  S O G P B
A D V S X  T K U Z L
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The visual problems of traumatic brain injury may affect nearly all aspects of vision and can hinder rehabilitation efforts. Early vision evaluation is crucial. A clinician skilled in both low vision and brain injury is often needed to understand the interaction of all of these visual problems in order to make the appropriate low vision rehabilitation plan for each patient with traumatic brain injury. The long road back from brain injury requires the teamwork of many doctors, therapists, and often neuro-opthalmologists throughout the rehabilitative process.

http://eyecanlearn.com/
Resources For Visually Impaired

• Each state has a department of the blind
• Lions Club
• NORA
• American Optometric Association
• American Occupational Therapy Association
• State Occupational Therapy Associations
• The Hadley School for the Blind
• The Low Vision Centers of Indiana
• Neuro-Optometric Rehabilitation Association
Resources For Adaptive Devices / Technology

• **Beyond Sight**
  5650 S. Windemere Street
  Littleton, CO 80120
  303-795-6455
  Fax: 303-795-6425
  To send an e-mail, go to [http://www.beyondsight.com/contact_us.php](http://www.beyondsight.com/contact_us.php)
  [www.beyondsight.com](http://www.beyondsight.com)

• **Maxi-Aids, Inc.**
  42 Executive Blvd.
  Farmingdale, NY 11735
  To order, call 1-800-522-6294.
  For information, call (631) 752-0521.
  Fax: (631) 752-0689
  TTY: (631) 752-0738
  To send an e-mail, go to [www.maxiaids.com/contactUs](http://www.maxiaids.com/contactUs)
Questions

Andrea.Hubbard@NeuroRestorative.com
(270) 442-9502 Ext. 215

Thank you for your attention!
References


Neuroscience for Kids – Visual Pathway