Clinical Evaluation and Management of Visual and Perceptual Impairments following Brain Injury

Amy Berryman, OTR MSHSA
Karen Rasavage, OTR

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Objectives

1. Apply knowledge of common visual terminology.
2. Describe common visual perceptual impairments with acquired brain injury and how they impact balance and mobility.
3. Perform a basic vision screening for referral to a vision specialist.
4. Integrate visually related treatment techniques into treatment.
Interdisciplinary rehabilitation

“Greatest challenge as a team is to know enough about the client, each other’s profession, and the rehabilitation process to give better feedback to each other and the client”

— Waleed Al-Oboudi
Sensorimotor Rehabilitation

A challenge in sensorimotor rehabilitation is to know enough about the sensory systems, how they communicate with one another, the impact they have on motor output, and related rehabilitation techniques to give better feedback the brain for learning.
Vision and Brain Injury

• Aspects of vision present in all lobes of the brain
• Over half of people with traumatic brain injury experience some type of injury-related visual impairment
• Devastating symptoms can result: blurry vision, dizziness, headaches, incoordination, imbalance, inattention, fatigue
Vision and Brain Injury

• The ultimate purpose of the visual process is to arrive at an appropriate motor, and/or cognitive response
• Vision is highly adaptive and flexible
• Can be remediated, and can be used to assist with learning in rehabilitation
• Is addressed in some capacity by all rehabilitation disciplines!
Foundational Thoughts: A Definition of Vision

“Vision is a dynamic, interactive process of motor and sensory function mediated by the eyes for the purpose of simultaneous organization of posture, movement, spatial orientation, manipulation of the environment, and, to its highest degree, perception and thought.”

William Padula, OD
Foundational thoughts:
Primary visual systems

Peripheral Vision  
(motion)

Foveal Vision  
(focus)
Peripheral (Ambient) Visual System

“WHERE AM I?”/“WHERE IS IT?”

“The forest”

Function:

- Movement detection
- Anticipating changes in balance, posture, movement
- Space and time orientation
- Verticality/midline awareness
- Visual-motor integration
- “Visual flow”
Central Visual System
“WHAT IS IT?”
“The Trees”

Function:
• Recognition
  – Symbols, objects, faces, etc.
• Comparison
  – Shapes, sizes, forms, etc.
• Sequential processing
• Visual cognition
Foundational Thoughts: Sensory Integration
Foundational Thoughts: Balance/Postural Control

From Balance Master® Laboratory Manual (pg. 4) (NeuroCom® International, Inc, Clackamas, OR)
Common Injury-Related Visual Impairments and their Impact on Balance, Posture and Mobility

- Visual Acuity
- Eye alignment
- Oculomotility
- Visual Field
- Visual Inattention
Visual Acuity: Function

- Function: Ability to see clearly
  - Myopia (Near-sighted)
  - Hyperopia (Far-sighted)
  - Astigmatism
  - Presbyopia
  - Optic nerve damage (CN II)
Visual Acuity: Central/Peripheral Integration

- Primarily central
- Impact of trauma
Visual Acuity: Impact on Balance, Mobility, Posture

• Myopia (nearsighted):
  – Mild impact, if any
  – Will squint when looking far away
  – May slow down ambulation

• Hyperopia (farsighted):
  – Will lean forward or back to get images clear when reading
  – Complaints of neck tension or headaches
  – Leaning forward with reading tasks
Visual Acuity: Impact on Balance, Mobility, Posture

- Optic Nerve Damage
  - Impaired depth perception
    - Visual-spatial mismatch with motor activity
    - Slowed ambulation
    - Colliding with objects
    - Compensatory Head Turns
Visual Acuity: Treatment Approach

• Lenses, prescribed by a vision specialist
• Altering size and shape of text

• Optic nerve damage
  – Depth perception retraining
  – Functional scanning
  – Parallax
Oculomotility: Function

- Ocular Fixations
  - Hold eyes steady while focusing
- Pursuits
  - Tracking objects
- Saccades
  - Shifting gaze/focus
- Convergence:
  - Hold an image single as it moves toward the body
- VOR
  - Stabilize gaze while head is moving
Oculomotility: Central/Peripheral Integration

– The peripheral (spatial) system directs and controls eye movements to allow for central processing
  
  – Fixations
  – Pursuits
  – Saccades
  – Convergence
Oculomotility: Impact on Balance, Mobility, Posture

• Ocular Fixations
  – Nystagmus
  – Imbalance
  – Dizziness
  – Reduced head and neck mobility “stiff” posture
  – Head turn or tilt to avoid directional nystagmus

• Pursuits
  – Eyes and head moving together
  – Imbalance
  – Dizziness
  – Inability to move and process at same time
Oculomotility: Impact on Balance, Mobility, Posture

• Saccades
  – Dizziness
  – Imbalance
  – Postural and attentional preference toward areas with faster saccades
  – Eyes and head moving together when scanning and ambulating
Oculomotility: Impact on Balance, Mobility, Posture

• Convergence
  – Double vision
    • Squinting
    • Turning head to get objects single (shift from midline)
  – Under-convergence:
    • Poor attention/Impulsivity
    • Difficulty sitting still
    • Leaning back
    • Neck strain/headaches
  – Over-convergence:
    • Overly focused
    • Fearful of movement
  – Imbalance
Oculomotility: Impact on Balance, Mobility, Posture

• VOR
  – Dizziness
  – Slowed ambulation
  – Wide base of support
  – Fearful of movement
Oculomotility: Treatment Approach

• Reduce double vision through compensatory and remedial means
• Provide support for central/peripheral interplay with patching
• Improve quality and accuracy of eye movements with therapy
• Improve central/peripheral interplay with therapy
Cranial Nerves III, IV, VI: Function

III (oculomotor):
  open eyelid, move eye up and down, adduct eye

IV: adduct eye when depressed intorsion/extorsion

VI: abduct eye
Cranial Nerve III Palsy: Impact on Balance, Mobility, Posture

• Head turn toward unaffected eye, impacting midline awareness
• Affected eye loses proprioceptive awareness and causes imbalance when other eye is covered
• Reduced depth perception
Cranial Nerve IV Palsy: Impact on Balance, Mobility, Posture

- Head tilt, impacting midline awareness
- Visuospatial mismatch in downgaze
  * tripping, missing curbs
- Tilting chin down when walking
Cranial Nerve VI palsy: Impact on Balance, Mobility, Posture

• Head turn toward affected eye, impacting midline awareness

• Affected eye loses proprioceptive awareness and causes imbalance when other eye is covered
Cranial Nerve Palsy: General Impact on Balance, Mobility, Posture

- Slow, unsteady gait from double vision
- Abnormal body positioning
- Unsteady gait
- Poor eye-hand coordination
- Poor attention
- Decreased depth perception
Cranial Nerve Palsy: Treatment Approaches

• Maximize visual comfort
  – Partial patching
  – Eye protection
  – Positioning

• Work with a vision specialist to determine course of treatment: remediation vs compensation

• Restore Range, Spatial Awareness
Visual Field: Function

• Anticipatory system

• Normal Visual Field
  – 60 degrees nasal
  – 100 degrees temporal
  – 60 degrees above horizontal
  – 75 degrees below horizontal
Visual Field: Central/Peripheral Integration

• Primarily Peripheral function
Visual fields

upper quadrants

lower quadrants

nose

retinal ganglion cell

optic nerve

chiasm

tract

lateral geniculate nucleus

temporal loop of visual radiation

primary visual cortex

Visual Field Defects

L

R

1

2

3

4

5

6

7

8
Visual Field Impairment: Impact on Balance, Mobility, Posture

- Decreased scanning/head turning in direction of field defect
- Decreased anticipation and response to stimuli in impaired field when ambulating
- Posture changes in relation to field defect
  - Head turn or tilt
  - Leaning away
- Impaired eye-hand coordination in impaired field
Visual Field Impairment: Treatment approaches

Increase awareness of field cut and improve scanning to impaired area

Re-establish normal midline orientation
Visual Inattention

• Alternate terminology: visual neglect, unilateral spatial inattention, unilateral spatial neglect, hemi-imperception, etc.
• Definition: Inattentiveness/imperception of one half of the visual field contralateral to lesion; perception of one side not existing
• Can occur with or without body/motor inattention
• Can occur with or without hemianopsia
• Extinction phenomenon
Visual Inattention: Impact on Balance, Mobility, Posture

- Head turn to right or left away from neglected field
- Eye movements reduced toward neglected field
- Difficulty crossing midline
- Collisions with objects on side of neglected field
- Leaning to left or right away from neglected field
Visual Inattention: Treatment Approaches

• Initially address patient on intact side during treatment for training, then move into neglected field as attention improves

• Use auditory, proprioceptive, and tactile cues to reinforce presence of neglected field

• Provide visual-motor coordination activities challenging field awareness, crossing midline, and localization
Visual Inattention: A Thought

Sensory Input in Hemiparesis
Other Notable Vision Impairments

Cranial Nerve VII palsy

Tersens Syndrome

Cortical Visual Impairment
Summary: Think *spatial*

Vision is more than 20/20!

Central/Peripheral Integration can be impacted without a specific vision impairment diagnosis, and can be used to influence and improve balance, posture, mobility
Vision Screening

Evaluation → Treatment
Vision Screen: Key Components

- History
- Patient complaints
- Acuity
- Oculomotility
- Eye Alignment
- Near Point of Convergence
- Visual Fields
- Functional observations
Vision Screening

Therapist: ___________________________ Date: ____________

Name: ___________________________ Age: ___ Date of Injury: ____________ Dx: ____________

History: ____________________________________________________________

Visual Complaints: ______________________________________________________

Visual Acuity:

<table>
<thead>
<tr>
<th>Without correction distance</th>
<th>With correction distance</th>
<th>Without correction near</th>
<th>With correction near</th>
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Oculomotor:

Ocular Fixations: steady unsteady nystagmus other: __________________________

Ocular Pursuits:

- Quality
- Description
- Comments

Gaze Stabilization:

- Quality
- Comments

Ocular Saccades:

- Quality
- Description
- Comments

Eye Alignment:

Hirschberg test:

[Diagram of Hirschberg test]

Near Point of Convergence (2-4 inches WNL):

__________ inches observations

Confrontation Visual Fields:

[Diagram of confrontation visual fields] R Eye L eye

Comments: ____________________________________________________________

Therapist Comments/Observations: __________________________________________

Assessment: ____________________________________________________________________________

Plan: ____________________________________________________________________________________

Tom Politzer, OD, FCOVD, FAAO, Amy Berreyman, OTR, and Karen Rasavage, OTR
Vision Screen: Acuity

• “Functional” acuity:
  – 20/40

• Near

• Far
Vision Screen: Oculomotility

• Demonstrate and Practice:
  – Fixations
  – Pursuits
  – Saccades
  – Convergence

  – VOR
Hirschberg Test Results

Vision Screen: Eye Alignment

EXOTROPIA

ESOTROPIA

HYPOTROPIA

HYPERTROPIA
Vision Screen: Visual Fields

![Normal Visual Fields]

Left Eye

Right Eye

![Right Homonymous Hemianopia]

Left Eye

Right Eye
Vision Screen: Inattention Extinction Test
Screening: Referral Criteria

- Decreased acuity
- Nystagmus
- Limited ROM
- Eye turn/misalignment
- Decreased convergence
- Suspected field loss
- Questionable eye health
Who to Refer to?

• Optometrist: lenses, prisms, vision rehabilitation
  – Neuro-optometrist
  – Rehabilitation optometrist

• Ophthalmologist: lenses, eye health, surgical issues
  – MD, eye health

Optometrist locators:
• Neuro Optometric Rehabilitation Association
  – www.nora.cc
• College of Optometrists in Vision Development
  – www.covd.org
Vision Collaboration Model
Integrating Vision into Treatment

- Visual Analysis/Processing Speed
- Scanning
- Convergence/Accommodation
- Visual Motor
- Oculomotility
- Body Awareness

**Spatial Awareness and Automaticity throughout**
Spot Patching for Double Vision

Purpose: Reduce central double vision while maintaining peripheral visual input. Allows for midline better orientation of head and neck.
Spot Patching: Central/Peripheral Integration

Purpose: Give “boundaries” to help simplify and guide input
Optometric Tool: Fresnel Prisms
Midline Orientation/Postural Awareness: Yoked Prism

Purpose: Yoked prisms symmetrically shift visual images in the direction of the apex of the prism. This can drive postural changes and visual-motor responses.
Midline Orientation/Postural Awareness: Yoked Prism

Applications:

“Static” (one-directional) application for:
Visual inattention
Toe or heel walking
Veering
Abnormal posture

“Dynamic” (rotational) application for:
Visual dominance
Visual motion hypersensitivity
Visual motor organization
Midline Orientation/Postural Awareness: Rotating Yoked Prism
Midline Orientation/Postural Awareness: Sensory Stretches

• Purpose: Give increased proprioceptive and input to the eyes in the orbit, like an “isometric” exercise, using other sensory modalities to reinforce

• Applications:
  – Dizziness and imbalance
  – Postural awareness/shift
  – Increase ROM
Central/Peripheral Visual System Integration

• Foggy Glasses
  – Purpose: Reduce visual fixation when moving in space, force peripheral processing

  – Applications: Visual motion hypersensitivity, visual dominance
Central/Peripheral Visual System Integration

Purpose: use central and peripheral systems simultaneously

Applications: Any oculomotor problems, Imbalance, Visual motion hypersensitivity
Central/Peripheral Visual System Integration

Central Processing activities while walking or balancing

Demonstrate:
- Peripheral Presentation of colored dots
- Partner juggle while walking
- Integrate visual activities while balancing
Eye and Head movements: adding a central/peripheral visual component to motion hypersensitivity exercise

- Visual fixation points with head turns
- Kirschner Arrows
Treating Visual Impairments Using Vestibular System Input

• VOR for:
  – ROM in cranial nerve impairment or palsies
  – Improved pursuit
  – Preparatory changes in posture

• Post-rotary nystagmus for:
  – Visual inattention
Depth Perception Training

• Parallax activities

• Adding visual motor activities to balance and mobility:
  – Bean bag toss
  – Marsden ball
Building Automaticity

- Increase complexity in another sensory system while working on vision

  - Cognitive “loading”
Summary

• Vision is more than just 20/20
• Central/Peripheral integration is a key concept for vision rehabilitation
• Vision screen guides referrals and treatment
• Spot patching is preferred over black patching to maintain ambient vision
• As physical therapists, you can help vision treatment by integrating spatial and oculomotor aspects into treatment
A note on research…
Objective Review

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Questions/Discussion
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