Vertical Heterophoria: New Discoveries Enable Treatment of Many Associated Disorders

Mark S. Rosner, MD, and Debby Feinberg, OD

New work on vertical heterophoria has dramatically advanced both our understanding of the condition and our ability to treat it.

In 2006, Penelope, a fabrics engineer, was critically injured in a car accident in which she suffered a significant traumatic brain injury. One year into her recovery, she continued to experience a myriad of symptoms, including headache, dizziness, nausea, neck pain, eye strain, fatigue, and anxiety. She found it difficult to walk or drive; she also had trouble focusing, reading, and writing. The worst, however, was that the symptoms did not improve, even though Penelope received the full range of treatments typically given to patients with traumatic brain injury.

By the time Penelope was referred to us in 2008, she had been through speech therapy, occupational therapy, physical therapy, and even vision therapy without gaining more than marginal relief from her symptoms. She received a comprehensive vision evaluation, was diagnosed with vertical heterophoria, and was prescribed vertically realigning prismatic spectacle lenses. In a matter of days, her symptoms were markedly reduced. Within one week, her occupational therapist and neuropsychologist noted significant improvements.

At this point, we have seen more than 1,000 patients similar to Penelope. What these cases have in common is a history of brain injury, a complex group of symptoms, and minimal improvement to multiple treatment modalities. These cases also share one other thing: successful treatment with vertically realigning prismatic lenses. All of these patients had vertical heterophoria, which we now know can produce a wide range of symptoms.

Vertical Heterophoria: A Brief History

A form of binocular vision dysfunction, vertical heterophoria is a visual condition in which the line of sight from one eye is higher than the line of sight from the other eye when at physiologic rest (an ocular posture created by disrupting fusion with a Maddox Rod or prism). Due to this alignment challenge, patients with vertical heterophoria have marked difficulty maintaining a binocular image. Two compensatory mechanisms employed by these patients to facilitate fusion include the overuse of the elevator and depressor extraocular muscles and the tilting of the head (Figure 1). The extraocular muscle overuse leads to strain and fatigue, which causes many of their other symptoms. The head tilt leads to chronic neck pain.

Although vertical heterophoria was first described in the 19th century, the medical literature has had very little to say about it since then.[1] More than a century ago, G.T. Stevens claimed to have successfully treated vertical heterophoria with surgical intervention (extraocular muscle tenotomy), but his results have not been reproducible.

FIGURE 1 Head tilt characteristic of vertical heterophoria. *(Photo courtesy of the authors.)*

	VERTICAL HETEROPHORIA
☑	Causes
	— Congenital
	— Acquired brain injury
☑	Classic Symptoms
	— Headache
	— Neck ache
	— Dizziness
	— Anxiety
	— Difficulty reading
☑	Typical physical sign
	— Head tilt
☑	Diagnostic testing
	— VHSQ
	— Prism challenge
☑	Treatment
	— Vertical prismatic lenses
	— Progressive prescription

In the 1950s, Raymond Roy, OD, successfully diagnosed and treated vertical heterophoria using prolonged monocular occlusion to delineate the direction of vertical misalignment. He utilized much smaller than standard units of prism in his spectacle lens prescriptions.[2] Since then, very little research has been published on vertical heterophoria.

New Correlations

The most common form of vertical heterophoria is congenital, and it is attributable to facial or orbital asymmetry. To date our practice has seen over 4,000 of these patients. Symptoms can occur at any age, but the average age of symptom onset is about 40, which is also the time at which normal age-associated skeletal muscle weakening begins.

It is not widely recognized that vertical heterophoria can be precipitated by brain injury (including traumatic, ischemic, or hypoxic) due to a cerebrovascular accident, near-drowning, asphyxia, or near-exsanguination.

We have recently described our observation that vertical heterophoria and traumatic brain injury are correlated, our hypothesis being that brain injury leads to the generation of an aberrant neural signal that vertically misaligns the visual axes of the two eyes.[3] The specific locus or loci of the brain injury responsible for these symptoms has yet to be identified, though. Vertical heterophoria is often unrecognized in these patients since the symptoms, as in Penelope's case, overlap significantly with those of traumatic brain injury.

Up to now, vertical heterophoria has been associated almost exclusively with visual symptoms, although some would include headache on the list. Based on our experience, patients with vertical heterophoria can have a wide range of symptoms in seven major domains (Table 1). The specific combination of symptoms, the severity, and the frequency can vary widely from patient to patient.

TABLE 1 Symptoms of vertical heterophoria (by symptom category). Blue lettering indicates traditional vertical heterophoria symptoms.

PAIN SYMPTOMS
- Headache
- Face ache / "sinus" pain
- Eye pain or pain with eye movements

HEAD TILT SYMPTOMS
- Neck ache and upper back pain due to a head tilt

DIZZINESS SYMPTOMS
- Dizziness
- Lightheadedness
- Off-balanced feeling
- Motion sickness (frequently the first symptom of vertical heterophoria—can occur very early in childhood)
- Nausea
- Poor depth perception
- Lack of coordination
- Unsteadiness or drifting to one side while walking
- Difficulty walking down grocery aisle
- Disorientation

READING SYMPTOMS
- Difficulty with concentration
- Fatigue with reading
- Difficulty with reading and reading comprehension
- Skipping lines while reading
- Using a line guide (finger, ruler, envelope) to maintain one's place while reading
- Words running together while reading
- Losing one's place while reading

ROUTINE VISUAL SYMPTOMS
- Blurred vision at near or far distances
- Difficulty with close-up vision (ie, reading or computer use)
- Difficulty with night vision
- Eye strain
- Sore eyes

BINOCULAR VISION SYMPTOMS
- Double or overlapping vision
- Shadowed vision
- Light sensitivity
- Difficulty with glare or reflection
- Closing / covering one eye while reading

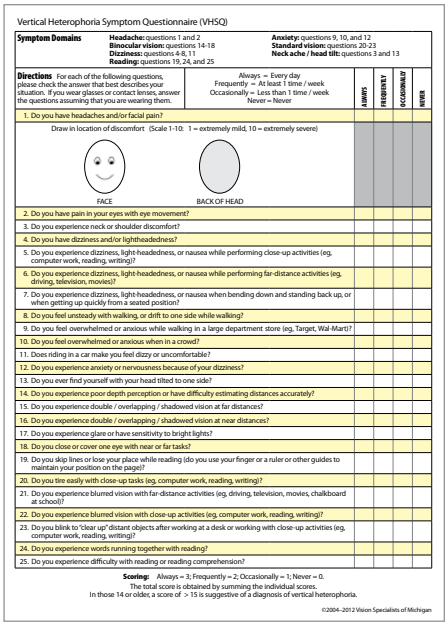
PSYCHOLOGICAL SYMPTOMS
- Feeling overwhelmed or anxious in crowds
- Agoraphobia
- Feeling overwhelmed or anxious when in large contained spaces like malls or big box stores

Testing for Vertical Heterophoria

Traditional vertical heterophoria tests include both dissociated phoria tests (Von Graefe, Maddox rod, and vertical vergence testing) and associated phoria tests. Our unpublished data indicates that the Von Graefe phoria far, Von Graefe phoria near, and vertical vergence tests are often inaccurate and produce contradictory results, making it difficult, or impossible, to determine the prism prescription.

The patient's physical appearance (head tilt, asymmetrical face, and unilateral furrowed brow) and history may suggest the presence of vertical heterophoria. To help identify key elements in the history, and to quantify a patient's symptoms, we have developed the 25-question Vertical Heterophoria Symptom Questionnaire (VHSQ), a validated self-administered survey instrument. The VHSQ includes questions from all seven major symptom domains (head and eye pain, dizziness, anxiety, head tilt or neck pain, reading difficulties, binocular vision symptoms, and routine vision symptoms) and asks the patients to assess the frequency of their symptoms (Figure 2). Scoring is accomplished by summing the values for all responses, with the maximum score possible 75 and the minimum 0. For those 14 years and older, a score of $\geq$ 15 is suggestive of vertical heterophoria.

We confirm the diagnosis with a technique we have named Prism Challenge, in which the examiner uses a trial frame to incrementally add small units of vertical prism to the baseline prescription, until the patient's vertical heterophoria-associated symptoms are significantly reduced (Figure 3). Patients usually recognize a significant reduction of symptoms 20 to 30 minutes after applying the appropriate prismatic lens prescription. We find that those who respond to Prism Challenge almost always do well at the end of the prism treatment process.



Vertical Heterophoria Symptom Questionnaire (VHSQ)

Symptom Domains **Headache:** questions 1 and 2; **Binocular vision:** questions 14-18; **Dizziness:** questions 4-8, 11; **Reading:** questions 19, 24, and 25; **Anxiety:** questions 9, 10, and 12; **Standard vision:** questions 20-23; **Neck ache / head tilt:** questions 3 and 13

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 = Every day
Frequently = At least 1 time / week
Occasionally = Less than 1 time / week
Never = Never

	ALWAYS	FREQUENTLY	OCCASIONALLY	NEVER
1. Do you have headaches and/or facial pain?				
Draw in location of discomfort (Scale 1-10: 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, light-headedness, or nausea while performing close-up activities (eg, computer work, reading, writing)?				
6. Do you experience dizziness, light-headedness, or nausea while performing far-distance activities (eg, driving, television, movies)?				
7. Do you experience dizziness, light-headedness, 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 (eg, Target, Wal-Mart)?				
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 accurately?				
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 (eg, computer work, reading, writing)?				
21. Do you experience blurred vision with far-distance activities (eg, driving, television, movies, chalkboard at school)?				
22. Do you experience blurred vision with close-up activities (eg, computer work, reading, writing)?				
23. Do you blink to "clear up" distant objects after working at a desk or working with close-up activities (eg, computer work, reading, writing)?				
24. Do you experience words running together with reading?				
25. Do you experience difficulty with reading or reading comprehension?				

Scoring: Always = 3; Frequently = 2; Occasionally = 1; Never = 0.
The total score is obtained by summing the individual scores.
In those 14 or older, a score of > 15 is suggestive of a diagnosis of vertical heterophoria.

FIGURE 2 Vertical heterophoria symptom questionnaire (VHSQ). Find a full-sized, downloadable PDF of this questionnaire at www.refractiveeyecare.com.

Differential Diagnoses

The differential diagnosis of vertical heterophoria is broad and includes conditions such as migraine or muscle tension headaches, idiopathic or psychogenic dizziness, frequent non-purulent sinusitis, anxiety or panic disorder, ADD/ADHD, reading or learning disability, chronic neck pain and convergence insufficiency (Table 2). Patients who have been treated for these diagnoses with minimal improvement may have vertical heterophoria.

Treatment

Although vision-care professionals are frequently advised to avoid or to be very sparing in their use of vertical prism, we have found that, when used with proper technique, vertical prismatic lenses can be very effective in reducing symptoms due to vertical heterophoria.

When treating vertical heterophoria with prism, patients are typically unable to accept the entire required prism in the first prescription; hence we use a technique we have named

FIGURE 3 Patient wearing a trial frame, in which small units of vertical prism are incrementally added to her baseline prescription. *(Photo courtesy of the authors.)*

Progressive Relaxation, which involves approximately three visits during which the vertical prism prescription is increased in small steps as the patient's eye muscles progressively relax. The Progressive Relaxation process can take anywhere from 2 weeks to 3 months to complete. Our experience indicates that most vertical prism prescriptions are about 1 D or less.

Patients on benzodiazepines, narcotics, muscle relaxants, or antidepressants may require additional time, as these medications can slow the prism prescription process by interfering with either muscle strength or neurological coordination of the two eyes. To obtain the full benefit of prismatic lenses, patients typically have to markedly reduce or completely eliminate their use of these medications. Partial reduction of symptoms resulting from the first prism prescription encourages patients to take this step, in cooperation with their other doctors.

Looking Forward

Improved diagnosis and treatment of vertical heterophoria and its many associated symptoms will come as clinicians (including both eyecare and other healthcare professionals) gain familiarity with the full set of symptoms and the condition's relationship to brain injury. Similarly, patients must become familiar with the symptoms of vertical heterophoria and learn to seek eyecare when experiencing those symptoms. To achieve these goals, more research and education will be critical.

TABLE 2 Differential diagnosis of vertical heterophoria (by symptom category).

PAIN SYMPTOMS
▪ Migraine headache
▪ Sinusitis
▪ TMJ
▪ Chronic daily headache
▪ TBI / Post concussion syndrome
HEAD TILT SYMPTOMS
▪ CN 4 lesion / SO palsy
▪ Scoliosis
▪ Torticollis
DIZZINESS SYMPTOMS
▪ Benign positional vertigo
▪ Menieres disease
▪ Visual vertigo
▪ Psychogenic dizziness
▪ Chronic subjective dizziness
▪ CVA
▪ Neuromuscular weakness
▪ Brain tumor
▪ TBI / Post concussion syndrome
▪ Migraine associated vertigo
▪ Cervical vertigo
▪ Superior semicircular canal dehiscence
READING SYMPTOMS
▪ Reading or learning disabled
▪ ADD / ADHD
▪ Convergence insufficiency
▪ Binocular vision abnormality
▪ Astigmatism
▪ Hyperopia
▪ TBI / Post concussion syndrome
ROUTINE VISUAL SYMPTOMS
▪ Myopia
▪ Hyperopia
▪ Astigmatism
BINOCULAR VISION SYMPTOMS
▪ CVA
▪ Neuromuscular weakness
▪ Brain tumor
▪ TBI / Post concussion syndrome
PSYCHOLOGICAL SYMPTOMS
▪ Anxiety
▪ Psychogenic dizziness
▪ Depression
▪ Agoraphobia
▪ Chronic subjective dizziness
▪ TBI / Post concussion syndrome

THE BOTTOM LINE

Vertical heterophoria, a condition in which the two eyes are vertically misaligned, can be congenital or precipitated by a brain injury and can manifest non-visual symptoms including headache, dizziness, neck ache, anxiety, and difficulty reading. Head tilt during normal upright posture is a characteristic physical sign. Vertically realigning prismatic lenses are an effective treatment for vertical heterophoria, with the prism prescription slightly increased as the patient's eye muscles progressively relax. The VHSQ and Prism Challenge technique can help establish the diagnosis and determine the proper prismatic prescription.

Mark S. Rosner, MD, is adjunct clinical instructor in the Department of Emergency Medicine at the University of Michigan Medical School and Emergency Department staff physician at St. Joseph Mercy Hospital in Ann Arbor, MI.

Debby Feinberg, OD, specializes in diagnosis and treatment of neurovisual conditions and is the owner of Vision Specialists of Michigan in Bloomfield Hills, MI. They have no financial interests to disclose.

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