Post Traumatic Vision Syndrome: Managing double vision, field deficits and dizziness

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Objectives for Today

- Describe a basic understanding of our two visual processes
- Identify why visual deficits occur after TBI
- Explain how to utilize different treatment options for post traumatic visual syndrome for both adults and children

The Myth of 20/20

Were you taught that the eye is like a camera?

The eye works like a camera…

…but vision takes place in the brain

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What is Vision?

“The global ability of the brain to extract, process and act on information presented to the retina.”

Steven J. Cool, Ph.D.

Definition of Vision

Vision is ...
the deriving of meaning and directing of action, as triggered by light

What is a Vision Problem?

The inability to effectively:
- take in
- process
- integrate
- respond to what is seen

Overview of Neurology in the Visual System

In the thalamic area vision integrates with:
- tactile
- proprioceptive
- vestibular
- auditory
- other systems

The Visual Process

- Clarity of Sight
- Visual information processing
  - Central/Focal processing
  - Peripheral/Ambient processing

Visual Pathways

- Parvocellular (80%)
  - Occipital Lobe
  - What?/Temporal/Ventral

- Magnocellular (18%)
  - Midbrain
  - Where?/Parietal/Dorsal

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Focal Process
“WHAT”
Object identification and recognition
When conflict occurs between visual and motor – vision usually wins.

Ambient Process
“WHERE”
Orientation and Centering:
Possible symptoms:
Spatial disorientation, objects appear to move, staring behavior, poor concentration and attention, poor balance, coordination and posture.

Why Do Visual Deficits Occur After TBI?
- There are over 1,900,000 nerve fibers that exit each eye.
- This represents 70% of the sensory nerve fibers in the body.

Why Do Visual Deficits Occur After TBI?
- Every lobe of the cerebral cortex is involved in the processing of visual information.
- Therefore, the major amount of sensory information received by the human cortex is through the visual system.

Visual Connection
- An injury to any part of the brain will impact the vision system in some way – regardless of where the lesion is in the brain.

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62 consecutive patients entering a rehab hospital with acquired brain injury had a high percentage of treatable vision problems:

- 42% eye-teaming problems
- 40% eye movement problems
- 10% focusing problems
- 32% field defects

Brain injury, developmental delay or sensory integration issues, often cause vision problems which can present with:

1. double vision
2. field loss or neglect
3. dizziness and motion sickness

Brain injury, developmental delay or sensory integration issues, often cause vision problems which can present with:

At least 35 areas of the brain are involved with the processing of visual information

Etiology of Visual Dysfunction

Visual Function depends upon:

- Effective hardware: Structural and physiological integrity
- Appropriate software: How well the systems are utilized

In the same way an individual with a head injury can have deficits in motor and speech functions, there may be deficits with regard to visual function.

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Traumatic Brain Injury and Its Impact on the Visual System

Our vision guides a broad spectrum of human abilities.
- Walking, Judgment of terrain
- Maneuvering between obstacles
- Positioning our car when driving
- Judging rate of approach
- Scanning in a crowd
- Alerting us to danger
- Sports: aiming, hitting and following a ball

Our Vision Guides a Broad Spectrum of Human Abilities
- Tracking and the formation of letters.
- Tracking and the orientation on page.
- Tracking and reading.
- Scanning for books on a shelf.
- Threading a needle.
- Finding food on our plate.

Vision is the Dominant Sense
- 70% of all sensory information is visual.
- 6 of the 12 Cranial nerves help coordinate our vision.
- Vision gathers more data per unit of time.
- Vision tends to override other senses.

Integration
- Need Vision to INTEGRATE with other senses.

Visual Symptoms and Performance Deficits Secondary to Brain Injury

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### Accommodative Dysfunction
Possible Patient Symptoms:
- Blur (even with 20/20)
- Headaches
- Pain
- Double vision
- Eye Strain
- Squinting

### Binocular Dysfunction

#### Strabismus

#### Muscle paresis/paralysis

#### Convergence Insufficiency (extremely common)

### Eyes Have to Point to the Same Place

### Once upon a time, there was a very ugly duckling.
One day a beautiful princess came along and rescued him from a horrible fate. She picked him up into her hands and was ready to kiss him when….

### Binocular Dysfunction
Possible Patient Symptoms:
- Head tilt or head turn
- Diplopia
- Depth/spatial judgments
- Closing one eye
- Eye strain/headaches

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### Disorders of Binocular Vision (Two-Eye Coordination)
- Convergence Insufficiency
- Convergence Excess
- Binocular Instability
- Impaired Stereopsis
- Intermittent or Constant Strabismus

### Strabismus
- Occurs when the eyes are not aligned when viewing an object
- The eye may turn inward toward the nose (esotropia) or outward toward the side (exotropia)
- Any eye turn can happen constantly or occasionally

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**Eyes Have to Point to the Same Place**

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**Patching**

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**American Academy of Pediatrics – Journal Academic Effects of Concussion in Children and Adolescents**
- In this study, the symptoms that were found for post-concussion that interfere with academic performance are very similar to symptoms relating to binocular vision disorders, such as convergence insufficiency.
- According to the optometric literature, vision problems resulting from concussion can cause loss of balance, dizziness, eyestrain and headaches with near work, loss of place while reading, and distance and near blur.
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Clinical Pediatrics – July 2015
Vision Diagnoses Are Common
After Concussion in Adolescents

- A total of 100 adolescents were examined, with a mean age of 14.5 years.
- Overall, 69% had one or more of the following vision diagnoses:
  - accommodative disorders (51%),
  - convergence insufficiency (49%), and
  - saccadic dysfunction (29%)
- In all, 46% of patients had more than one vision diagnosis.

CONCLUSIONS AND GUIDANCE FOR
PHYSICIANS

Students with symptoms lasting longer than 3 to 4 weeks may benefit from a more detailed assessment by a concussion specialist (licensed physician, such as a pediatrician, neurologist, primary care sports medicine specialist, or neurosurgeon with expanded knowledge and experience in pediatric concussion management)...

Adult TBI

- Gianutsos reported that nearly half of persons admitted to a long-term rehabilitation facility after brain injury had visual system deficits, primarily in the area of binocular vision and accommodation.

Other commonly reported vision problems:
- reduced visual acuity
- decreased contrast sensitivity
- visual field deficits and neglect
- strabismus
- oculomotor dysfunction
- accommodative dysfunction
- reduced stereopsis

The injuries may not show up on x-ray, CT scan or MRI

The insult to the cortex produced from a TBI causes stress in the central and autonomic nervous systems

The effect on vision seems to be an interference with the ambient visual process

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Post Traumatic Vision Syndrome (PTVS) Characteristics

- Postulated that the disruption occurs at the level of the midbrain where vision is matched with kinesthetic, proprioceptive and vestibular processes
- Primarily affects peripheral fusion and spatial organization

Post Traumatic Vision Syndrome (PTVS) Characteristics

- Exotropia or high Exophoria
- Convergence Insufficiency
- Accommodative Dysfunction
- Low blink rate

Post Traumatic Vision Syndrome (PTVS) Characteristics

- Spatial disorientation
- Poor fixations and pursuits
- Unstable ambient vision (hate shopping centers, escalators, overwhelmed by moving lights, and moving objects)

Post Traumatic Vision Syndrome (PTVS) Characteristics

- Blurred vision
- Asthenopia – many times severe and out of proportion to findings
- Photophobia (huge problem)
- Diplopia

Ocular Motor Dysfunction

- Limitations of gaze
- Speed and quality of pursuits and saccades

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Ocular Motor Dysfunction

Nystagmus
- Observable rapid eye movements
- Different positions of gaze
- Postural skews to compensate

Post Traumatic Vision Syndrome (PTVS) Characteristics
- Poor concentration and attention
- Objects appear to move
- Associated neuromuscular difficulties with balance, coordination and posture
- Dizziness
- Motion sickness

Visual-Spatial--Visual Information Processing Dysfunctions

Possible Patient Symptoms
- Balance
- Motor coordination problems
- Eye hand coordination
- Left-right confusion

Possible Patient Symptoms
- Disturbances in body image
- Disturbances in spatial relations
- Agnosia – difficulty in object recognition
- Apraxia – difficulty in manipulation of objects

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Possible Patient Symptoms
- Differentiating, analyzing, categorizing, sequencing, etc.
- Visual attention (very common)
- Visual closure – recognizing faces
- Visual memory
- Figure-ground analysis
- Reading
- Writing

Possible Patient Symptoms
- Other:
  - Low blink rate (artificial tears)
  - Staring
  - Dry eye

Common Vision Deficits After Stroke
- Convergence deficits, most common is Convergence Insufficiency
- Impaired depth judgments
- HA’s/eyestrain with near work
- Diplopia, closes one eye

Common Vision Deficits After Stroke
- Diplopia at distance and near, increasing with change of gaze
- Impaired depth and space judgements
- Cranial nerve palsies: 3rd nerve, 6th nerve, 4th nerve

Cranial nerve palsies
- 3rd nerve
- 6th nerve
- 4th nerve

Common Vision Deficits After Stroke
- Left hemispheric stroke may result in right VF defect and right hemiparesis
- Right hemispheric stroke results in left VF defect and left hemiparesis
- May have full hemianopsia or quadrantanopsia
- Visual Field Loss and Neglect
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Hemianopsia

Common Vision Symptoms After Stroke
- Bumps into things on side of VF cut
- Does not see items on side of VF cut (ie: food on plate, finding things in fridge)
  Walks to one side or shifts torso to side

Common Vision Deficits After Stroke
- Visual-Perceptual Deficits
  - Impaired visual memory most common
  - Directional confusion, spatial disorientation, impaired body concept

Visual Perceptual-Motor Dysfunction
- One of the most common and devastating residual impairments resulting from TBI.
- Rehabilitation of Visual Information Processing Deficits can take considerably longer than physical recovery.

Working Together

Optometry
- Ensure that the focal system is working.
- Treat the ambient system.
- Screen the vestibular and motor systems.
- Take history and Refer for OT evaluation.

Occupational Therapy
- Evaluate and treat sensory integration
- Ensure that muscle strength and tone are available, evaluate visual motor and visual perception.
- Screen for visual problems, review PTVS symptoms and refer for specialized vision evaluation.

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OT/PT Screenings
- Symptom checklist
- Eye movement assessment
- Visual field assessment
- Convergence assessment
- Visual perceptual skills assessment

Double Vision
Screening
- What do you use?
- Popsicle stick target
- NPC to the nose or the bridge

Eye Movements
- Observation of both pursuits and saccades with appropriate targets
- Tongue depressors with stickers
- Assess both accuracy and amount of motor support required (head, body, tongue, hand support?)
- Sustainability

Convergence
- Tongue depressor with detailed target
- Subjective response (blur/diplopia)
- Objective response (when do eyes deviate)

Normal findings:
3 inches or closer

Visual Field Assessment
- Assess saccadic eye movements for significant differences in different areas of space
- Standard Confrontation Fields

OT Intervention
- Compensation:
  - Practice Scanning
- Therapeutic Intervention:
  - Improve Visual Field Awareness

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<table>
<thead>
<tr>
<th>Type of Deficit</th>
<th>Compensatory Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agnosia</td>
<td>Augment visual with tactile/auditory stimuli when possible</td>
</tr>
<tr>
<td>Alexia</td>
<td>Utilize pictures and multi-sensory stimuli</td>
</tr>
<tr>
<td>Apraxia</td>
<td>Ocular motor techniques. Augment with verbal and tactile stimuli</td>
</tr>
<tr>
<td>Ataxia</td>
<td>Provide additional proprioceptive and kinesthetic input and cuing</td>
</tr>
<tr>
<td>Depth perception</td>
<td>Emphasize safety issues. Use tactile and kinesthetic reinforcement for tasks such as walking down stairs. Use landmarks for location. Reduce impulsivity with movement.</td>
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Strategies for Patients with Visual Perceptual Deficits

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<tr>
<td>Figure ground</td>
<td>Reduce clutter in visual environment. Use high contrast markers or tape to identify figure. Teach patient to be very systematic when examining a small area.</td>
</tr>
<tr>
<td>Form perception/constancy</td>
<td>Augment visual with tactile, kinesthetic stimuli</td>
</tr>
<tr>
<td>Spatial relations</td>
<td>Use landmarks for location. Have patient orient himself in space and then proceed from object to object.</td>
</tr>
<tr>
<td>Unilateral spatial neglect</td>
<td>Important communication should take place in the field of awareness. Advise safety issues. Augment with verbal and tactile cues.</td>
</tr>
</tbody>
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Planning & Pacing
(aka How you get out of rest)

The Key to Success in Recovery
(Dr. Fitzgerald)

Many of our patients...

Do not see the connection between activities and symptoms.

Some don’t realize it’s the AMOUNT of activity they are doing.

Some don’t realize it’s the TYPE of activity that is the trigger for symptoms.

Common Mistakes

People will think I’m lazy (or I feel guilty)
I am not trying hard enough
I need to push through these symptoms
But I am already not doing anything (or less than I was before)

Just like with exercise...

Stop activities prior to symptom onset
Re-introduce activities in a graded and gradual way
We are aiming for patients to participate in ALL activities BELOW the level of symptoms
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Energy Conservation
- Think of your brain like a car
- And your energy level as a gas tank

Biggest “Gas Guzzlers”
- Talking
  - Phone, crowded environment, while others are talking
- Visually stimulating environments/activities
  - Evil triad: bright, colorful, and moving
- Driving
  - Even as a passenger, when raining, on crowded streets
- Any activity that requires "filtering"
  - Any noise in the background will be distracting, and it takes a lot of energy to put up a filter

Biggest “Gas Guzzlers”
- Cognitive Tasks (increased attention and processing):
  - Reading, Sudoku/cross words
- Physical Activity
  - You are not efficient with physical activity; so simple tasks in the past may be exhausting now
  - Need to make sure your heart rate doesn’t go too high, or could bring on symptoms (HR monitor?)

We wanted a better visual…

Current Activity Pattern

Target Activity Pattern

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Long Term Activity Goal

Danger Zone

Safe Zone

Symptom Onset

Time

Intensity

Activity

Strategies

- Pace and plan activities, incorporating rest into the day
- Build breaks into the day
  - 15 minutes per hour
- Alternate types of activities
  - Thinking (banking) vs. Doing (dusting)
- Reduce activities that cause symptoms (i.e. TV, computer, etc.)
- Encourage routine, good sleep patterns, exercise and nutrition

The ultimate goal:

- Live in the Green
- Have a Green Day
- Have a headache free day

#1 way to pace...

- Use a Timer!

Target Activity Pattern

Danger Zone

Safe Zone

Symptom Onset

Time

Intensity

Activity

In order to properly pace activities, there needs to be a plan

And therefore, a planner...
(paper or electronic)
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Pacing and Planning Toolkit

Activities
- There are many activities that we do
  - DAILY (bathing, dressing, eating, work, get the mail)
  - WEEKLY (laundry, garbage day, dusting)
  - MONTHLY (pay taxes, give meds to dog, etc.)
  - INFREQUENTLY (visit the dentist, wash the windows)
- It’s important to prioritize these activities so that the most important stuff gets done first (but this is not a way to get out of doing homework)

Sometimes...
- They are going to find that they have too many activities in one day...
- They may see a pattern that you can group some activities together save on driving/trips out of the house
- Doing too much will bring on symptoms (NOOOO!)
- Need to re-prioritize their activities...

Rules for Agenda Use:
- Check the agenda each morning to see what you have to do today
- Check your agenda often throughout the day
- Record ALL activities that you do in your agenda (or symptoms that occur)
  - Many patients fail to record the so called “insignificant” tasks, which also take a lot of energy and can bring on symptoms.
- Add new appointments as they come up
- Review yesterday’s tasks and transfer any unfinished business if necessary
- Free time is okay, but write something in that spot to log what you did

The beauties of an agenda...
- You know what day it is...
- You know what you have planned for the day
- You can schedule in needed rest breaks/naps so that your brain can heal and reduce symptoms onset
- You can keep track of what you did that may have triggered symptoms (it’s a journal or a log!)
- You can stay focused on the tasks that need to get completed

“But I’m really not doing ANYTHING”
- A lot of our patients resist the agendas/planners for various reasons
  - I don’t do anything all day because of my symptoms, so what am I going to write in it
  - Those things are not “cool” and I don’t want people thinking I’m disabled
  - I don’t carry a purse or a bag with me, so where am I going to put it?
  - I can keep it all in my head
- MOST patients who embrace the use of a planner/agenda begin to have fewer symptoms, sooner

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We need patients to self-manage their schedule, and pace their tasks...

What we really need is to LIMIT what they do all day...

The Principle

- Every activity has a points value based on
  - How difficult a task is
  - How much it takes out of you
  - How many symptoms you get
- You get a maximum number of points per day

Why it works:

- Provides a simple, structured way of tracking activities within a limit
- Provides a framework for limiting tasks
- Provides concrete limits to activity, rather than “guessing” if they have done too much

How it works:

- Patients are given 10-12 points per day
- Activities are given a point value, based on the level of difficulty (and symptoms that are caused)
- Patients are to plan the day to ensure they have enough points to do the tasks they want to do within their maximum

The Change:

- As tasks are limited, symptoms will improve
- Like any food diet or a budget, this is not a temporary thing, but a lifestyle change (be prepared!). This is probably one of the things that will linger after most of the rehabilitation is over.
- Once they start to recover, we can increase the total points in a day, and activities will be worth less (kind of like the maintenance portion of a diet).

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No cheating…

- Like any diet, there’s temptation to ‘cheat’ or sneak ‘junk food’…what happens if we do this?
- If patients cheat themselves of points (or give a task a value that’s not accurate), the consequence may be increased symptoms

Typical point values:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Point Value</th>
<th>Activity</th>
<th>Point Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADLs (bathing, dressing, grooming)</td>
<td>5 – 2</td>
<td>TV use</td>
<td>2 pts per hour</td>
</tr>
<tr>
<td>Meal Preparation</td>
<td>2-3 (depending on complexity)</td>
<td>Computer use</td>
<td>2 pts per hour</td>
</tr>
<tr>
<td>Dishes</td>
<td>1/2</td>
<td>Reading</td>
<td>2 pts per 1/4 hour</td>
</tr>
<tr>
<td>Grocery Shopping</td>
<td>5</td>
<td>Talking on the phone</td>
<td>2 pts per 15 minutes</td>
</tr>
<tr>
<td>Hockey game</td>
<td>5</td>
<td>Eating out at a restaurant (2 people)</td>
<td>5 (+1 for each additional person)</td>
</tr>
<tr>
<td>Working</td>
<td>1-2 pts per hour</td>
<td>Attending an appointment</td>
<td>3-5</td>
</tr>
<tr>
<td>Childcare</td>
<td>1-2 pts per hour</td>
<td>Attending group sessions</td>
<td>3-5</td>
</tr>
</tbody>
</table>

How are you getting these numbers?

- Complexity of activity (does it require a lot of thinking?)
- Stimulation (are you going to be bombarded with auditory and visual stimulation)
- The amount of talking involved
- The amount of ‘filtering’ involved
- Visual processing
- Experience of what tasks are difficult for my patients

Bottom line…

- Pacing activities below the level of symptoms can bring relief, and promote healing and recovery

Treatment Options

The visual problems that can accompany head injury can vary significantly from one individual to the next.

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Treatment Options
Treatment requires creative optical and sensory treatment modalities including:
- Lenses
- Prisms
- Filters
- Visual Aids
- Lifestyle Modification
- Vision Therapy

Vision Therapy
Uses of Lenses in Vision Therapy:
- Therapeutic. Not compensatory.
- Modify visual function and perception.

Lens Use In Vision Therapy
- When there is a conflict (disconnect) between what a person sees and what the tactile/proprioceptive senses convey, visual function determines the perception.

Occlusion
- Occlusion is chosen when fusion cannot be achieved with the application of lenses and/or fusional prisms.
- Treatment that includes occlusion eliminates double vision
- Do not use full occlusion (patching)!

Full occlusion impedes rehabilitation
- Interferes with peripheral vision
  - Balance issues
  - Posture
  - Navigation difficulties

Selective Occlusion
- There are many ways to occlude vision, depending on the individual’s needs.

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Methods of Selective Occlusion

Managing Visual Field Loss/Neglect

- Treatment Options
  - Peli Prisms
  - Yoked Prism Adaptation technique

Prism Adaptation Training

Optometrists will guide you:

Play “ball”, or “catch”, or stack blocks using prescribed prism glasses

Vision Therapy

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**Pointer-in-Straw**
- Patient holds stick, therapist holds straw
- Patient judges where is straw and puts into straw
- Poor depth judgments?
- Do eyes deviate or does one eye close?

**Optometric Rehabilitative Treatment Of TBI**

Main Goals of Rehabilitation Are to Help the Patient:
- Eliminate or compensate for visual problems
- Become more independent
- Re-enter his/her former occupation or to be trained for a new one
- Improve daily living skills

Areas that must Improve:
- Visual function-oculomotor, accommodation, binocularity, VIP
- Motor function-General movement abilities, bilaterality, eye-hand (starting with primitive reflexes and balance)
- Patients intention and goals

**Areas that must Improve:**
- Attention – especially visual attention
- Central-Peripheral integration (visual fields are usually collapsed)
- Ability to integrate multiple stimuli (huge problem – can’t filter out stuff (auditory)
- JND’s – usually can’t discriminate – not detailed oriented.

**Vision Therapy:**

Overall Program Structure
- In Office with a vision therapist
- Doctor programs each session
- Sessions include lenses and prisms
- Home Reinforcement Activities
- Progress Evaluations
- Length of Treatment varies depending on depth of vision problem and any accompanying diagnoses

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Vision Therapy: 
Overall Program Structure
1. Gross Motor Deficiencies
   • Eye movements
   • Accommodation
   • Peripheral Awareness
   • Binocularity
3. Visual Information Processing

Refer for a 
Neuro-Optometric Vision 
Rehabilitation Evaluation by a 
Developmental Optometrist

Additional Resources

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

Neuro-Optometric Rehabilitation Association, International 
www.nora.cc

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Discussion
&
Questions