Effect Of Binasal Occlusion (BNO) On The Visual-Evoked Potential (VEP) In Mild Traumatic Brain Injury (mTBI)

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Background

Traumatic Brain Injury (TBI) • TBI is a major medical and public health problem in the United States (Okie, 2005). • Every year approximately 8 million people suffer a TBI in the United States (Cluff and Ludlam, 2011).

The prevalence of TBI has increased in recent years due to the past Iraq/Afghanistan wars (Warden, 2006), as well as greater recognition of sports-related concussions (Sukiewicz et al., 2005) and possibly related neurodegenerative disorders (e.g., Alzheimer’s, Parkinson’s) (Daneshart et al., 2011).

TBI occurs as a result of insult to the head and the underlying brain structures. It induces widespread brain damage due to the initial and immediate biomechanical effects (e.g., coup-contrecoup, shearing, diffuse axonal injury, etc.) and later the slower-acting biomolecular/cellular mechanisms, with the latter correlated to recovery.

Types of impairment in the TBI population • TBI will result in a constellation of adverse effects of a sensory, motor, perceptual, linguistic, cognitive, attentional, and behavioral nature (Cluff and Ludlam, 2011).

• TBI causes adverse visual consequences (e.g., cataract problems, visual-field defects, visual attention deficits) (Kapoor and Cluff and Ludlam, 2002; Cluff and Ludlam, 2011).

• One of the most common and debilitating, yet poorly understood, visual sequelae of TBI particularly in mild traumatic injury (mTBI) patients is “increased visual motion sensitivity” (VMS), i.e., the presence of naturally-occurring visual motion in the visual-field will have adverse physiological and perceptual effects in some individuals with TBI (Winkler and Cluff and Ludlam, 2009).

• They may report nausea, vertigo, unsteadiness, balance difficulties, disorientation, and a sense of visual confusion/kinesia (Cluff and Ludlam, 2009). These specific symptoms have been referred to as the visual-vertigo syndrome (Cluff and Ludlam, 1999), as well as the “sensory storm” syndrome.

Remediation of VMS by using Binaural Occlusion (BNO) • Binaural occlusion (BNO) has been used clinically to reduce the intensity of the symptomatic increased VMS, in particular for mild traumatic brain injury (mTBI).

• BNO can be accomplished by using strips of transparent scotch tape, transparent nail polish, and/or opaque electrical tape, placed either on the front or the back surface of the spectacle lenses, nasal to the pupil-limbal margin.

• The BNO can be oriented either vertically, or tilted 10° superiority-temporally to allow for convergence at near to be unobstructed (Figure 1).

• The occluders block a region of visual space in the near retinal periphery contralateral to the occluder eye placement.

• There has been only one formal research investigation by Padula et al. (1994) specifically dealing with the combined effect of BNO with base-in prisms in TBI on the VEP.

Purpose & Hypothesis

• The purpose was to assess the effect of binaural occluders (BNO) alone on the visually-evoked potential (VEP) amplitude and latency in visually-normal and in mild traumatic brain injury (mTBI) individuals.

• The hypothesis of the present study is that there will be an increase in VEP amplitude, with little if any change in latency, in BNO in the mTBI population, due to presumed reduction in chronic visual inhibition/suppression effects in the near retinal periphery.

Methods

• Subjects were comprised of adult visually-normal (n=10, mean age 26 years) and mTBI (n=10, mean age 28 years, 10-years post-injury) individuals with VMS.

• Conventional full-field VEP testing was employed (64 x 64 checkerboard pattern, 17° x 17° V Maxwell stimulus size, 86% contrast, 64 cdm² square, 1 meter distance, average of 2 trials, binocular viewing with spectacle correction) (Figure 2).

• The VEP amplitude and latency were measured with corrective refraction under the following two experimental conditions in both groups:

  ➢ Condition 1: Full-field stimulus without binaural occlusion (BNO)

  ➢ Condition 2: Full-field stimulus with binaural occlusion (BNO)

• A 5.7° x 17° V Maxwell region of space 5.5° lateral to the edge of the test stimulus on either side was blocked by the binaural occluders (Figure 3).

• Subjective impressions while walking, and attempting to grasp near objects, were also assessed with and without BNO.

Results

• The purpose was to assess the effect of binaural occluders (BNO) alone on the visually-evoked potential (VEP) amplitude and latency in visually-normal and in mild traumatic brain injury (mTBI) individuals.

• The hypothesis of the present study is that there will be an increase in VEP amplitude, with little if any change in latency, in BNO in the mTBI population, due to presumed reduction in chronic visual inhibition/suppression effects in the near retinal periphery.

• There was no significant change in the mean latency (P100 ms) in the two conditions in both groups.

• The mechanism has been unclear, although some have speculated on various neuromodulatory and central neurotransmitter systems involved (Padula et al., 1994; Gallop, 1998); however, these explanations were not well-formulated.

• We speculate that mTBI patients habitually attempt to suppress visual information in the near retinal periphery to reduce their abnormal VMS. With addition of the BNO in mTBI, suppression is rendered unnecessary.

• This leads to the spread of reduced inhibition producing enhanced central visual field responsiveness. In contrast, in VN, it may reflect reduction of normal excitation over the same spatial regions, thus reducing central visual field responsiveness.

• There are three important clinical implications of the present VEP findings;

  ➢ First, an objective correlate to the decreased symptoms was found.

  ➢ Second, and related to the above, an objective correlate to the improved sensorimotor and visuomotor performance was found.

  ➢ Third, and perhaps most directly clinically relevant, in these mTBI patients with the symptom of the VMS, if one does not obtain a consistent increase in VEP amplitude with BNO, the clinician should proceed with caution; BNO may be fact confounded, and this normalization warrants further investigation.

References


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Program/Poster# 498B/D979

STATE UNIVERSITY OF NEW YORK COLLEGE OF OPTOMETRY

OPTOMETRY

SUNY EYE INSTITUTE Collaborative Research Consortium The State University of New York

Acknowledgements

We thank Dr. Michael Alkon for his helpful discussions, and ODYSYS Inc., Pine Brock, New Jersey, USA for providing the VEP system.