

Vertical Prism: A Small Amount Goes a Long Way

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Abstract

Background: *Patients who present with complaints of headaches, or vague visual symptoms are often the most difficult to manage. A thorough history to explore the nature of the symptoms, including onset, duration, frequency, and severity is essential. Once the more serious differentials have been ruled out, diagnosis and management can be as simple as performing a cover test and prescribing glasses with vertical prism. Three cases will be presented in which vertical prism alleviated the visual symptoms.*

Case Summary: *Three patients presented with various complaints of headaches associated with near work that occurred multiple times per week. Entrance testing on all three patients was within normal limits. During cover testing, no movement was seen. However, all three patients reported subjectively noticing a small vertical “phi” motion during cover testing. This “phi” motion was neutralized with small amounts of vertical prism placed before one eye. Each patient was then prescribed the indicated prescription and told to return for a one month follow up appointment. All three patients reported dramatic reduction in the frequency and severity of their headaches at the one month follow up appointment.*

Discussion: *The treatment and management of vertical phorias should be considered when headache/eye strain symptoms are presented. While recent literature related to TBI (Traumatic Brain Injury) demonstrates successful treatment of vertical phorias with prism, the same evidence in the general population is scarce. The purpose of this presentation is to bring light to the topic of small angle vertical phorias, and provide a straight-forward and simple approach for their treatment.*

Key Words

headaches, prescribing prism, vertical heterophoria, vertical prism

Vertical Heterophoria

Vertical heterophoria is a visual condition in which the line of sight from one eye is higher than the line of sight from the fellow eye when at physiologic rest.¹ It can also be termed latent hyperphoria or vertical phoria. Patients with vertical phorias have to over use the elevator and depressor extraocular muscles to maintain single binocular vision, which can lead to eye strain or asthenopia.¹ The incidence of vertical heterophoria has been reported to range from 7% to 52%.² This is a wide range and the exact incidence is difficult to infer. However, based on study results over the past 100 years, the number of patients with symptoms consistent with vertical heterophoria is more accurately thought of as being in the 10 – 20% range.²⁻⁴ The exact cause of vertical heterophoria is uncertain and has been thought to be due to orbital, neuromuscular, or innervational factors. The following paper will detail three case reports of patients diagnosed with and treated for symptomatic vertical phoria. An alternative method for diagnosing and prescribing vertical prism will be presented.

Patient KL

Patient KL was a 17-year-old white female and a senior in high school. She presented for a full examination with a chief complaint of “I didn’t go to school today because I have a headache.” She reported getting sick from the headaches, which happened two to three times per week. This had been occurring for about two years. She reported that the headaches were worse after reading, and that she took ibuprofen for moderate relief. She had problems climbing stairs, stat-

ing, “I tend to fall a lot; I’m clumsy.” She also reported getting car sick and had vague reading difficulties.

Best corrected visual acuities with -3.00 DS OU were 20/20 OD, 20/20 OS, and 20/15- OU in the distance, and 20/20 OU at near. Pupil reactions were normal with no afferent pupillary defect. Extraocular motilities were full and smooth. On stereo acuity testing she saw 25" of arc, + RDS. Near point of convergence was to the nose and confrontation fields were full to finger count OD and OS. Anterior and posterior segment evaluations showed ocular health to be within normal limits (Table 1).

On objective cover testing at distance, orthophoria with a (+) phi motion was reported. Phi is defined as the apparent motion of the stationary cover test target perceived by the patient. Orthophoria was noted at near as well. When asked about the phi motion, she said the target moved up and down/diagonally. The vertical phi motion was neutralized with ½ prism diopter (^) BU OD.

The primary diagnosis was vertical heterophoria—symptomatic, with myopia as a secondary diagnosis. The plan was to order new glasses with ½^ BU OD, and to return in one month for follow up. At that visit the patient reported a dramatic reduction in headaches. She could only remember one headache and it was not nearly as severe as previous occurrences. Additional in-office testing revealed no vertical phi motion on cover test. The patient was told to return on an annual basis for regular exams or sooner should any problems arise.

Patient AA

Patient AA was a 27-year-old white female and worked as a pharmaceutical representative. She presented for an exam with a chief complaint of “I want some prism glasses to wear over my contacts.” She dropped out of medical school after only two years because of headaches. The headaches occurred when reading with contact lenses but not with her current glasses. She reported already having glasses with vertical prism, and wanted glasses to wear for more comfort while driving without needing to remove her contacts.

Best corrected visual acuities with -4.25 D of spherical equivalent OU distance were 20/20 OD, 20/20 OS, 20/20 OU, and 20/20 at near. Pupil reactions were normal with no apparent papillary defect. Extraocular motilities were full and smooth. Near point of convergence was to the nose and confrontational fields were full to finger count OD and OS. Slit lamp and ocular health findings were all within normal limits.

On objective cover testing at distance orthophoria was noted. No vertical motion was detected. however, when asked, the patient reported a (+) vertical phi motion. The vertical phi motion was neutralized with 1^ BU OS.

Primary diagnosis was a vertical heterophoria. The plan was to order a new prescription with plano OU and 1^BU OS for wear over her contact lenses. Since she was an established patient and had successfully worn vertical prism without problems in the past, she was told to return for her annual exam in one year or sooner if she had any problems with the new prism glasses.

Patient NR

Patient NR was a 14-year-old female and in the eighth grade. She presented with the chief complaint of “I have trouble reading and the words on the page jumble after 10-15 minutes.” She reported getting headaches often, “almost every day after school.” She did not get awakened by the headaches at night, and often fell when climbing stairs. She also indicated that car sickness was an occasional problem. The patient and parent had been referred after an eye exam three weeks prior was unable to determine the cause of the headaches.

Her unaided visual acuities were 20/20 OD, OS, OU at distance and 20/20 OD, 20/20-2 OS and 20/20 OU at near. Pupil reactions were normal with no apparent papillary defect.

Extraocular motilities were full and smooth. Near point of convergence broke at 5cm and she recovered at 7cm. Ocular health was all normal, per parent, at an eye exam three weeks prior.

On the objective cover test at distance, orthophoria was noted, and there was no observable vertical movement. Near cover testing also showed orthophoria. The patient reported variable responses to subjective vertical phi motion and noted the right eye image was higher at distance, but it varied at near. After having the patient read in office for 15 minutes, a reliable and repeatable subjective observation of a vertical phi motion was elicited from the patient. The patient’s vertical phi motion was neutralized with ½ ^ BU OD.

The primary diagnosis was a vertical heterophoria. The plan was to order a new prescription with +0.25 DS OU with ½ ^ BD OS. The patient was scheduled to return for a one month follow up visit to check the status of the headaches. At that visit the patient reported less jumbling of words when reading and a reduction in frequency and severity of headaches.

Discussion

Reports of vertical phorias are found in the literature including one case report that highlighted a 29-year-old patient who reported noticing symptoms consistent with a vertical phoria during the 2nd trimester of her pregnancy. Objective findings supported this being new onset, as a vertical motion was detected on cover test, but there was no previous record of any vertical deviation. She was successfully treated with 2^ BD OS which was incorporated into her contact lens.⁵ A logical explanation as to the cause of vertical heterophorias points to the patient’s inability to continue to compensate for the vertical deviation. This could be due to aging, stress, sickness, or other similar factors.⁶ The subject of symptomatic vertical heterophorias and their relation to patients with traumatic brain injuries (TBI) demonstrates support for the decreased compensation concept as these patients were asymptomatic prior to their injuries.

While this paper is not specifically focused on TBI patients, the successful use of vertical prism in the TBI patient population can be extended to patients without TBI. The study by Doble et al. showed that the effective use of vertical prism can help relieve asthenopia symptoms in TBI patients.

Table 1: Patient examination information

	Patient KL, 17 yr. old, F	Patient AA, 27 yr. old, F	Patient NR, 14 yr. old, F
Chief Complaint:	“I didn’t go to school today because I have a headache.”	“I want some prism glasses to wear over my contacts.”	“I have trouble reading and the words on the page jumble after 10-15 minutes.”
History:	2-3 headaches per week, worse with reading, trips climbing stairs.	Dropped out of medical school because of headaches when reading.	Gets HAs often, almost every day after school.
BCVA:	20/15-1 OU	20/20 OU	20/20 OU
EOMs:	full and smooth	full and smooth	full and smooth
NPC:	BON	BON	5cm/ 7cm
Stereo:	25” of arc	not tested	not tested
Cover Test:	phi motion neutralized with 1/2 ^ BU OD.	phi motion neutralized with 1^ BU OS.	phi motion neutralized with 1/2 ^ BU OD.
Plan:	Order new RX with ½ ^ BU OD; RTC 1 month for follow up.	Order new RX with plano OU and 1^BU OS.	Order new RX with ½ ^ BD OS; RTC 1 month for follow up.

A group of TBI patients who were examined and treated by one physiatrist but still had complaints of postconcussive symptoms despite standard treatments and medications was referred to an optometrist and upon examination was found to have a vertical heterophoria. The more common symptoms reported were headache, face pain/eye pain or strain, dizziness/vestibular symptoms, vision symptoms such as blurred vision, diplopia, or reading difficulties, and neck and shoulder pain. These patients were treated with glasses and prism. Of the 83 patients that were referred for evaluation, 43 had complete data sets and were included in the analysis (Mean age: 44.4 years old, 28% male/72% female, TBI cause in 93% of cases was motor vehicle crash).

In addition to the physical exam, all patients filled out an objective, self-administered survey (Vertical Heterophoria Symptom Questionnaire [VHS-Q]¹ - see Appendix A) developed by one of the authors, to quantify the severity and changes in symptoms noticed. The mean baseline VHS-Q score was 34.8 points (SD, 16.1) with a range of 0-75 points. With the primary outcome measure of the study being the mean improvement on the VHS-Q survey, the mean difference in the VHS-Q score from before to after treatment was improved by 16.7 points. This was statistically significant ($p < 0.01$) and additionally, the mean subjective improvement in symptoms after prism treatment was 71.8%. The thought of the study authors is that in a TBI patient, "the brain injury results in the generation of a faulty alignment signal that is vertically misaligning the lines of sight of the eyes." This extends to other visual alignment reflexes activating elevator and depressor eye muscles to correct for the misalignment to prevent vertical diplopia and maintain a fused single binocular image.¹ The constant use of the opposing elevator and depressor muscles, and the effort exerted to compensate for the vertical deviation, leads to the extraocular muscle strain and asthenopia and headache symptoms.^{1,2}

An important thing to remember with any headache patient or recent onset strabismic patient is to rule out any recent onset tumors, or more of a medical/pathological reason to account for the headaches, by doing a careful history. As long as the history points to a binocular vision issue, it does not matter why the world appears to be vertically misaligned. The fact that the brain perceives an image that is vertically misaligned places undue stress on the visual system. The human visual system is anatomically not as well equipped to deal with vertical misalignments as horizontal. The use of vertical prism for any patient reporting symptoms consistent with a vertical phoria is justified and should be considered no matter how small the vertical prism prescription is determined to be.

Some patients with a vertical phoria can present with slight head tilts. These patients are more easily identifiable as potential candidates for needing vertical prism, but not all patients that need vertical prism present in such an obvious fashion. Skimming through the complaints of the patients from the previously described cases, one can see similar, yet varying subjective complaints that are listed in Table 2. Even after the symptoms are identified, some patients still do not receive vertical prism. Various reasons abound for not prescribing vertical prism including not recognizing the need for the vertical prism, avoiding prescribing because of patient adaptation fears, or not knowing how much vertical prism to

start with for a given patient. Those patients who need vertical prism will accept the prism and will wear it comfortably. Patients who have a vertical deviation have reduced adaptation ability, compared to orthophoric patients, and tend to wear prism comfortably.⁷ Sometimes patients return and need increased amounts of vertical prism in their glasses, making it seem like they adapted to the prism and needed more to alleviate the symptoms.

A likely explanation for this is not that the patient adapted to their prism, but that the patient actually needed more from the start. Latent hyperphoria can be thought of as being similar to latent hyperopia. A patient with latent hyperphoria may still be able to compensate for a portion of the vertical deviation or may not want to be fully corrected with vertical prism from the outset. For this type of patient, a small vertical prism prescription that they find comfortable can work very well in the beginning. As the patient begins to relax and allow the vertical prism to help do the work of aligning the visual system, the additional vertical prism prescription may then become apparent. The additional vertical prism can then be added to the patient's prism prescription once their visual system stabilizes and allows outside assistance to help them maintain clear, single binocular vision.^{2,8,9} In addition, the ability to compensate for a vertical phoria deteriorates with age. This is an additional reason why a stronger prism prescription may be needed for an established prism patient, or a new patient might need vertical prism for the first time with increasing age.⁶ The amount of vertical prism should not be a deterring factor in deciding whether or not to prescribe vertical prism. A vertical prism prescription of as little as 0.5^Δ can have large effects on binocular fusion and relief of patient symptoms.⁹ The prognosis for improvement in patients with a vertical heterophoria is good as witnessed in the above three patients reporting improvement in symptoms.

Traditional Diagnostic Testing

There are several methods used in the past to diagnose and treat vertical heterophorias. Common diagnostic tests used to determine magnitude and direction of deviation found in the literature review were magnitude of vertical heterophoria tests (cover test, Maddox rod, and von Graefe testing), vertical vergence ranges, flip prism tests, and vertical fixation disparity testing.^{2,4,8,9,10} Common fixation disparity tests are the Disparometer, the Woolf Cards, and the Wesson Card.⁸ Despite all the available tests for vertical phoria testing, there seems to be a disconnect between the various tests and successful treatment of vertical phorias. Various factors, include a practitioner's unfamiliarity with the tests, or not knowing which test is the correct one for a given patient, can contribute to a disconnect between the diagnosis and treatment of the problem.

Diagnostic occlusion is a way to uncover the amount of vertical deviation. If a vertical phoria is suspected, 24 hours of patching occurs followed by testing in a dark room. The goal of the occlusion therapy is to uncover all of the vertical disparity that is present.^{2,9}

Vertical fixation disparity testing seems to have been accepted as the most precise way to determine the amount of prism needed.^{3,8} Vertical fixation disparity testing measures the direction and magnitude of the phoria while the patient has fusion. This is thought to relate best to symptomatic patients because the test is conducted under conditions where

Table 2. Categories of symptoms attributed to vertical heterophoria and the real world description or patient complaint.

Symptom category	Symptom type/description
Pain	Headache, face ache/"sinus" pain, eye pain, burning sensation with reading, pain with eye movements
Head Tilt	Neck ache, upper back pain related to head tilt
Dizziness	Lightheadedness, off-balanced, motion sickness, carsickness, vertigo, nausea, inability to read in a moving vehicle due to induced nausea, Poor depth perception, lack of coordination, unsteadiness or drifting to one side while walking, difficulty walking down grocery aisle, difficulty climbing stairs, disorientation, clumsiness
Reading	Difficulty with concentration/reading/comprehension, fatigue with reading, eyes tire easily, skipping lines when reading, reads same line again, using a line guide to maintain place while reading, words run together or blur while reading, losing one's place while reading, slow reading
Routine visual	Blurred vision at near or far distances, difficulty with close up vision, difficulty with night vision, eye strain, sore eyes
Binocular vision	Double or overlapping vision, vertical diplopia, shadowed vision, light sensitivity, difficulty with glare or reflection, difficulty driving at night, closing/covering one eye while reading
Psychological symptoms	Feeling overwhelmed or anxious in crowds, Agoraphobia, Feeling overwhelmed or anxious when in large contained spaces like malls or big box stores ^{1,2,3,8,9,10}

fusion is present. The amount of prism that reduced the patient's fixation disparity to zero can be prescribed to relieve the symptoms.^{3,8} However, there is an easy alternative.

A Novel Approach

A prism prescription that is based on the patient's phi movement on cover test can be used to relieve symptoms secondary to a vertical heterophoria. The method is much easier to use because there is no need to purchase or use any extra equipment outside of a cover paddle, prism bar, and a distance or near cover test target. Begin by having the patient fixate on a distance target, just as would be done during cover test. Perform a traditional cover test and watch for vertical movement. The patients in the previous cases had very small vertical phorias, so no movement was actually objectively observed on cover test. Then ask the patient if the target appears to move at all "either left, right, up, down, or diagonally." If the patient reports up, down, or diagonal motion find out which eye perceives the target image to be higher when the fellow eye is covered. Start by placing 1^Δ BU prism over the eye that sees the higher image, and increase or decrease the amount of prism accordingly, until the patient stops noticing any vertical phi motion. Record the amount of prism and direction over the corresponding eye that neutralizes the patient's vertical phi motion. This prism amount is the initial amount and direction used, along with the prescribed dioptric lens power, to prescribe for relief of the patient's symptoms.

Conclusion

Further research is needed to assess the effectiveness of this treatment. Research shows that patients with abnormal binocular systems wear prism successfully, however, long term follow up care would demonstrate if increased amounts of prism are necessary or if the amount is stable. This would help determine the long term accuracy of the proposed prescribing method of using the patient's vertical phi motion to determine the amount of vertical prism needed. If the patient returns for a follow up examination after receiving a spectacle prescription with vertical prism, and still complains of frequent headaches or eye strain symptoms, vision therapy could be considered as an alternative or concurrent mode of treatment.

The diagnosis and treatment of vertical heterophoria is not a new topic, but it is one that needs to be brought to light for practicing optometrists. Many patients can be helped; es-

pecially those whose visual issue might have otherwise been overlooked in the past. The intent of this writing was to detail the symptoms and signs of vertical phoria patients and to demonstrate the ease and importance of their treatment. The three patients described in the case reports all reported relief of their headache symptoms after treatment with vertical prism. A careful case history and attention to detail is crucial in the care of any patient, especially one with odd complaints of eye strain that are not obvious at first glance. In offices where vision therapy may not be an offered treatment modality, simply prescribing vertical prism can help patients with a vertical heterophoria. A vertical prism prescription, no matter how small, can make an enormous positive impact on the quality of life of these patients.

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Appendix A.

Vertical Heterophoria Symptom- Questionnaire

Directions: For each of the following questions please check the answer that best describes your situation. If you wear glasses or contact lenses, answer the questions assuming that you are wearing them.

Always = Everyday Frequently = At least 1 time/week Occasionally = Less than 1 time/week Never = Never	V Always	V Frequently	V Occasionally	V Never
1. Do you have headaches and / or facial pain?				
Draw in location of discomfort (scale 1=extremely mild, 10= extremely severe) Face Back of Head				
2. Do you have pain in your eyes with eye movement?				
3. Do you experience neck or shoulder discomfort?				
4. Do you have dizziness and / or lightheadedness?				
5. Do you experience dizziness, lightheadedness, or nausea while performing close-up activities (i.e. - computer work, reading, writing)?				
6. Do you experience dizziness, lightheadedness, or nausea while performing far-distance activities (i.e. - driving, television, movies)?				
7. Do you experience dizziness, lightheadedness, or nausea when bending down and standing back up, or when getting up quickly from a seated position?				
8. Do you feel unsteady with walking, or drift to one side while walking?				
9. Do you feel overwhelmed or anxious while walking in a large department store (i.e. - Target, Wal-Mart, Meijer)?				
10. Do you feel overwhelmed or anxious when in a crowd?				
11. Does riding in a car make you feel dizzy or uncomfortable?				
12. Do you experience anxiety or nervousness because of your dizziness?				
13. Do you ever find yourself with your head tilted to one side?				
14. Do you experience poor depth perception or have difficulty estimating distances correctly?				
15. Do you experience double / overlapping / shadowed vision at far distances?				
16. Do you experience double / overlapping / shadowed vision at near distances?				
17. Do you experience glare or have sensitivity to bright lights?				
18. Do you close or cover one eye with near or far tasks?				
19. Do you skip lines or lose your place while reading (do you use your finger or a ruler or other guides to maintain your position on the page)?				
20. Do you tire easily with close-up tasks (computer work, reading, writing)?				
21. Do you experience blurred vision with far-distance activities (i.e. - driving, television, movies, chalkboard at school)?				
22. Do you experience blurred vision with close-up activities (i.e. - computer work, reading, writing)?				
23. Do you blink to "clear up" distant objects after working at a desk or working with close up activities (i.e. - computer work, reading, writing)?				
24. Do you experience words running together with reading?				
25. Do you experience difficulty with reading or reading comprehension?				