Post Trauma Vision Syndrome: Part I

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A person who has suffered a traumatic brain injury (TBI) or cerebral vascular accident (CVA) may often experience difficulties with balance, spatial orientation, coordination, cognitive function, and speech. In most cases, a referral for visual consultation only occurs if there's an injury to an eye or if ocular pathology is suspected. Persons with a TBI or CVA frequently will experience symptoms of double vision, movement of print or stationary objects such as walls and floor, eye strain, visual fatigue, headaches and problems with balance, to name several. Frequently, people will report problems with their vision to rehabilitation professionals and be referred for eye examination. Unfortunately, many will be told that there is nothing wrong with their eye and that it is the effects of their TBI or CVA. Others will be told that their symptoms are not related to their vision.

Visual problems are among the most common sequella following a TBI or CVA, but frequently not dealt with in a rehabilitation model. In order to address visual problems, the Neuro-Optometric Rehabilitation Association is a multi disciplinary institution that provides literature and educational programs for its members. It also serves as a referral source for doctors and rehabilitation professionals who have specific understanding of visual difficulties that arise following a neurological event. A definition of neuro-optometric rehabilitation is: an individualized treatment regimen for patients with visual deficits as a direct result to physical disabilities, traumatic brain injuries, and other neurological insults. Neuro-optometric therapy is a process of rehabilitation to visual/perceptual/motor disorders. It includes, but is not limited to, acquired strabismus, diplopia, binocular dysfunction, convergence and /or accommodation paresis/paralysis, oculomotor dysfunction, visual-spatial dysfunction, visual-perceptual and cognitive deficits, and traumatic, visual acuity loss.

Patients of all ages who have experienced neurological insults require neuro-optometric rehabilitation. Visual problems caused by traumatic brain injury, cerebrovascular accident, cerebral palsy, multiple sclerosis, etc., may interfere with performance causing the person to be identified as learning disabled or as having attention deficit disorder. These visual dysfunctions can manifest themselves as psychological sequella such as anxiety and panic disorders as well as spatial dysfunctions affecting balance and posture.

A neuro-optometric rehabilitation treatment plan improves specific, acquired vision dysfunctions determined by standardized diagnostic criteria. Treatment regimens

encompass medically necessary noncompensatory lenses and prisms with and without occlusion and other appropriate medical rehabilitation strategies.

Vision: The Process

The visual system is composed of two separate processes. The process that we are most familiar with has been called the focal process. (Trevarthen2, Leibowitz and Post3). This process is neurologically is related to the central visual function. The eye represents central vision primarily through an area called the macula located in the retina. Aiming your eye directly at an object causes focalization by the brain through the macula.

As noted by Leibowitz and Post, the focal process does not have to be delivered directly by the macula. For example, you can aim your eye at a particular object such as a doorknob on a door across the room. Fixating on the doorknob represents a central focalization. However, you can also focalize with your peripheral vision. While you are aiming your eye at the doorknob, you can use your peripheral vision to focalize on objects about the room, such as a picture or a chair. The focalization process, however is most easily delivered through the macula. While you can focalize in any portion of the visual field, the peripheral vision is primarily used as a general spatial orientation system. The reason for this is that peripheral vision is mostly a function of a second visual process called the ambient process.

The ambient process lets you know where you are in space and provides general information needed for balance, movement, coordination, and posture. Neurologically, nerve fibers from the peripheral retina that are part of the ambient visual process provide axons that are delivered to a level of midbrain where they become part of the sensory-motor feedback loop. The importance of this system is that it is a less sensorially involved and more motoric in function. It must match information with kinesthetic, proprioceptive, vestibular, and even tactile systems for the purpose of orienting and acting as a master organizer of these other processes. Once this is accomplished, a feed-forward mechanism enables this information to be directed to higher cortical areas, including the occipital cortex, as well as 99% of the cortex.

The ambient visual process must let you know where you are in space and essentially where you are looking before you process information about what you are looking at.

Given a neurological event such as a traumatic brain injury (this includes a mild whiplash), multiple sclerosis, cerebrovascular accident, etc., the ambient visual process can lose its ability to match information with other components of the sensory-motor feedback loop.

Even a whiplash, as mentioned, can cause significant dysfunction at the level of midbrain. Thomas4 has calculated that at the level of the foramen magnum, as much as 14,000 lbs. of inertial force is exerted on the spinal cord with a minimal 10 mile an hour rear-end collision. This can cause a dysfunction in the sensory-motor feedback loop and more specifically in the ambient visual process. Although this type of an injury cannot be seen in most cases on a CT scan or MRI, injured individuals will frequently experience the types of symptoms explained in the introduction of this paper.

Clinical findings have led the authors to document a new syndrome called Post Trauma Vision Syndrome (PTVS). This syndrome is caused by a dysfunction of the ambient visual process and has the characteristics, as well as symptoms, presented below.

Persons who are not treated for PTVS can experience this syndrome for many years following a neurological event. Treatment of this syndrome may include binasal occlusion in conjunction with low amounts of base-in prism and other types of neuro-optometric rehabilitative approaches, including vision therapy. It has been the author's experience that most cases of PTVS can be treated effectively through neuro-optometric rehabilitation. The authors have found that clinically approximately 15% of persons with PTVS may require more extensive vision therapy.

The significance of this discussion is to recognize that the exotropia, exophoria, accommodative insufficiency, convergence insufficiency, and oculomotor dysfunction are part of the greater dysfunction of the ambient visual process and are essentially characteristics of this function. For example, frequently persons with a diagnosed exotropia after a traumatic brain injury are diagnosed with a 3rd nerve palsy. It has been the author's experience that treating the ambient vision dysfunction through neuro-optometric rehabilitation can in many cases reduce the exotropia. Therefore, the authors question the diagnosis of a neurological/muscular problem without consideration being given to the overall dysfunction of the ambient system causing PTVS when no specific lesion is found by a MRI or CAT scan.

Research has been conducted by the authors utilizing Visual Evoked Potentials (VEP) to capture this state of dysfunction at the level of midbrain5. Subjects were given binocular visual evoked cross-pattern reversal P-100 evaluation with their best distance correction. An experimental group was used in this study. Immediately following phase one of the VEP testing, binasal occlusion and base-in prisms were introduced before both eyes. In the experimental group there was an increase in the amplitude of the VEP.

The increase in amplitude of the binocular VEP for the experimental group when using base-in prisms and bi-nasal occluders suggests that by affecting the ambient visual process through structure from the bi-nasal occluders and field expansion from the base-in prisms, the binocular cortical cells increase in effectiveness. This increase in binocular cortical function is also correlated with the verbal responses from the subjects. Frequently, the subjects reported that the perceived movement of the letters on the chart stabilized. They also reported that it was easier to fixate with two eyes and, for some, the diplopia was eliminated.

This study further indicates that the ocular conditions diagnosed after a TBI may be due to a dysfunction of the ambient visual process in its inability to organize spatial information with other sensory-motor systems. This in turn causes a compromise of the focal process.

This disturbance in the ambient system appears to cause the dysfunction of binocularity for the persons in this study and, for many affected persons, may actually lead to strabismus, convergence insufficiency, accommodative insufficiency and oculomotor dysfunction. It is suggested that, following a TBI, ambient processing dysfunction may be the cause of Post Trauma Vision Syndrome. Understood in this way, the specific binocular dysfunctions are actually characteristic of PTVS.