PERSPECTIVE

Head Tilt Secondary to Vertical Heterophoria: An Overlooked Cause of Neck and Back Pain in Ocular-Cervical Postural Syndrome (OCPS)

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ABSTRACT

A Binocular vision disorder that is frequently untested and therefore undetected may contribute to significant morbidity within the general population. While patients with Ocular-Cervical Postural Syndrome (OCPS) may or may not have visual symptoms, they often seek care from diverse medical specialists for neck and back disorders.

A vertical heterophoria accompanied by a compensatory head tilt adopted to maintain binocular alignment results in OCPS. Individuals with this condition commonly report chronic neck and upper back pain and/or reduced cervical mobility.

The underlying etiology of these symptoms is often undiagnosed, misdiagnosed, attributed to stress or considered a normal baseline variant.

Optometrists are uniquely positioned to identify this condition through evaluation of vertical heterophoria and to provide treatment through compensatory prism correction, vision therapy, and visual hygiene interventions.

Interdisciplinary collaboration is encouraged. Medical professionals encountering patients with unexplained cervical discomfort or persistent head tilt should consider referral to optometrists specializing in binocular vision disorders for further evaluation.

A hypothesis is also presented suggesting that the prevalence of vertical heterophoria may be increasing, potentially associated with prolonged digital device use and forward head posture, commonly referred to as "Tech Neck."

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INTRODUCTION

Vertical heterophoria, often overlooked in general eye care, may contribute to neck and upper back morbidity in both visually symptomatic and asymptomatic individuals.[1] The term *individuals* is emphasized rather than *patients* because many affected people may not present for eye care. The term Ocular-Cervical Postural Syndrome(OCPS) is proposed to categorize this syndrome.

Many practitioners of Binocular Vision Dysfunction (BVD) limit its clinical consequences to asthenopia, visual processing interference, avoidance of reading and/or pseudomyopia.

However, a review of the anatomy and physiology of the visual, vestibular, neurologic, and cervical systems suggests that these systems are highly interconnected and function in a symbiotic relationship.[2]

It is well documented that the visual system maintains complex interrelationships with other bodily systems.[3] Many ocular structures share embryonic origins with other organs and connective tissues, and therefore may be subject to similar

pathologic processes. Eye care practitioners routinely observe and manage the significant effects of systemic diseases, such as diabetes and thyroid eye disease, on the eyes, adnexia, and binocular system.

The significant interrelationship between the eyes, brain, vestibular system, balance, and posture has contributed to the continued evolution and expansion of the subspecialty of neuro-optometry.

While these systemic influences on ocular health are well recognized and routinely addressed in clinical practice, the potential impact of musculoskeletal dysfunction on binocular alignment — and conversely, the influence of binocular dysfunction on musculoskeletal health — remains largely underrecognized.

A review of the peer-reviewed literature reveals limited discussion of the potential effects of vertical heterophoria on the musculoskeletal system in *visually asymptomatic individuals*. If such relationships exist, eye care practitioners may be able to expand their role in interdisciplinary patient care by identifying and treating a visually induced contributor to musculoskeletal morbidity.

Therefore, an important question remains: *what is the relationship between relatively benign, often overlooked vertical heterophoria-with its often associated compensatory head tilt-and disorders of the neck and upper back?*

The primary purpose of this paper is to inform eyecare practitioners about the importance of addressing patients with vertical heterophoria, whether or not they present with visual symptoms. A secondary purpose is to raise awareness among other medical specialties that the visual system may contribute to chronic neck pain and upper back morbidity.

Vertical Heterophoria

Vertical heterophoria is a subtype of binocular vision disorder resulting from a vertical misalignment of the eyes. The incidence of vertical heterophoria has been estimated to range from 7% to 52%.[4] While this range appears excessive to many experienced clinicians, it nevertheless suggests that vertical heterophoria is not a rare finding.

Within the specialty of optometric management of head trauma, the incidence of vertical heterophoria is undoubtedly higher, secondary to damage to the Trochlear nerve.[5]

Vertical heterophoria may result from several etiologies, including orbital asymmetry, cranial nerve damage, tendon sheath disorders, neurologic disease, systemic conditions, vestibular disorders, and a newly theorized origin commonly referred to as "tech neck".

It is well documented that vertical heterophoria can cause a variety of symptoms, including headaches, diplopia, dizziness, anxiety, and other psychological manifestations.[6] Correction through the use of compensatory prism can ameliorate these symptoms.[6]

Head Tilt

Head tilt, often called torticollis, is an abnormal posture where the head leans towards one shoulder.

Musculoskeletal conditions such as Congenital Muscular Torticollis, Cervical Dystonia (Spasmodic Torticollis), arthritis, herniated discs as well as central neurological disorders could be a cause.

Ocular torticollis is a compensatory head posture tilt, turn or lift adopted to fix vision issues. It is most commonly associated with vertical heterophoria, strabismus, Fourth Nerve Palsy, partial Third Nerve palsy, orbital asymmetries, and Infantile Nystagmus syndrome.

Vestibular disorders such as Benign Paroxysmal Positional Vertigo and Meniere's Disease may produce head tilt due to disturbances in spatial orientation. Loss of hearing in one ear can cause a person to tilt their head to the better hearing ear.

Neck Pain

Neck pain is a major global cause of disability. According to Physiopedia, a widely used physiotherapy reference resource, neck pain ranks fourth among causes of disability worldwide. The incidence of neck pain is reported to range between 10%-20%.[7] Prevalence is higher in women than men, higher in high-income countries, higher in urban areas and peaks around 45 years of age.[7]

It is likely that most individuals have experienced neck pain at some point in their lives. The incidence of neck pain is likely increasing due to modern societal demands. Humans are upright animals, and the visual system most likely evolved primarily for horizontal distance viewing, such as that required for hunting and navigation.

Accordingly, the neck experiences the least musculoskeletal stress when the head is maintained in a neutral, forward-facing position. A review of the anatomy and physiology of the neck and spine in the following discussion clearly supports this premise.

As survival is paramount in all species the practicality for directional mobility is built into the cervical anatomy and physiology.

However, modern lifestyles increasingly require individuals to spend prolonged periods of time looking downward at desks, computers, and digital devices. According to TechNewsWorld, an e-commerce technology news outlet, the average daily screen time for individuals in the United States is approximately 6 hours and 40 minutes.[8]

Therefore, it is not surprising that the excessive mechanical stress on the musculoskeletal system from an abnormal head posture may create cervical problems.

The Connection

It may be injudicious to assume that the visual system, and therefore binocular function, operate independently of the musculo-skeletal and postural systems.

Behavioral optometrists have long proposed connections between the visual system and the rest of the body. In 1963, A.M. Skeffington introduced his well known "four circle" model, which conceptualizes the visual system as interconnected with balance(anti-gravity), movement and speech.[9]

Behavioral optometrists have noted that foot direction (inward or outward pointing) may sometimes mirror ocular alignment patterns, such as under- or over-convergence. There are studies that support these clinical observations.[10] Likewise, some reports have suggested relationships between posture and refractive error.[11]

A brief review of the neck anatomy and physiology may help illustrate the complex relationship between visual input, head posture, and musculoskeletal alignment. The purpose of this discussion is not to fully integrate cervical biomechanics into optometric care, but rather to highlight the interconnected nature of these systems and their potential influence on each other.

The cervical spine consists of the first seven vertebrae (C1-C7). It provides structural support for the head, protects the spinal cord, and allows for a wide range of head movements necessary for visual orientation in space. The first cervical vertebrae (C1), known as the atlas, articulates with the base of the skull and supports much of the weight of the human head, which averages 10-13 pounds. The second vertebrae (C2), known as the axis, allows (C1) to pivot, facilitating rotational movements of the head that are essential for coordinating gaze shifts and maintaining visual fixation during head movement.

The cervical vertebrae are connected by facet joints that allow forward, backward, and rotational movements of the neck and head. Surrounding the spine is a complex network of muscles, nerves, tendons, and ligaments, while shock-absorbing intervertebral discs lie between adjacent vertebrae. Major muscles associated with the cervical spine include the sternocleidomastoid, trapezius, levator scapulae, erector spinae, deep cervical flexors and the suboccipital muscle group.

These muscles contain an exceptionally high density of proprioceptive receptors, including muscle spindles and Golgi tendon organs, embedded within the muscle tissue. Sensory input from these receptors contributes to vestibular reflex pathways that are essential for detecting head position relative to the trunk, coordinating eye movements, stabilizing visual input, and maintaining balance.[12]

Together, the cervical vertebrae, facet joints, proprioceptive receptors, and associated musculature contribute to the maintenance of optimal posture and head position. Postural control is further regulated through the integration of sensory information from multiple systems, including visual, vestibular, and

somatosensory inputs. Among these, visual input plays a critical role in postural stabilization by providing spatial orientation cues that guide head positioning and facilitate balance during both static and dynamic activities.[13]

The spinal column is not perfectly straight. The upper spine is curved inward toward the nose while the lower spine has the reverse curve. This normal cervical curvature is called cervical lordosis. This lordosis serves to maintain structural stability, shock absorption, and efficient support of the head while allowing normal mobility. Proper alignment of the head over the cervical spine allows the visual axis to remain relatively stable during fixation and binocular tasks. When the normal cervical curvature of the spine is lost the weight of the head is no longer properly balanced.[14]

It makes sense that if the head has an abnormal shifting the weight is unequally distributed. Head tilting drastically increases gravitational forces on the neck, turning a manageable 11 pound head into a 27-60 pound weight at various angles.[15] Additionally, the activity of the vestibulo-ocular reflexes are altered which can lead to vertigo, dizziness and balance issues.[16]

This causes strain and potential anatomical changes in cervical and thoracic muscles, spinal discs, ligaments and joints leading to pain, stiffness, headaches and potential nerve damage as the body struggles to support the extra load.[17]

Electromyography (EMG) studies of the splenius and upper trapezius muscles have demonstrated altered muscle activity in individuals with forward head tilt. These individuals reported chronic neck pain compared to a control group.[18] Such findings suggest that abnormal head posture stresses the cervical muscles.

Tech Neck

The relevance of discussing tech neck in this context is to illustrate a parallel syndrome in which a visually driven abnormal head posture results in secondary musculoskeletal consequences. A further hypothesis is that these may not represent parallel systems at all, but rather components of a highly interconnected system.

"Tech Neck" is a visually driven syndrome that has been more widely described in other medical specialties. The term was first coined in 2008 by Dr. Dean Fishman, a chiropractor in Florida. According to the University of Nebraska Medical Center it is classified as an overuse syndrome.[19]

Tech neck refers to chronic neck pain resulting from prolonged downward head posture during the use of mobile phones, tablets and other electronic devices. This persistent strain on the bones, nerves and muscles can result in muscle stiffness, joint inflammation, pinched nerves and potentially even herniated discs.[20]

The degree of forward head posture associated with tech neck can be quantified by measuring the angle of the tragus (the cartilaginous prominence anterior to the ear canal) and the C7 vertebra using a protractor like device and/or postural imagining techniques. An angle measuring less than 50 degrees was considered an abnormal forward head tilt.[21]

Mechanical stress in the cervical spine can induce poor posture and abnormal body alignment. A variety of anatomical and physiologic adaptations have been observed in association with prolonged neck flexion, including changes in the length and strength of cervical musculature and weakening of the thoracic wall and middle back muscles.[22] Many chiropractors add impaired balance, altered respiration, digestive disorders and anxiety disorders as further consequences.

The more one researches tech neck, the more one encounters research from numerous other professions and its effects on other bodily functions.

Case Studies

It is well recognized that patients with a vertical ocular misalignment may experience diplopia unless compensatory mechanisms are employed. The first line of compensation is most likely the use of vertical fusional vergence through increased extra ocular muscle activity. This strain on the vergence system can lead to symptoms commonly associated with Binocular Vision Dysfunction (BVD).

Another compensatory mechanism to avoid both diplopia and reduce asthenopia is a down-

ward head tilt, usually to the side with the hyper deviation. This posture is frequently observed clinically and should be considered a potential red flag for vertical heterophoria. Such a strategy appears logical, as most striated muscles fatigue and diplopia isn't well tolerated.

As previously discussed a persistent head tilt could disrupt the intrinsic balance of the muscles, joints, tendons, ligaments in the cervical region and the vestibulo-ocular reflexes.

While many symptoms may arise from this persistent head tilt[23] neck and upper back morbidity is discussed in these case studies.

The two cases discussed in this paper were selected because they were visually asymptomatic except for refractive error. Both were seen in a private practice setting for routine refraction and ocular health evaluation. Presumably, these patients did not mention cervical symptoms during the case history because they were unaware of any potential connection between their visual system and neuromuscular neck status.

Case One

A 23 year-old white female presented to a private practice for a routine eye examination. Her ocular history was remarkable for low myopia, and she denied any visual asthenopia.

Upon entering the examination room and sitting in the chair, an orbital asymmetry was noted. Her right eye appeared to be positioned a few millimeters higher than her left. The patient was completely unaware of this asymmetry and was also unaware that she intermittently tilted her head downward to the right.

Her corrected visual acuity at both distance and near was 20/20 in each eye with a refractive correction of -0.75 DS in the right eye and -0.50 DS in the left eye. Ocular health findings were unremarkable, and her general health was reported to be good.

At the conclusion of the examination, the patient was asked whether she experienced any neck or back discomfort. She responded enthusiastically, asking, "How did you know?" It was explained that binocular vertical asymmetry can often lead to a compensatory head tilt, which can contribute to chronic neck strain.

She reported a longstanding history of chronic neck and upper back discomfort. To manage these symptoms, she receives weekly chiropractic adjustments and massage therapy. While these treatments temporarily reduce her symptoms, they typically recur several days later. She rated her neck discomfort as approximately 3.5 on the 10 point subjective pain scale.

The option of incorporating a small amount of vertical prism into her spectacle correction was discussed as a potential method to reduce the compensatory head tilt and possibly alleviate her neck discomfort. She agreed to proceed with a prism correction. In this clinician's practice, the need and amount for prism correction in a non-stabismic patient is typically guided by fixation disparity testing.

Based on these findings, a prescription incorporating 2 prism diopters of base-down prism in the right eye was trial framed. The patient reported that her visual acuity appeared sharper and that both her eyes and neck felt more relaxed.

Her final prescription included her myopic correction with 2 diopter base-down prism in the right eye. She was asked to return in 3 months for follow-up.

Although she scheduled the follow-up appointment, she did not return. She was later contacted by telephone and expressed appreciation for the prism correction in her glasses. She reported that her neck and back pain had decreased to approximately "1" on the subjective pain scale and that she was visiting both the chiropractor and massage therapist less frequently.

Case Two

A 34 year-old Asian male in his fourth year of medical school presented to a private practice for a routine eye examination. His ocular and systemic health histories were unremarkable.

No obvious orbital asymmetry or history of head trauma was reported, and initially there was no apparent head tilt. Best corrected visual acuity was 20/20 in each eye at both distance and near

with a refractive correction of -2.75-0.50x20 in the right eye and -3.00-0.25x75 in the left eye.

Initial cover testing revealed no obvious vertical heterophoria, and the examination proceeded uneventfully. At the completion of monocular refraction, both phoropter occluders were opened and the patient was asked about the clarity of his binocular vision. He responded that the vision was very clear but concurrently asked whether he should be seeing two vertically separated Snellen lines.

Surprised by this comment, a repeat cover test was performed at distance while the patient maintained a straight head posture. This revealed a definitive 4 prism diopter right hyperphoria. As these findings were discussed, the patient began tilting his head downward to the right.

He was unaware of this head posture, however, his wife later confirmed that he frequently demonstrated this head tilt.

The patient was then asked whether he experienced neck or upper back discomfort.

Similar to the first patient, he appeared surprised and asked, "How did you know?" He rated his neck discomfort as approximately 4 on the 10 point pain scale and attributed it to the prolonged studying required during his medical school studies.

The findings of vertical heterophoria, compensatory extra-ocular-muscle effort, and resulting head tilt were explained. A trial of 2 prism diopter base-down prism over his habitual right eye correction was demonstrated. He reported an immediate subjective improvement in both clarity and comfort.

A recommendation was made to incorporate a total of 2 prism diopters of vertical prism split between the two eyes in his spectacle prescription as a possible method of reducing his neck discomfort. It was emphasized that no guarantees could be made regarding improvement in neck pain, as such discomfort can have many etiologies.

He agreed enthusiastically, stating, "If I can reduce this neck discomfort and tightness , I am willing to try."

Two weeks later, he returned to pick up the glasses and requested to speak with the author. He reported that his vision was clear and that his eyes felt more comfortable. Five weeks later, he responded to a text message reporting that his subjective neck pain had decreased to approximately "2". He also expressed that he believed continued use of the prismatic glasses might lead to further improvement over time.

Tech Neck and Vertical Heterophoria

Based on clinical experience there appears to be an increase in the incidence of vertical heterophoria unrelated to cranial nerve disease or anatomical asymmetry.

This raises the question of whether there may be a correlation between the relatively new "Tech Neck" syndrome and a possible increase in vertical heterophoria.

Important mechanisms linking head posture and the musculoskeletal system are the vestibulo-ocular reflex (VOR), the Cervico-Ocular Reflex (COR) and the vestibulo-spinal reflex (VSR).

The VOR is an involuntary reflex that stabilizes vision by moving the eyes in the opposite direction of head movements.[24]

The COR uses proprioceptive signals from the neck joints and neck muscles to stabilize gaze by coordinating eye movements in response to neck stretches and neck twists.[24]

The VSR is a critical involuntary mechanism that maintains balance, posture and stability by inducing muscle contractions in the limbs and trunk in response to head movements.[25]

These reflexes work in synergy to keep you stable and oriented when moving.

The condition benign paroxysmal positional vertigo (BPPV) illustrates the clinical implications of these connections.

Within the semicircular canals, calcium carbonate particles (otoconia) normally move freely within the endolymphatic fluid and stimulate hair-like cilia, transmitting information about head position and balance to the brain. In BPPV, these particles become trapped and cannot move freely to compensate for head movement. When the patient suddenly sits up, tilts the head back, or turns to the side, abnormal signals are transmitted to the brain.

As a result, normal vestibulo-ocular coordination may be disrupted, producing symptoms such as vertigo, dizziness, lightheadedness, nausea, blurred vision and nystagmus. This condition typically resolves within several days, and canalith repositioning procedures are often curative.[26]

A hypothesis is therefore proposed that the sustained maladaptive head posture associated with tech neck may affect the vestibular system, which plays an important role in positional stabilization and ocular alignment. Disruption of this system could potentially contribute to the development of vertical heterophoria in patients without cranial nerve pathology or anatomical asymmetry. Thus, a possible physiologic mechanism for the apparent increase in vertical heterophoria may exist.

Alternative physiologic mechanisms are proposed by Ross Hauser, et al.[27] In this paper they propose that multiple ocular pathologies can be induced by forward head position (Tech Neck) common in today's societal demands. They propose that cervical structural dysfunctions induced by extended forward head position causes carotid sheath compression. This compression can lead to impaired venolymphatic drainage of the eye and brain by compressing the internal jugular veins. This can also cause ocular dysautonomia from a disruption in the parasympathetic/sympathetic system balance. Irregular blood flow and or drainage may impair the cranial nerves and or the extra-ocular muscle function which may impair binocular alignment.[27]

There are optometric case reports describing the development of a significant and symptomatic vertical heterophoria following trauma to the cervical area in several patients. The optometrist hypothesized a mechanism where the cervical damage caused the vertical heterophoria. The reporting optometrist subsequently began co-managing certain patients with a local chiropractor.[28]

If this hypothesis proves correct, an adjunctive treatment approach for some cases of vertical heterophoria may involve repositioning digital devices to promote a more natural gaze posture. Such ergonomic repositioning is commonly recommended by specialists in the management of tech neck syndrome.

Optometry is a Human Service

Optometry is not just a science; it is a human service. While we specialize in eye health and the visual system, we can aid the population in many other ways.

Optometrists can recommend supplements that support both visual function and overall systemic health. We can screen for conditions such as high blood pressure and counsel patients with diabetes on the importance of healthy eating and increased physical activity. In visual rehabilitation, we often recommend consultations for children with attention disorders, and we frequently work with school systems to assist with appropriate child placement, special needs support, and learning aids.

In addition, optometrists may aid patients experiencing neck or upper back pain by testing for vertical heterophoria and /or being observant for consistent head tilts. Besides assigning a possible cause and or symbiotic relationship between the vertical heterophoria and neck/back problems we can ameliorate these conditions by simple prismatic correction.

Raising awareness by interdisciplinary education can further aid both our profession and sufferers of unexplained cervical morbidity.

If the theorized origin in some cases is 'tech neck," we can recommend ergonomic modifications, such as raising digital devices or lowering chair height to improve posture and reduce strain.

Visually it is well established that constant close work can lead to accommodative-binocular dysfunctions as well as dry eye disease. Systemically, prolonged sedentary near work does not support a healthy cardiovascular system.[29] It may also contribute to cervical discomfort, decreased cervical mobility, and potentially irreversible musculoskeletal dysfunction.

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