

## **VISUAL PROBLEMS ASSOCIATED WITH ACQUIRED NEUROLOGICAL EVENTS**

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### **INTRODUCTION**

In the United States, approximately one person every sixteen seconds suffers some form of acquired brain injury. Additionally, there are approximately thirty thousand persons per year who are hospitalized for other forms of brain insult such as cerebrovascular accidents (CVA) and diseases such as cerebral palsy, multiple sclerosis, etc.

Following a neurological event, there is often an interruption to the neurological system which innervate the extraocular muscles controlling eye movement as well as the system that regulates focusing. The common visual symptoms often associated with acquired brain injury are:

- diplopia ( double vision)
- ocular pursuits (eye tracking ability)
- saccadics ( difficulties with shifting gaze quickly from one point to the other),
- accommodative inability ( focusing).
- binocular vision (eye alignment)
- glare sensitivity
- Inability to maintain visual contact

Neuro-optometrists have long recognized symptoms and visual problems associated with trauma that affect the functional visual system and have identified a syndrome, Post Trauma Vision Syndrome (PTVS). The following categorizes the clinical characteristics:

### **FUNCTIONAL VISION PROBLEMS**

- Exotropia (eye turned outward)
- Exophoria (tendency for the eyes to turn out)
- Convergence Insufficiency
- Accommodative Insufficiency
- Oculomotor dysfunction
- Increased myopia
- Common Symptoms
- Diplopia (double vision)
- Blurred near vision
- Perceived movement of print
- Asthenopia
- Headaches
- Photophobia (sensitivity to light)

PTVS can be treated effectively through neuro-optometric rehabilitation. The treatment may include different lens prescriptions in conjunction with prism lenses, and other neuro-optometric rehabilitative approaches, including vision therapy.

Additionally, depending on the extent of the injury, there are often deficits in many areas of visual information processing ability. Problems with visual processing may contribute to and or exacerbate symptoms of eye strain, fatigue, headaches, difficulties with balance and posture, depth perception, memory loss, and excessively slow visuomotor performance affecting handwriting.

## **VISION: AN INFORMATION PROCESSING SYSTEM**

Visual processing is organized through two main and separate systems. The one that we are most familiar with is called the focal pathway, which is related to central vision. The eye processes central vision primarily through an area called the macula located in the retina and seeing clearly is mainly through this system. However, one can also see receive visual information with their peripheral vision. For example, when aiming one's eye at a specific object, one can use peripheral vision to be aware of other objects about the room. Peripheral vision is primarily used as a general spatial orientation system and is mostly a function of the other visual process called the ambient pathway.

The ambient process provides information about where one is in space and contributes to balance, movement, coordination and posture. Nerve fibers from the peripheral retina, part of the ambient visual system, are directed primarily to the midbrain where they become part of the sensory motor pathway. The importance of this system is that it integrates visual information with information from kinesthetic, proprioceptive, vestibular and tactile systems which is important for orientation and movement. Thus, the ambient visual process is important in providing information about where one is in space and where one is looking, while the focal system provides information about what one is looking at.

After a neurological event such as a traumatic brain injury (including whiplash), multiple sclerosis, cerebral vascular accident, etc., the ambient visual process can be compromised and this would affect one's ability to match information with other components of the sensory motor feedback loop.

## **VISUAL FIELD DEFECTS**

Visual field loss following a CVA or TBI causes significant problems for persons when reading or walking, in an unknown environment. Although the field loss is due to nerve damage, often the prescription of yoked prism lenses and optometric visual therapy for ocular scanning will help patients to identify objects in the affected field and react and process at a more functional level.

## **VISUAL MIDLINE SHIFT SYNDROME**

An unusual phenomenon that often occurs following a neurological event is a change in how the ambient process provides information about orientation relative to the true midline. This syndrome is usually associated with hemiplegia and hemiparesis and often the patient will adjust to this visual mismatch by shifting their weight and will actually walk as if the floor is tilted. The neuro-optometrist can prescribe special prisms called yoked prisms, which helps to re-establish a visuomotor balance and often these lenses in conjunction with physical therapy and optometric visual therapy significantly speed up the overall rehabilitative process.

## **NEURO-OPTOMETRIC REHABILITATION**

Neuro-Optometric Rehabilitation is the blending of the art and science of optometry and vision rehabilitation. Neuro-Optometric Rehabilitation is defined as: An individualized treatment regiment for individuals with visual deficits as a result of physical disabilities, traumatic brain injuries, and other neurological insults. Neuro-optometric therapy is a process for the rehabilitation of functional visual problems as well as visual-perceptua1 motor disorders. It includes, but is not limited to, acquired strabismus, diplopia, binocular dysfunction, convergence and accommodation problems, oculomotor dysfunction, visual-spatial dysfunction, visual perceptual and cognitive deficits and traumatic visual acuity loss.

Individuals of all ages who have experienced neurological insults can benefit from neuro-optometric rehabilitation. Visual problems caused by traumatic brain injury, cerebral vascular accident, cerebral palsy, multiple sclerosis, etc., may interfere with their performance and learning ability. Other problems such as balance and vestibular disorders may be exacerbated by the visual dysfunction.

Often, persons who have a neurological problem will mention these symptoms to their physician and rehabilitative therapists who may recommend a routine eye examination rather than a neuro-optometric exam. This often results in the eye doctor stating that the visual acuity and the health of the eye is normal and that their problems are not related to the eyes. In addition, if there are balance disorders, persons will be referred for physical and occupational therapy and/or vestibular evaluation and treatment. In many cases, if the underlying visual processing problem is not determined and treated, there will be limited progress. A neuro-optometric rehabilitation treatment plan improves and or enhances the specific acquired visual deficits that are identified during the neuro-optometric evaluation. Treatment regimens encompass lenses and prisms, specifically prescribed occlusion and optometric visual therapy.

**Conclusion:** Persons who have suffered a neurological event often have visual processing problems and functional vision problems that are not adequately managed. These problems cause extreme difficulty, not only with balance and movement, but also could affect the person's perception of space and their ability to process this information. The patient often experiences difficulty functioning in an environment with a lot of visual stimulation such as a grocery store, and will experience difficulty finding a specific object on a shelf. Often movement in a crowded environment becomes quite disturbing and may cause symptoms of vertigo. This can be extremely debilitating to the patient.

The problems associated with Post Traumatic Vision Syndrome can affect higher cognitive levels of function as well, by causing a slowing of responses in general and interference with higher perceptual cognitive function. Therefore, neuro-optometric rehabilitation will often have a positive affect on cognitive therapy.

Motor function deficits associated with neurological problems often can be helped with yoked prism therapeutic lenses which help make significant changes in posture, balance and movement. The use of yoked prisms can be incorporated into existing physical and/or occupational therapy programs.

The neuro-optometrist is an important member of the multi-disciplinary team serving this special population.

**About the Author:**

Dr. Allen Cohen is a partner of [Eye Vision Associates](#) in Lake Ronkonkoma N.Y. Dr. Cohen has been in practice since 1965 and specializes in visual therapy and neuro-optometric rehabilitative services.

Dr. Cohen is Chief, Optometry Service, Northport VA Medical Center and Professor of Clinical Optometry, SUNY State College of Optometry. He has lectured and written extensively on the subject of visual therapy and visual rehabilitation.

## **VISION PROBLEMS ASSOCIATED WITH BRAIN INJURIES**

Brain injuries can come in many forms. Below are some common diagnoses:

- Traumatic Brain Injury (TBI)
- Mild Acquired Brain Injury
- Mild Closed Head Injury
- Post-Concussive Syndrome
- Cervical Trauma Syndrome
- Post Traumatic Vision Syndrome
- Stroke
- Cerebral Palsy
- Cerebral Vascular Accident

Essentially, **Traumatic Brain Injury** or **Acquired Brain Injury** is an insult to the brain, such as a blow to the head, stroke, or neurological dysfunction. The insult can produce cognitive, sensory or physical impairments; most are amenable to rehabilitation. The following is a list of symptoms of visual problems which can result from brain injuries:

- Blurred vision
- Sensitivity to light, glare sensitivity
- Reading difficulties; words appear to move
- Comprehension difficulty
- Attention and concentration difficulty
- Memory difficulty
- Double vision
- Aching eyes
- Headaches with visual tasks
- Inability to maintain visual contact
- Reduction or loss of visual field
- Difficulties with eye movements, such as:
  1. ocular pursuits (eye tracking ability)
  2. saccadics (shifting gaze quickly from one point to the other)
  3. accommodative inability (focusing)
  4. binocular vision (eye alignment, eye teaming)
- Visual field loss
- Visual Spatial Confusion

These visual problems can be successfully decreased or eliminated with various treatments, such as:

- Vision Therapy
- Neuro-optometric Rehabilitation Therapy
- Visual-Neuro Integration Therapy
- Therapeutic Yoked Prism Lenses
- Compensatory Corrective lenses, such as prism lenses
- Phototherapy programs (Syntonic Optometry, Light Therapy)

Eye muscle surgery (strabismus surgery) is a very questionable treatment option for visual consequences of brain injury, because -- unlike rehabilitative therapy, eye muscle surgery does not treat the problems **occurring in the patient's brain.**

## **TRAUMATIC BRAIN INJURY & HIDDEN VISUAL PROBLEMS**

by Optometric Extension Program, a non-profit organization.

Often visual problems resulting from Traumatic Brain Injury are overlooked during initial treatment of the injury. Frequently these problems are hidden and neglected, lengthening and impairing rehabilitation. Vision is the most important source of sensory information. Consisting of a sophisticated complex of subsystems, the visual process involves the flow and processing of information to the brain. Because there is a close relationship between vision and the brain, Traumatic Brain Injury can disrupt the visual process, interfering with the flow and processing of information. The result is a vision problem. Symptoms indicating a vision problem are:

- Blurred vision
- Sensitivity to light
- Reading difficulties; words appear to move
- Comprehension difficulty
- Attention and concentration difficulty
- Memory difficulty
- Double vision
- Aching eyes
- Headaches with visual tasks
- Loss of visual field

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### **GOOD VISUAL SKILLS -- GOOD VISION**

Good visual skills are necessary for efficient information processing. When processing visual information is difficult, one may "try harder," straining without even knowing it because the effort is subconscious. If the visual system is inefficient, every task can seem difficult, using more energy than required. Visual skills affected by Traumatic Brain Injury include:

**Tracking:**

The ability of the eye to move smoothly across a printed page or while following a moving object

**Fixation:**

Quickly and accurately locating and inspecting a series of stationary objects, such as words while reading.

**Focus Change:**

Looking quickly from far to near and back without blur.

**Depth perception:**

Judging relative distances of objects - how far or near they are.

**Peripheral vision:**

Monitoring and interpreting what is happening in the surrounding field of vision

**Binocularity:**

Using both eyes together as a team - smoothly, equally and accurately

**Maintaining attention:**

Keeping focused on a particular activity while interference, such as noise, is present.

**Visualization:**

Accurately picturing images in the "mind's eye," eye retaining and storing them for future recall.

**Near vision acuity:**

Clearly, seeing, inspecting, identifying and understanding objects viewed within arm's length.

**Distance acuity:**

Clearly seeing, inspecting, identifying and understanding objects viewed at a distance.

**Vision perception:**

Understanding what is seen.

## **OPTOMETRY AND REHABILITATION**

Very few in the health care professions, including head trauma rehabilitation centers, are adequately aware of visual problems resulting from Traumatic Brain Injury and the visual-perception consequences. Unfortunately, this creates a gap in rehabilitative services, resulting in incomplete treatment and frustration for the patient, family and treatment team.

The vision care professional can play an important role in the rehabilitation effort. Through vision therapy and the proper use of lenses, a behavioral or developmental optometrist specifically trained to work with Traumatic Brain Injury patients can help improve the flow and processing of information between the eyes and the brain.

Vision therapy can be a very practical and effective. After evaluation, examination and consultation, the optometrist determines how a person processes information after an injury and where that person's strengths and weaknesses lie. The optometrist then prescribes a treatment regimen incorporating lenses, prisms, low vision aides and specific activities designed to improve control of a person's visual system and increase vision efficiency. This in turn can help support many other activities in daily living.

### **WHAT IS BEHAVIORAL OPTOMETRY OR DEVELOPMENTAL OPTOMETRY?**

Behavioral optometry is based upon the core principle that vision is a learned process and can be developed or enhanced at any age. Optometrists practicing this method have continued their education beyond the basic Doctor of Optometry (O.D.) degree. This continuing education emphasizes the use of lenses, prisms, and vision therapy to enhance a patient's visual capabilities, reduce visual stress, prevent and rehabilitate vision problems. As a member of the rehabilitative team, behavioral optometrists have extensive experience treating the vision problems stemming from Traumatic Brain Injury.

Not all optometrists practice behavioral optometry. To find a list of doctors who practice behavioral optometry, you can check out the sites of these nonprofit organizations: [www.oepf.org](http://www.oepf.org) or [www.covd.org](http://www.covd.org)

**CONDITIONS TREATED BY NEURO-OPTOMETRIC REHABILITATION**

contributed by Dr. Errol Rummel, FAAO, FCOVD, FNORA

1. Visual Consequences of Traumatic Brain Injury (TBI, stroke, etc.)
2. Hemianopsia (Hemi Field Loss)
3. Binocular Vision Difficulties (uncoordinated eye movements)
4. Accommodative Dysfunction (focusing problems)
5. Convergence Insufficiency (difficulty moving visual fixation inward toward nose)
6. Ambient Vision Function (confusion in a busy visual environment, like the mall)
7. Spatial Disorientation (difficulty organizing visually presented material)
8. Ocular Motor Dysfunction (inaccurate pursuit, or saccadic eye movements)
9. Diplopia (double vision)
10. Poor Visual Concentration or Poor Visual Attention
11. Asthenopia (eyestrain)
12. Visual Distortion (things seem to move or distort in shape)
13. Headaches when reading or during other visually directed tasks (usually frontal, or temporal)
14. Blurred Vision (occurring at distance and/or at near, and may be intermittent or constant)
15. Squinting or Facial Grimacing (during visual tasks)
16. Photophobia (light sensitivity)
17. Loss of Place When Reading (skips words, re-reads)
18. Loss of Visual Awareness to one or both sides (side vision loss or peripheral vision constriction)
19. Visual Memory Problems (forgets what was just being read)
20. Nystagmus (rapid oscillating side to side eye movements)
21. Poorly centered standing balance (weight shift and/or loss of balance laterally; forward (flexion) or backwards (extension))
22. Depth Perception Problems (cannot judge spatial distances)
23. Inaccurate Eye-Hand/Eye-Foot Coordination (mis-judges when reaching or walking)
24. Slow Reaction Time to Visual Stimuli (poor visual attention)
25. Visual-Perceptual Problems (e.g. form perception, figure-ground, etc)
26. Dizziness/Visual-Vestibular Dysfunction (related to reading, or in a busy visual environment)
27. Ptosis (a droopy eyelid)
28. Blepharoparesis (an eyelid which does not blink well or doesn't close fully)