ARTICLE

Traumatic Brain Injury and Binasal Occlusion

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ABSTRACT

Background: Most individuals who have experienced a traumatic brain injury (TBI) have some degree of visual, physiological and/or behavioral change that accompanies the injury. Symptoms vary from diplopia to vertigo and from reading problems to memory loss. For many patients with TBI, using binasal occlusion (BNO) as a treatment option can bring relief.

Case Report: A forty-six year old Caucasian male with a history of multiple mild traumatic brain injuries presented with complaints of dizziness triggered by moving objects. In addition to the vertigo, he also exhibited poor depth perception. All prior examinations, including visits to his primary care physician, the emergency room, a neurologist, an otologist, and an optometrist were unremarkable. No interventions were offered to relieve the patient's symptomology. Upon the completion of the evaluation an oculomotor dysfunction and exophoria were diagnosed. Base-in prism was prescribed and optometric vision therapy was initiated. Three months after his first examination, binasal occlusion was applied to his glasses. Immediate improvement in symptoms and visual function occurred after the application of the binasal occlusion.

Conclusion: Many visual dysfunctions diagnosed after a TBI may be related to a problem within the ambient system's ability to process and organize spatial information. This may reduce the focal system's processing ability. Binasal occlusion provides the brain with an opportunity to process information differently. This alteration in visual input may improve vision function and relieve visual symptoms for patients who are post TBI as noted in this case report.

Keywords: ambient vision, binasal occlusion, optometric vision therapy, TBI, traumatic brain injury

Introduction

Historically, binasal occlusion (BNO) has been used for patients with strabismus. One of the earliest written reports in American optometric literature was by Louis Jacques, in his 1950 book, *Corrective and Preventive Optometry*. He discussed his *half cover technique* which helped transform a patient with unilateral strabismus into a patient with alternating strabismus.[1] Jacques felt that binasal occlusion worked because it removed visual inhibition and suppression and allowed "the opportunity to establish the basic vision patterns of the normal human being."[2]

Binasal occlusion is considered a form of sector occlusion.[2] Strips of tape, opaque or translucent, or stippled nail polish can be applied to the front and/or back surface of the patient's spectacles. Typically the tape is tapered slightly to allow for convergence at near. Greenwald[3] suggested that the placement of the BNO be just nasal to the Hirschberg reflex in both eyes. Depending on the condition being treated, symmetry may or may not be indicated. Others felt that the tape should be placed nasal to the limbus.[4] Many clinicians have found the opaque or translucent Streff Wedge[A] to be helpful in finding the best placement for the binasal occlusion. After initial placement, changes may be made based on the patient's perception or performance while wearing the occlusion.

Greenwald[5] was also an early proponent of binasal occlusion. He provided a written in-depth description of its use in esotropia. In a 1974 *Optometric Weekly* publication, he wrote "*binasal occlusion has value far beyond Jacques' original purpose.*" Binasal occlusion has been recommended for many vision disorders. The

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following case report is a demonstration of the use of binasal occlusion for something other than esotropia.

Case Report

A forty-six year old Caucasian male was referred to the Traumatic Brain Injury (TBI) Clinic at Northeastern State University's Oklahoma College of Optometry because he was experiencing dizziness and poor depth perception. He noticed that when objects moved in front of him at a relatively fast speed he immediately felt dizzy but denied any nausea. In public places, he had difficulty walking when there were other people around him. These symptoms were present for 10 years post TBI.

The referring clinic noted that the patient had difficulty maintaining fixation and concluded that he would benefit from an optometric vision therapy evaluation. A review of the medical history, including copies of his medical records, showed that he had not suffered overt head trauma. He had, however, been involved in approximately 13 minor motor vehicle accidents as a regional driver for a car rental company. After multiple medical evaluations, including a full neurological evaluation with neuroimaging and an inner ear evaluation, no cause for the visual symptoms was found. Documented medical diagnoses included chronic sinusitis and degenerative change in the thoracic spine. Neither was considered causative of the visual symptoms. The patient was currently under chiropractic care for neck pain and muscle spasms.

A College of Optometrists in Vision Development Quality of Life (COVD-QOL) 30 Item Checklist[6] was given producing a score of 49. A score of 20 or above is considered indicative of a binocular vision or perceptual dysfunction. The items checked 'always' included "words run together when reading", "skips/repeats lines reading", "dizzy/nausea with near work", "avoids near work/reading", "holds reading too close", and "poor hand/eye coordination."

The initial examination showed 20/15 distance acuity OD, OS, and OU with his habitual glasses in place (-3.75 -2.25 x 048 OD and -3.50 -1.75 x 137 OS with a +2.00 add). Near acuity with his habitual glasses was 20/30 OD, 20/25 OS, and 20/20 OU. Pupils were unremarkable with his confrontation fields and versions being full. The cover test with his habitual correction in place showed a 6^{Δ} exophoria at distance and 8^{Δ} exophoria at near. NSUCO saccades were 5/3/4/0 and pursuits were 1/1/1/0 with so much body movement he had to be seated during both procedures.[7] Near point of convergence was difficult to assess as the patient jerked his head away as the target approached and had to close his eyes for several moments between tests.

The manifest refraction showed myopia, astigmatism, and presbyopia that was minimally different from his habitual worn spectacles (-3.25 -2.25 x 051 OD and -3.25 -2.00 x 141 OS with a +1.75 add). Dissociated and fused cross cylinder testing showed +1.75D OD, OS, and OU. His near phoria with the manifest refraction was 13^{Δ} exophoria. Negative relative accommodation and positive relative accommodation showed +0.50D and -0.50D respectively. Dynamic retinoscopy revealed +0.50D lag OD and +0.75D lag OS. The patient's base-in vergence ranges at near were 20/28/16 and his base-out ranges were x/18/12. His vergence facility with the VO Series was 16 seconds with slide 6; 18 seconds with slide 7; unable to fuse slide 8 on the bottom; 12 seconds with slide 11; and unable to fuse slide 12 on the bottom.

The vectographic slide at distance confirmed the exophoria and measured 6^{Δ} BI in free space. Based on the measurement, horizontal prism (3^{Δ} BI OD/OS) was trial framed with the new refractive findings. The patient indicated that he felt more comfortable walking and that his depth perception was improved. The assessment of the ocular health was unremarkable. Updated spectacle lenses with base-in prism (-3.25 -2.25 x 048 OD and -3.25 -2.00 x 137 OS with 3^{Δ} BI OD/OS and +1.75 add) was prescribed and he was scheduled for additional testing.

Two weeks later the patient returned for further evaluation. He had not yet obtained the updated spectacle lenses so their benefit could not be ascertained. Additional case history information included worsening symptoms in the last six months, including faintness when watching TV and falling down at home. The Van Orden (VO) Star showed the centers below the midline with the left point shifted laterally

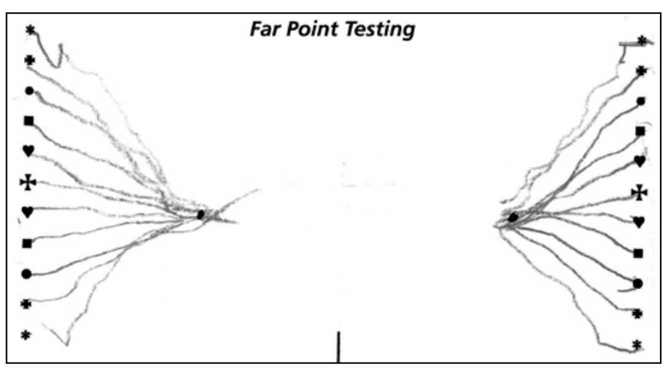
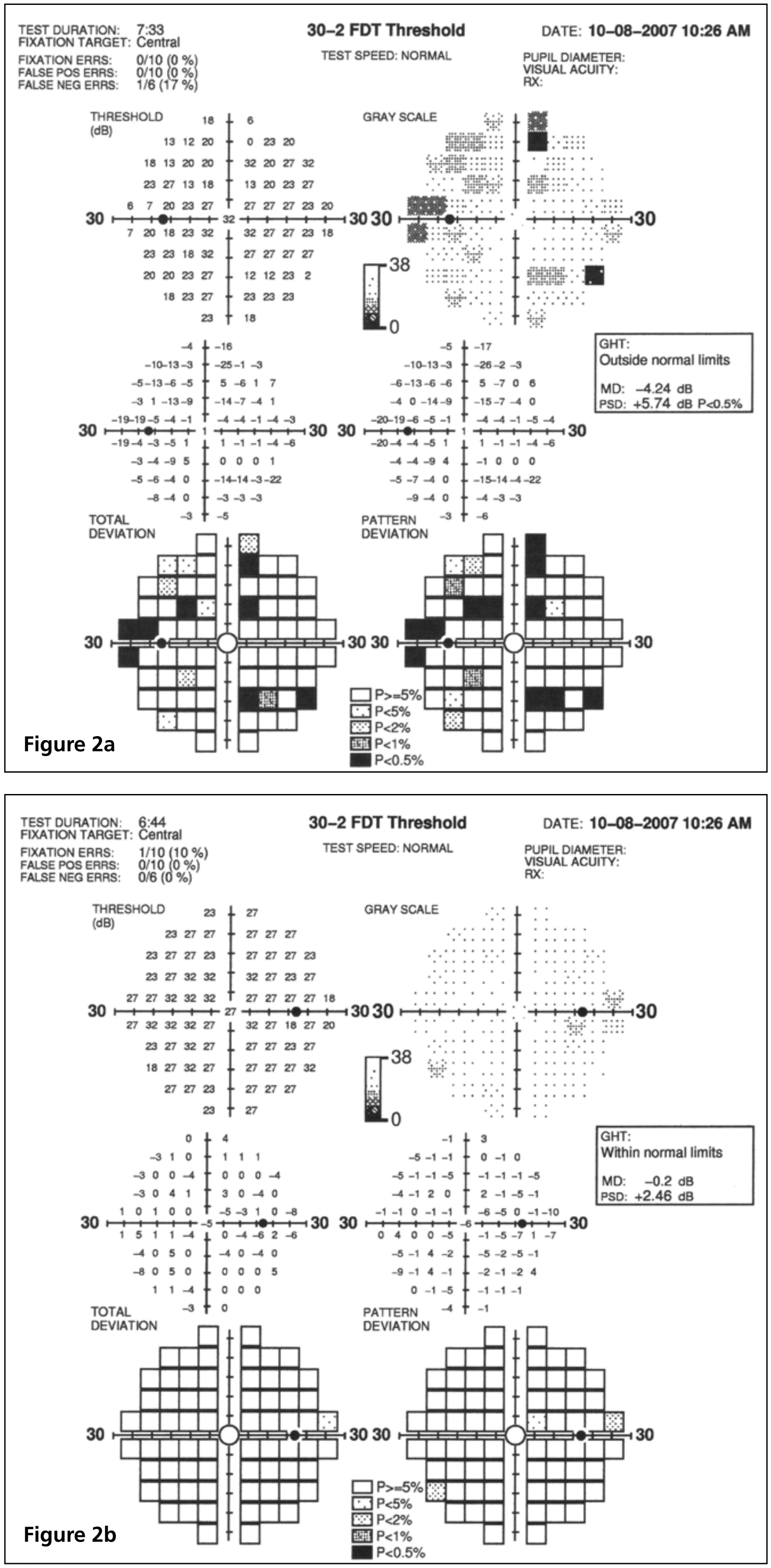


Figure 1: *Van Orden Star showed the centers below the midline with some disorganization.*

toward the right side (See Figure 1).[8] Stereo acuity was 100 seconds of arc. When performing any procedure with moving targets or lights, the patient became dizzy. Because of his report of worsening symptoms in the last six months, a cranial nerve assessment was performed. All twelve cranial nerves functioned properly. A threshold automated visual field was also performed with no defects [the patient closed his eyes a great deal during the test to control his dizziness] (See Figure 2). A line walk with 8Δ yoked prism (BU, BD, BR, and BL) was attempted, but the patient experienced dizziness.[9] Moreover, no positive change in movement, gait or posture was noted by the examiners or the patient. This testing ruled out yoked prism as a treatment option at that time.

The management and treatment plan following this second evaluation included an order for an additional MRI due to the fact that the patient's symptoms were worsening. Two months after the initial examination, another MRI was completed. As in previous testing, it was found to be unremarkable. The treatment plan at this time included initiation of an office based optometric vision therapy program. The therapy goals included improving fixation ability at all distances, improving pursuit and saccade ability, symmetry in the VO Star, and improving the patient's peripheral awareness. (See Table 1 for some of the activities prescribed for office and home therapy).

Three months after his initial visit, binasal occlusion was attempted for the first time at the end of his sixth therapy session. This treatment strategy was suggested by optometrists presenting at the Invitational Lens Symposium held in Tahlequah, OK in November of 2007. Scotch® tape was applied to the nasal portion of the front surface of the patient's



Figures 2a, 2b: *2a) Threshold visual field showing only scattered defects in the left eye. 2b) The right eye field shows no defects.*

Table 1. Optometric Goals and Sample of Vision Therapy Activities

Optometric Goal	Office Therapy	Home Therapy
Improved fixation	Pointer in the straw Brock string	Pointer in the straw Brock string
Improved pursuits	Marsden ball	Thumb pursuits
Improved saccades	Wayne saccadic fixator	Saccadic fixation sheet
Improved peripheral awareness	Wayne saccadic fixator (central to periphery program)	Fixation Worksheet
VO Star symmetry	Line walk	

Table 2. Conditions Treated with Binasal Occlusion[3,10,11]

• Amblyopia	• Esotropia	• Esophoria
• Anomalous Correspondence	• Vertical Imbalances	• Asthenopia
• Post-Trauma Vision Syndrome	• Visually "Tight" Patients	• Highly Central Patients

Figure 3: *Initial placement of the binasal occlusion.*

glasses (See Figure 3). He was then instructed to walk down the hallway. He seemed to be more confident moving through doorways and past those walking by him. He also reported feeling better. The BNO was then added to his home therapy. He was instructed to ride in his car as a passenger with the BNO in place to see how he felt during this activity. If he was able to function comfortably in the car, it was recommended that he continue to utilize the BNO for the remainder of the week. If the binasals hindered his ability to drive, he was instructed to remove the tape.

The following week the patient reported that the BNO helped his mobility, but he did not feel comfortable driving with them on. After his therapy session, we tried different placements of the BNO until we found the occlusive area that felt the most comfortable and maximized the mobility improvement. Optometric vision therapy was continued for two more weeks with the BNO in place. Due to scheduling issues, he discontinued therapy but returned three months later. At that visit, the binasal occlusion was adjusted and it was suggested that therapy resume with an emphasis on home activities. The patient, unfortunately did not follow through with this plan of action. After a six month absence, he was contacted by phone at which time the patient stated that he was still wearing the BNO for most activities except driving. The patient noted that he feels much more comfortable walking with the binasals on, but that his peripheral vision is restricted while driving. He will continue to be seen yearly as he did not wish to continue vision therapy due to transportation difficulties.

DISCUSSION

Binasal Occlusion

Optometrists have treated patients with binasal occlusion for over fifty years, and have used binasal occlusion in the treatment of several functional vision conditions (See Table 2). Numerous case reports have been written regarding the use of BNO, but the neurophysiology behind this treatment option has not been fully documented in the literature.

How does binasal occlusion lead to improved visual function for TBI patients like the one documented in the case report? Greenwald used "defocusing" to describe a "forceful change" in the patient's habitual way of handling his visual problem. Binasal occlusion acts as a "persistent change in the patient's central visual space forcing [them]" to alter the way they handle the world.[1] Binasal occlusion also makes the patient more dependent on peripheral clues.[5] It reduces confusion and helps stabilize the image, helping the patient to understand where they are in their personal visual space and how to adjust to changes regarding that space.

Gallop[12] reported on the use of binasal occlusion for an adult with cerebral palsy. He proposed that BNO was successful for several reasons. First, by occluding the middle of the binocular nasal field there is an effect on binocular integration. Because this portion of the visual field overlaps, it is an area of intense demand which requires the highest degree of binocular integration to be efficient and comfortable. When this process is changed by acquired brain injury or strabismus, the integration of this portion of visual space may be the most difficult when trying to produce single, clear, comfortable, and stable binocular vision. If the input from this area is modified, it may serve to relieve visual stress. This alleviates the confusion of trying to organize this portion of space and allows the patient to process information from the peripheral areas. In the end, this may reduce the patient's perception of overall visual stress.[12]

His second point was that binasal occlusion allows the temporal visual fields to become more stimulated causing greater awareness of the environment. If an incident causes the patient to shut down peripheral awareness, it reduces the information crucial to allowing the patient to feel secure about his relationship between himself and the world around him. This increases stress, which can be manifested in other areas of the body. This stress may reduce peripheral awareness, creating a vicious cycle.[12]

The final point Gallup proposed was that binasal occlusion provides a visual reference point which helps to steady visual-spatial perception. Binasals may act as a constant and consistent reminder, even if not consciously noticed, interjected between the patient and the visual environment to help organize visual input.[12]

Traumatic Brain Injury

Patients who have suffered from a traumatic brain injury will frequently experience trouble with balance, spatial orientation, coordination, cognitive function, and speech.[13] Often TBI patients also experience symptoms such as double vision, apparent movement of print or stationary objects like walls or floors, eye strain, visual fatigue, light sensitivity, and headaches. Visual symptoms are one of the most common problems following a TBI. Visual dysfunctions may also manifest as anxiety and panic disorders.[13] Several articles written by Padula have documented what he termed "Post-Trauma Vision Syndrome" (PTVS).[14, 15] (See Table 3) Patients not properly treated for PTVS can experience symptoms for many years following a neurological event. Padula suggested that treatment of PTVS include binasal occlusion in conjunction with low amounts of base-in prism and optometric vision therapy.[16]

Table 3. Post-Trauma Vision Syndrome (PTVS)[14,15]

Characteristics	Symptoms
Exotropia	Diplopia
Exophoria	Objects Appear to Move
Accommodative Dysfunction	Memory Problems
Convergence Insufficiency	Staring Behavior
Poor Tracking Ability	Asthenopic
Sensitivity to Light	Fatigue
Low Blink Rate	Difficulty Reading
Spatial Disorientation	Irritability
Balance and Postural Difficulties	Inability to Follow Sequential Instructions
Visual Memory Problems	

Padula and Argyris have noted that many of the clinical findings associated with TBI are caused by a dysfunction of the ambient (magnocellular) visual process. Neurological events like TBI and multiple sclerosis, and conditions like cerebral palsy can cause the ambient visual processing system to lose the ability to match information with other parts of the sensory-motor feedback loop. Even a whiplash can cause significant problems at the level of the midbrain.[13] In most cases, damage from this type of injury cannot be seen on a CT or MRI, but the patient will experience symptoms.[13] Dysfunctional ambient vision can cause patients to have problems while they are moving through a crowd. The normal functioning ambient system usually stabilizes images of the peripheral retina, but in a patient who has had TBI, this situation may cause complaints of vertigo.[16] The patient may not be able to cope and will avoid situations where moving through groups of people is necessary.

Padula, Argyris, and Ray have used visual evoked potentials (VEP) to study the damage occurring in the midbrain. In their research two groups were given binocular visual evoked cross-pattern reversal P-100 evaluations while wearing their best distance correction. The experimental and control groups were given the VEP test. Testing was then repeated with the subjects in the experimental group while wearing binasal occlusion and base-in prism. The results of these tests showed an increase in the amplitude of the VEP in the experimental group while they were wearing the binasal occlusion and base-in prism. The authors suggested that by producing a change in the ambient vision process via BNO and prisms, the binocular cortical cells increased in effectiveness. The patients also objectively noticed that while wearing the binasal/prism glasses, they saw less movement of the letters on the chart and for some the diplopia disappeared completely.[17]

Binasal occlusion may not be an appropriate treatment option for all TBI patients. Although Jacques was not addressing binasal occlusion as a treatment for brain injury, some of his cautionary statements apply to these patients as well. He indicated that some patients may experience feelings of discomfort as they cannot or will not function with any type of treatment that obstructs the use of their central field. Forcing patients to cope with increased peripheral awareness may bring a great deal of distraction into their visual system.[11] Many patients with TBI may benefit from smaller sections of binasal occlusion. Aiming for areas nasal to the limbus rather than covering the pupil is recommended for optimal success in treating these patients.[4]

Conclusion

The value of binasal occlusion in treating patients with brain injury has been demonstrated on an individual basis. After TBI, many associated visual dysfunctions may be related to the ambient system's inability to process and organize spatial information which in turn reduces the focal system's ability to process incoming information. When BNO is used, the patient is provided an opportunity to experience a change which creates the potential for improved symptomology and behavior.[5] This simple procedure can be utilized alone as a form of effective therapy or in conjunction with active therapy. It is inexpensive, easy to apply, and readily available to all practitioners. The success reported on a case by case basis has encouraged clinicians to try this technique on similar patients. Additional case reports, research and controlled clinical trials are necessary to validate the use of binasal occlusion. By utilizing BNO as a part of the therapeutic regimen, we can change those with traumatic brain injury so that they can interact with their world in an effective and productive manner.

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Materials

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