Vision and ABI: A Rehabilitation Approach

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Lisa Griffiths, ABI patient & ABI Mom

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I see, I see

Tanya Polonenko, practitioner
I see, I see

Lisa Griffiths,
living with ABI
It’s not what you look at that matters, It’s what you see ~ Henry David Thoreau
Lecture Outline

- What is Vision?
- Vision and ABI
- Symptoms of inefficient vision
- Vision Rehabilitation
  - Neuroplasticity
  - Goals and Improvements
  - Sample Exercises
  - Does it work?
Q: What is vision?

A: Vision is the ability to make a meaningful interpretation of what is seen.
Vision requires more than having 20/20 eyesight.

A child who sees like this has 20/20 vision.

We need to gather and interpret visual information.
There is so much more to vision than meets the eye. How are you supposed to read this easily if it is moving around or going blurry?
How does ABI affect vision?

70% of our brain is involved with vision
“When vision is working well, it guides and leads in all that we do; when not, it interferes.”

- John Streff, O.D.
Visual functional skills:
“how info gets into the brain”

These skills determine the speed, accuracy, endurance and comfort of gathering visual information:

- Eye Focusing (Accommodation)
- Eye Teaming (Binocularity)
- Eye Tracking (Ocular Motility)
- Visual-Vestibular Interaction
- Visual Field
- Aiming/Aligning (Fixation)
Visual perceptual skills:
“what the brain does with visual info”
I'M SO TIRED
The mind-eye connection

- **What do I do about it?**
- **What is it?**
  - Focusing, following
  - Targets
- **Where is it?**
  - Aiming, scanning space
  - Background
- **When is it?**
  - Time judgement
  - context
- **Who am I?**
  - How do I feel about it?
  - Attention to detail
    - Intentional movement
    - Awareness of context
    - Habitual/anticipatory movement
- **Where am I?**
- **How Am I?**
  - Electrical signals
  - Chemical signals
26-50% of those with ABI reported trouble with their vision most of the time.

The OBIA Impact Report 2012 https://www.ontario.ca/img/ontario@2x-print.png

Reduced ability to use vision

Either:
- Vision getting to the brain
- Brain processing visual info

...or both
Post Trauma Vision Syndrome

The visual component to post concussion syndrome
# Post Traumatic Vision Syndrome

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Deficits</th>
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</thead>
<tbody>
<tr>
<td>Blur (sometimes intermittent)</td>
<td>Accommodative dysfunction</td>
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<tr>
<td>Trouble focusing</td>
<td>Vergence issues / misalignment</td>
</tr>
<tr>
<td>Double vision</td>
<td>Oculomotor abnormalities</td>
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<tr>
<td>Eye strain/fatigue</td>
<td>Visual field defects</td>
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<tr>
<td>Headaches</td>
<td>Perception deficits</td>
</tr>
<tr>
<td>Difficulty tracking</td>
<td>Visual inattention (Neglect)</td>
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<td>Slow visuomotor performance</td>
<td>Perceived visual midline shift</td>
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<tr>
<td>Difficulties with balance and posture</td>
<td>Visual-vestibular</td>
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<tr>
<td>Glare sensitivity and photophobia</td>
<td>Dry eye</td>
</tr>
</tbody>
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Behavioural Implications to Vision

- Fatigue
- Reduced confidence
- Anxiety & uncertainty
- Passive in decision making
- Difficulty with dynamic environments
- Fear of falling
- Community activities become challenging:
  - Driving
  - Shopping
  - Working
  - Sports, leisure interests
So tired
Accommodation

- How well our eyes can change its focus for different distances
  - Ability
  - Flexibility
  - Sustained over time

- Symptoms
  - Headache
  - Blurred vision
  - Eye strain
  - Fatigue
Vergence

- How well the eyes are working together as a team

- Symptoms:
  - Double vision
  - Eyestrain
  - Depth perception struggles
  - Clumsiness
Vergence

- Coping Mechanisms
  - Falls asleep while reading
  - Avoids visual tasks
  - Squints
  - Closes an eye
  - Nausea/dizziness
Oculomotor

There are many areas of the brain needed for tracking:

- Cerebral
  - Control of saccades and pursuits

- Brainstem
  - Horizontal and Vertical Gaze Centers

- Cranial Nuclei
  - Control of eye muscles

- Extra-ocular Muscles
  - Execute the eye movements
Associated Symptoms

Reading difficulties:
- Slower reading speed
- Loss of place / skipping lines
- Missing words
- Poor comprehension
- Print seems to move / swim / jumble
- Nausea / dizziness
Oculomotor and Vestibular Systems

- Vision integrates with balance through the Vestibular Ocular Reflex (VOR)
- Keeps vision stable when you are moving
Associated Symptoms

- Imbalance and sensitivity to visually-stimulating environments
  - Grocery stores
  - Malls
  - Restaurants

- Dizziness/Nausea/Vertigo with visual tasks
  - TV
  - Reading, computer
  - Driving
I can't even
Visual Field Loss in ABI

- Vision loss in 32-65% of ABI
- May occur due to damage to the eye, optic nerve, or brain
Implications of Visual Field Loss

- Missing Information
- More time needed
Visual Midline Shift Syndrome

- Abnormal Egocentric Localization
- Deviated perception of visual midline
  - Poor eye/hand coordination
  - Postural changes
  - Diminished ability to navigate environment
Visual Information Processing

- Prognosis guarded with severe ABI

- Goal of therapy:
  - create strategies that maximize performance

- Strategies:
  - Auditory strategies
  - repetition
  - different viewing perspectives
Photosensitivity

- Elevated sensitivity to lights
- Dark and light adaptation problems
- Tints/Filters beneficial
Treatment Options
Treatment: Vision

- Balanced Prescription
- Glasses or Contact Lenses
- Filters
- Yoked prism
- Occlusion
- Vision Therapy
What is Vision Rehabilitation?

An individualized treatment regimen prescribed to a patient in order to:

- Provide medically necessary treatment to normalize diagnosed visual dysfunctions
  - Vergence
  - Accommodation
  - Oculomotor

- Improve visual comfort, ease, efficiency, and processing
Neuroplasticity and Therapy

- Brain (visual system) is able to create new connections and fortify old ones by experience.

- Learning and plasticity can occur by myelination formation or re-modeling white matter.

- Neurogenesis continues throughout lifetime.
Goals of Vision Therapy

- Alleviate signs and symptoms
- Achieve desired visual outcomes
- Improve quality of life
- Return to daily activities
Improvements to Expect

- Oculomotor Skills
  - Accuracy and speed
  - Span of recognition
  - Reduced re-fixations and regressions while reading

- Vergence & Accommodation
  - Ability, speed, flexibility
  - Quality and stability of vision
  - Reduced symptoms

Comfort + Efficiency + Accuracy = Performance
Managing Expectations

- Rehabilitation is a process that takes time
- Initially can cause exacerbated symptoms
- Manage the increased symptoms while strength training
General Therapy Sequence

Phase 1
- Awareness

Phase 2
- Monocular

Phase 3
- Bi-ocular

Phase 4
- Binocular
  - Integration
  - Flexibility
  - Stamina

Phase 5
- Integration
- Flexibility
- Stamina
Eye Focusing Training

- Train by using lenses or changing distances
Eye Teaming Training
Space matching
Scanning
Scanning
Scanning
Scanning
Scanning
Visual-Spatial Organization
The struggle is real.
Yoked Prism

- More efficient information processing

- Influences *plasticity* of multi-sensory integration processes and cognitive processes related to mental representation of visual space (Rode 2001)
  - Alters body posture
  - Changes center of gravity
  - Improve higher cognitive levels
  - Assists in judging distance and stabilization
Life Therapy

- Meal Times
  - Prep
  - Eating arrangement

- Navigation
  - Walk, maps
  - Website

- Recreational
  - Virtual Reality
  - Board Games
  - Bocce Ball
  - Mini Golf
DOES IT WORK?
VT improves Vergence and Accommodation in Adults with mTBI

- 12 non-strabismic individuals with mTBI and diagnosed vergence and accommodative disorders participated

- 6 weeks (2 sessions/wk, 3 hours each); half did oculomotor training (OMT) and half did placebo (P) training

**Results:**
- Improved amplitude and peak velocity of
  - vergence (pfv and nvf)
  - accommodation (monocular and binocular)
- Improved stereoacuity
- Improved visual attention
- Reduced near symptoms (CISS score)
- No change in patients that did placebo VT

VT improves eye movements, reading rate, visual attention

- 12 subjects with mTBI participated in either oculomotor training (OMT) or sham training (ST).
- 6 weeks, 2 sessions a week. Trained vergence, accommodation, version in randomized order across sessions.
- Visual attention assessed by VSAT

Results:
- Over 80% of abnormal parameters significantly improved
- Reading rate improved
- Amplitudes of vergence, accommodation improved
- Saccadic eye movements improved in rhythmicity and accuracy
- Improved visual attention and CISS score

VT improves eye movements and reading ability

- 5 adults with stroke and 9 adults with TBI
- 8 weeks of training, 2 sessions/week

- Training included single- and multiple-line simulated reading, as well as basic versional tracking (fixation, saccade, and pursuit) using infra-red eye movement recording technology

- Internal oculomotor visual feedback in isolation (4 weeks) or concurrent with external oculomotor auditory feedback (4 weeks)

- Results:
  - Improved objective accuracy with versional tracking
  - Improved reading ability

VT improves clinical and fMRI measures in Adults with CI

- 13 control normal BV adults; 4 convergence insufficiency adults
- All participated in 18 hours of VT

Results:
- Reduction in NPC and NPC recovery point
- Reduction in Near Phoria
- Improved PFV, average peak velocity of convergence
- Significant increased functional activity within the frontal areas, cerebellum, and brain stem significantly

fMRI shows brain changes with vergence training

- Functional activity and vergence eye movements were quantified from 7 BV normal and 4 CI patients before and after 18 h of vergence training.

- Results: CI patient measurements after vergence training were more similar to levels observed with BV normal
  - Increased fMRI activity levels
  - Increased speed in convergence response
  - Improvement in CISS score

Vergence peak velocity and phoria improves with VT

- 12 BV normal patients and 4 CI patients. CI patients underwent 18 hours of VT.

- Results: After VT, peak velocity and exophoria magnitude improved significantly in CI patients

Professional team collaboration

- Family Physician
- Occupational Therapist
- Physical Therapist
- Speech and Language Therapist
- Case manager
- Psychologist
- Classroom Teacher and Tutors
- Workplace
Referral Process

- Can book directly for
  - ABI Exam
  - MVA Exam
- Medical history is helpful

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Summary

- ABI can impact many aspects of vision
- The brain is neuroplastic
- Research shows VT improves vision function & quality of life
- In-office VT is most effective; at-home is an option
- ABI is multi-faceted and benefits from a health team
References

- Sutter P and Harvey LH (editors). Vision Rehabilitation: Multidisciplinary Care of the Patient Following Brain Injury. 2011. Taylor and Francis Group, Florida
Questions?
Thank you!

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