A Retrospective Analysis of Vertical Heterophoria Treatment and Amelioration of Post-Concussive Disorder Symptoms Utilizing a Multifaceted Assessment Battery

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Objectives

Traumatic brain injury (TBI) appears to precipitate vertical heterophoria (VH) (a form of binocular vision misalignment) in a subset of patients after TBI, and the VH appears to be causing post-concussive symptoms of headache, dizziness, anxiety, neck pain and reading difficulties in this group. We hypothesized that treatment of the VH utilizing realigning prismatic spectacle lenses would significantly reduce these post-concussive symptoms. The objective of this study is to utilize validated survey instruments and other metrics to quantify the reduction of headache, dizziness and anxiety resulting from prismatic lens treatment.

Methods

Thirty eight patients with a history of TBI, who presented to an optometric binocular vision subspecialist with persistent post-concussive disorder symptoms and who were simultaneously diagnosed with VH, had completed data sets and were included in this retrospective analysis. Data was collected prior to and at the conclusion of VH intervention from validated survey instruments (Headache Disability Index (HDI), Dizziness Handicap Inventory (DHI), Zung Self-Rating Anxiety Scale (SAS); from the Vertical Heterophoria Symptom Questionnaire (VHSQ) (a self-administered VH symptom assessment instrument developed by the authors to determine VH symptom burden); from a subjective rating (0-10 scale) of headache, dizziness and anxiety severity; and from a sub-analysis of VHSQ questions that pertain specifically to headache, dizziness and anxiety. Upon conclusion of treatment, subjective assessment of overall improvement of VH symptoms was obtained utilizing a 10 cm visual analog scale (VAS). Effect of treatment was analyzed using paired *t*-test.

Results

When compared with pre-intervention baseline, there was an 80.2% decrease in subjective overall VH symptom burden as measured by the VAS (p=0.0001). There was a relative reduction in the VHSQ (50.5%; p=0.0001); HDI (29.9%; p=0.028); DHI (40.7%; p=0.002); Zung SAS (19.1%; p=0.0001); 0-10 scores for headache (55.4%), dizziness (60.8%) and anxiety (33.9%); two VHSQ headache questions (49.6%); six VHSQ dizziness questions (51.2%); and the three VHSQ anxiety questions (42.1%). (Figure 1).

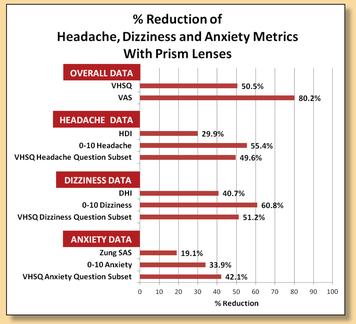


FIGURE 1

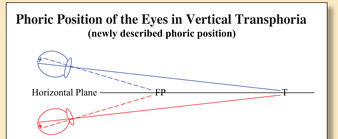
Discussion

VH is an uncommonly diagnosed and poorly understood binocular vision disorder. This is due in large part to the inconsistent performance of the current tests used to identify the direction and amount of VH,[1,2,3] which makes diagnosing, treating and researching this condition almost impossible. Unpublished data demonstrates that Von Graefe Phoria – near, Von Graefe Phoria - far and Vertical Vergence tests individually identified the correct prism direction only 50% of the time. Furthermore, the results of the three tests frequently conflicted with each other, making identification of the correct prism direction unreliable.

We began developing our technique for diagnosing and treating VH (previously described[4]) in 1995, derived from encounters with over 5000 VH patients. Our first step is to utilize the ***VHSQ*** a VH symptom assessment instrument developed by the authors to determine VH symptom burden) to identify ***VH suspects*** (those who would benefit from binocular vision subspecialist consultation). The next step is to ascertain the direction of prism base, which is derived directly from the direction of the head tilt. Finally, the correct amount of vertical prism is determined by incrementally adding small units of vertical prism to the baseline prescription until VH symptoms are significantly reduced and comfort is maximized (a process we named ***Prism Challenge***).

Pathophysiology of VH

Vertical heterophoria is a form of binocular vision dysfunction where the phoric posture (line of sight) of one eye is higher than that of the other eye. Our research indicates that TBI can precipitate this condition by causing vertical transphoria [Figure 2 – dotted lines pointing to FP]. To avoid diplopia, two physiological mechanisms are employed:



(For ease of demonstration, this Figure is showing eye position as if the head is tilted, with the left eye high.)

TBI is causing the lines of sight (phoric position) of the eyes to become ***Vertically Transphoric*** (dotted lines pointing to FP). To correct for this faulty message, retain a binocular single image and avoid diplopia, the eyes undergo ***Compensatory Vertical Divergence***, where the eyes rotate so that the lines-of-sight / phoric posture are returned to midline (solid lines pointing to T). These conflicting actions result in overuse and strain of the opposing elevator and depressor extraocular muscles, which leads to headache, dizziness and anxiety (previously described[4]).

FIGURE 2

1. The eyes undergo ***compensatory vertical divergence,*** moving the lines-of-sight / phoric posture back to midline (solid lines pointing to T). The conflict between the faulty message (causing vertical transphoria) and the compensatory message (causing compensatory vertical divergence) results in overuse of the opposing elevator and depressor extraocular muscles (EOM's), causing EOM strain and fatigue, which leads to headache, dizziness and anxiety (previously described).[4]

2. Tilting the head toward the shoulder vertically realigns the images, but this leads to neck ache [Figure 3]

Physical Findings of VH

Physical findings indicative of VH may include head tilt [Figure 3], worsening of headache with eye movement, worsening of headache / dizziness with Near Point of Conversion (NPC) testing, veering to one side with ambulation, tender trapezius muscles and furrowed brow.

FIGURE 3 – Head Tilt

VH Symptoms Prevalent in TBI Patients

This study demonstrates that VH symptoms are prevalent in this TBI patient cohort, yet traditionally most of this information is not sought from patients with TBI. Figure 4 lists these symptoms by category and frequency. The VHSQ queries a representative sample of these VH symptoms and is used for identifying VH suspects.

Conclusions

Currently there is not an association between VH and TBI. In our patient cohort, it appears that TBI is precipitating VH, that VH is the cause of many post-concussive disorder symptoms (including headache, dizziness and anxiety), and that treatment of VH with prismatic lenses resulted in marked reduction of all metrics for headache, dizziness and anxiety, which coincided with the patient's perception of overall VH symptom reduction. Since effective treatment is available for VH which significantly reduces post-concussive disorder symptoms (realigning prismatic lenses), it should be a high priority to screen TBI patients with prolonged post-concussive disorder symptoms for VH. Identifying VH suspects can be accomplished by utilizing the VHSQ. While anecdotally VH is common in this cohort, further studies will be required to determine true VH prevalence. Also anecdotally, while there is significant improvement in gait, balance, reading comprehension / speed and cognitive performance, further studies will be needed to ascertain whether these types of functional improvements are to be routinely expected with correction of VH.

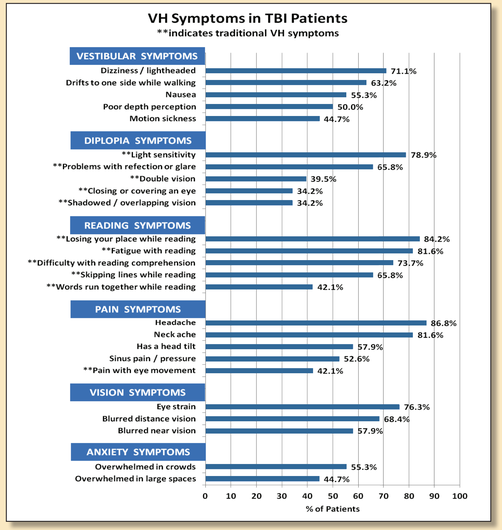


FIGURE 4

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