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VISUALLY INDUCED TRIGEMINAL DYSPHORIA: A POTENTIAL LEADING SOURCE OF HEADACHES, EYESTRAIN, AND DRY EYE SENSATION

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VISUALLY INDUCED TRIGEMINAL DYSPHORIA: A POTENTIAL LEADING SOURCE OF HEADACHES, EYESTRAIN, AND DRY EYE SENSATION

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CONTENT SOURCE

This continuing education (CE) activity captures content from a live event held on February 22, 2019.

ACTIVITY DESCRIPTION

Trigeminal dysphoria is a term that describes a variety of symptoms including headaches, eyestrain, dry eye sensation, neck, and shoulder pain. New research suggests that computer vision syndrome, also called digital eye strain, is a form of visually induced trigeminal dysphoria. Clinicians who treat patients with these symptoms must be aware and understand why patients with trigeminal dysphoria are symptomatic and how to treat it.

TARGET AUDIENCE

This certified CE activity is designed for optometrists who treat patients with symptoms of dry eye disease.

LEARNING OBJECTIVES

Upon completion of this activity, the participant should be able to:

- **Describe** the optical neurological mechanism triggering headaches and how it relates to neck pain/tension and eye fatigue
- **Explain** how trigeminal dysphoria is a condition resulting from a misalignment in the visual system that causes stimulation of the trigeminal nerve, triggering patient symptoms
- **Identify** insights into how to identify and treat patients suffering from a misalignment in their vision

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VISUALLY INDUCED TRIGEMINAL DYSPHORIA: A POTENTIAL LEADING SOURCE OF HEADACHES, EYESTRAIN, AND DRY EYE SENSATION

Trigeminal dysphoria is a term that describes the constellation of symptoms commonly experienced by many patients. These symptoms are exacerbated following prolonged use of digital devices after long periods of reading or other close work. The symptoms of trigeminal dysphoria include headaches, eyestrain, dry eye sensation, neck, and shoulder pain.[1] New research suggests that Computer Vision Syndrome, also called Digital Eye Strain, is a form of visually induced trigeminal dysphoria.[2,3,4] While this is a relatively new term, the problems associated with it are not new and have been documented since the 1800s as asthenopia, convergence insufficiency, and fixation disparity, among others.

This continuing education activity explains the mechanism of why patients with trigeminal dysphoria are symptomatic and what to do to resolve their symptoms. We discuss the huge rise in digital devices over the past few years and how this digitally evolving environment has such an impact on our vision. We also review the research happening between neurology and optometry.

I come from a long line of eye care providers, and never did I think as an optometrist that I'd be involved with neurology. However, I believe we will continue to coexist with that field to solve patients' headaches and related problems.

-Jeffrey P. Krall, OD

1. Digre KB. More than meets the eye: The eye and migraine—what you need to know. *J Neuro-Ophthalmol*. 2018; 38: 237-243.
2. Ackerman R, Krall J, Vance Thompson V, et al. A new treatment for computer vision syndrome. eyeBrain Medical Inc. Data on File.
3. Karpecki PM. The dry eye misalignment. *Review of Optometry*. Updated Aug. 15, 2018. Accessed May 20, 1019.
4. Thompson V. Eye pain and strain that masquerade as dry eye. *Cataract & Refractive Surgery Today*. February 2019. Accessed May 20, 2019.

NEUROLOGICAL MECHANISM OF TRIGEMINAL NERVE PAIN

The neurological aspect of computer vision syndrome, also known as digital eye strain.

BY CAROL M. NELSON, MD

I'm a general neurologist, but about 80% of my practice consists of patients with headache. When I initially met with Jeffrey Krall, OD, I was at a point where I was running through all my tools, and I was still struggling with this group of headache patients whose symptoms I couldn't resolve.

These patients had been through the gamut of recommended medications for treatment of migraine[1] and were still symptomatic. We were out of options, which is very frustrating for a practitioner. This is what led us to undertake the Chronic Daily Headache Study in 2013.

TYPES OF HEADACHES

There are several types of headaches (Figure 1). The patients enrolled in the study were experiencing migraine-type headaches. Migraines (without aura) tend to be one-sided, cause throbbing, nausea, vomiting, light and sound sensitivity, and become worse with activity.[2]

Only about 20% of patients have migraine with aura and those headaches are generally reversible in about 20 to 30 minutes, even though they can last up to a couple of hours. These patients can have numbness or tingling on one side of their body. In rare cases, patients can have weakness or one-sided paralysis.[2]

Migraine without Aura:
- Unilateral
- Throbbing
- Nausea/vomiting
- Light and sound sensitive
- Worse with activity
- Severe
- Last 6-8 hours untreated

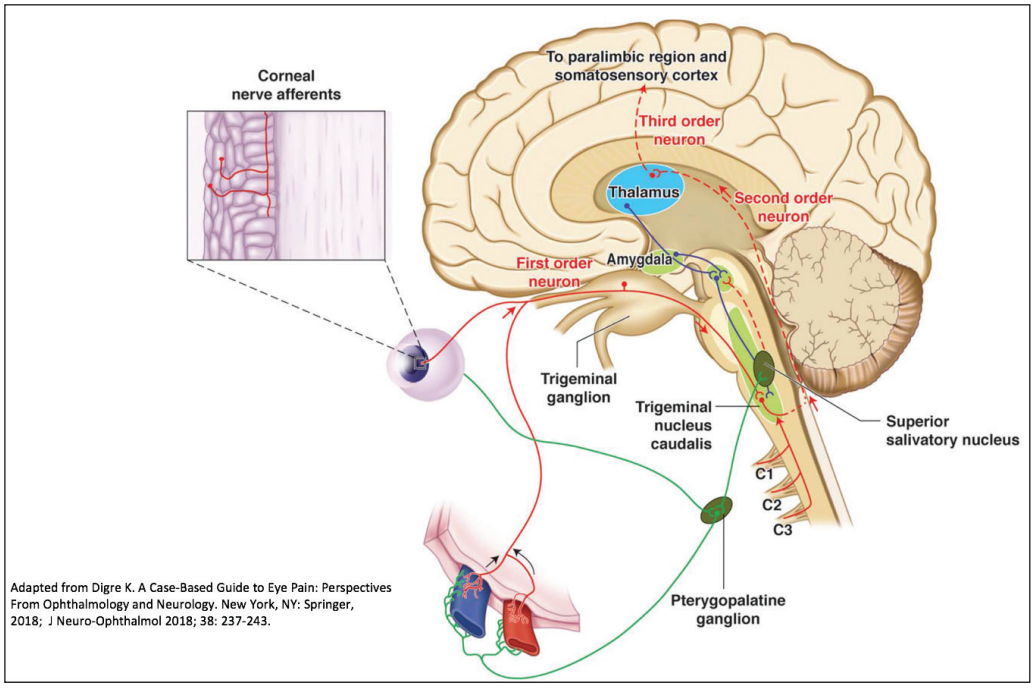
Migraine with Aura:
- Reversible neurologic symptoms that are fully reversible
- Usually last 20-30 minutes
- Can be visual, unilateral numbness, unilateral weakness or dysphasia

Tension Type Headache:
- Bilateral squeezing headache
- Rare nausea/vomiting
- No light or sound sensitivity
- Better or no change with activity
- Mild to moderate

Medication overuse headache:
- Diffuse dull ache, pressure or discomfort
- Non throbbing
- No nausea/vomiting
- No light or sound sensitivity
- No change with activity
- Mild

Trigeminal Dysphoria:
- Bilateral occipital and neck pain that radiates to the retro-orbital regions
- Constant pressure or ache
- Dry eye sensation
- Fatigue
- Light sensitive
- Worse with reading and working on the computer

Figure 1. Types of headaches.



Adapted from Digre K. A Case-Based Guide to Eye Pain: Perspectives From Ophthalmology and Neurology. New York, NY: Springer, 2018; J Neuro-Ophthalmol 2018; 38: 237-243.

Figure 2. The pathophysiology of migraine as a sensory processing disorder receives peripheral pain input from the dura and from the ocular sensory system—both by way of the first division of the trigeminal nerve.

Tension headaches are common and most of your patients have likely described that kind of "squeezing all over" headache. They tend not to be as severe and do not include nausea or sensitivity to light or sound.[2]

Medication overuse headaches can occur in patients who use any sort of pain medication, whether it's acetaminophen, morphine or anything in between. Patients who use those more than 3 days a week can develop medication overuse headaches, which I used to diagnose frequently in my patients before we conducted the trigeminal nerve study. There's a great deal of crossover in how patients feel with medication overuse headaches and trigeminal dysphoria. It's a dull, nondescript headache, without nausea or sound sensitivity.[2,3]

Trigeminal dysphoria is a term that describes the constellation of symptoms commonly experienced by patients following the prolonged use of digital devices or after long periods of reading or other close work. It typically produces a dull type of an ache. I've seen patients describe the pain as coming from the front to the back and from the back to the front. They tend to have significant neck pain and feeling of dry eyes. These patients become fatigued when they're reading and working on the computer and are typically light sensitive. In contrast to a migraine headache (light sensitive during the headache), patients with trigeminal dysphoria tend to be light sensitive all the time. They don't like the sunlight or bright headlights at night. They tend to turn down the brightness on their computer and cell phone screens.[2,3,4]

THE TRIGEMINAL NERVE FUNCTION

The trigeminal nerve is the fifth cranial nerve. Its primary function is to provide sensory and motor innervation to the face. The three sensory branches of the trigeminal nerve emanate from the ganglia to form the three branches of the trigeminal nerve. The different branches are namely the ophthalmic (V1), maxillary (V2), and mandibular (V3) nerves (Figure 2).[3,5]

The ophthalmic branch of the trigeminal nerve sets the bar for the irritability of the trigeminal nerve. It can become irritated by many common triggers: too much caffeine, too little caffeine, excess alcohol consumption, weather change, hormonal change, sleep schedule change, not eating on time, etc.[3]

With migraine headaches, we believe the nerve is simply too sensitive in some individuals.[3] We don't know why, possibly genetic. This variance in nerve levels is likely genetic, which explains why some people can get them and other people do not.[2,3]

The trigeminal nucleus caudalis is the longest nucleus in the brainstem. It goes through the brainstem and into the cervical spine at the C1 and C2 vertebrae, which is partly why patients with migraines and with trigeminal dysphoria have neck pain.[6] We believe the entire

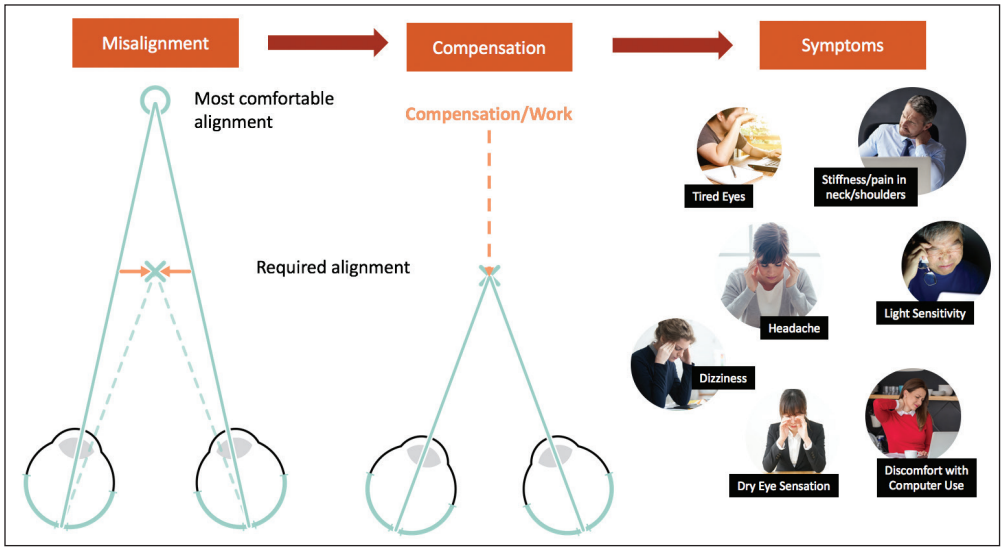


Figure 3. Eye alignment at all distances is essential for comfortable vision.

trigeminal nucleus caudalis becomes irritated and overstimulated. As this irritation continues, it can affect the entire brain, which is called central sensitization. That's when a patient has difficulty concentrating, plus nausea, vomiting, light and sound sensitivity, etc.[2,6]

Also worth noting is that that the trigeminal nerve innervates both the cornea and the meninges, which is the source of migraine pain. There are no pain receptors located in the brain, so the pain is generated from the meninges.[6] When reading, our eyes must constantly transfer images from our peripheral tracking system to our central vision. If there's an imbalance between these two systems, the extraocular muscles are forced to make constant binocular readjustments of eye position, which lead to overstimulation and nerve irritation that results in painful impulses that are transmitted to the eyes, head, and neck.[2,3,6]

RELIEF FOR PATIENTS

With the research conducted at our headache center, plus the work by Dr. Krall and others, we believe we have found a solution to this problem of overworking the brain and overstimulating the trigeminal nerve, which causes eye fatigue, neck pain, light sensitivity, etc., that occurs after prolonged close work and especially after extended use of digital devices. Contoured prism lenses compensate for the eye misalignment and relieve these symptoms.[4,7,8]

To help patients understand the technology, I begin by explaining that he or she has a misalignment between their eyes and the central and peripheral vision. There's quite a large area that has to be compensated for between where your eyes want to focus and where they actually do focus. If one eye is open, you can see an image. If the other eye is open, you can see an image. But when both eyes are open, they must be perfectly aligned. If they're not, like when watching a 3D movie without the 3D glasses, the brain doesn't like that, so it tries to keep those images in focus together (Figure 3). Because the proprioceptive fibers are in the first branch of the cranial nerve fiber, the trigeminal nerve, it's constantly overstimulating that nerve, which likely stimulates the headache pain.[6] This occurs especially when looking at digital devices including computer screens, tablets and smart phones.[4,9]

This overstimulation worsens severe headaches, but it likely triggers trigeminal dysphoria. Therefore, we suggest the best way to prevent trigeminal dysphoria is to keep the nerve calm by ensuring those images are perfectly aligned instead of the brain trying to keep those together through the proprioception. We have found that using contoured prism technology can help keep the nerve calm in certain patients.[4,7,8] ■

1. Loder E, Burch R, Rizzoli P. The 2012 AHS/AAN Guidelines for prevention of episodic migraine: A summary and comparison with other recent clinical practice guidelines. *Headache*. 2012;52:930-945.
2. Rizzoli P, Mullally WJ. Headache. *Am J Med.* 2018;131, 17–24.
3. Digre KB. More than meets the eye: the eye and migraine—what you need to know. *J Neuro-Ophthalmol.* 2018; 38: 237-243.
4. Ackerman R, Krall J, Vance Thompson V, et al. A new treatment for computer vision syndrome. eyeBrain Medical Inc. Data on File.
5. Huff T, Daly DT. Neuroanatomy, cranial nerve 5 (Trigeminal). StatPearls [Internet]. Last Update: April 8, 2019. Accessed May 15, 2019. https://www.ncbi.nlm.nih.gov/books/NBK482283/.
6. Weir C. Proprioception in extraocular muscles. *J Neuro-Ophthalmol.* 2006;26:123-127.
7. del Mar Segui M. A reliable and valid questionnaire was developed to measure computer vision syndrome at the workplace. *J Clin Epidemiology.* 2015;68: 662-673.
8. Teitelbaum B, Pang Y, Krall J. Effectiveness of base in prism for presbyopes with convergence insufficiency. *Optom Vis Sci.* 2009;86(2):153-156.
9. Thompson V. Eye pain and strain that masquerade as dry eye. *Cataract & Refractive Surgery Today.* February 2019. Accessed May 20, 2019.

A PROBLEM AND A PROMISING SOLUTION


Neurology and optometry come together to investigate relief for patients with dry eye symptoms and chronic headache.

BY JEFFREY P. KRALL, OD; AND CAROL M. NELSON, MD

Our work together began with a curious letter. We both practice in South Dakota, and we began corresponding because Dr. Nelson's chronic headache patients were finding relief after being fitted with contoured prism lenses at Dr. Krall's practice. This curiosity and a need to care for our overlapping patients eventually led to the initiation of the Chronic Daily Headache Study in 2013.

Patient Reported Symptom Relief – 90 Day

- 179 participants – inclusion criteria = refractory, end-of-line chronic headache
- 81.6% positive response to treatment at 90 days
- **54%** reported headache symptoms as "Reduced Substantially" or "Basically Gone"

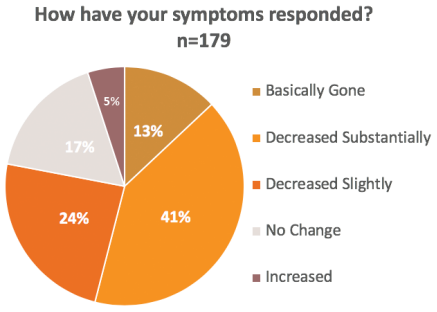


Figure 1. Clinical results of the Chronic Daily Headache Study.

THE STUDY DETAILS: DR. NELSON

The study initially started at my general neurology group practice but became so large that we built a headache center to accommodate all of the patients interested in participating in the feasibility study.

Patients enrolled were those who had recalcitrant symptoms untouched by previous treatments. They were having chronic headaches, defined as a headache at least every other day for 3 months. This study with Dr. Krall's contoured prism lenses was the only thing I had left to offer my patients. And to get a 50% response rate in headache medicine is impressive against the general population of migraine patients.

- In traditional prescription lenses, no correction is made to fix the patient's misalignment; this can put unwanted stress on the trigeminal nerve from overcompensation resulting in symptoms.
- More than just lenses designed for computer use (which don't account for eye alignment), contoured prism brings the eyes into alignment, which can relieve stress on the trigeminal nerve.

Figure 2. Standard prism lenses address only eye misalignment at a single distance. Contoured prism provides effortless eye alignment at all distances by gradually increasing the prism from distance to near.

We started with 186 patients, with only seven lost to follow-up. We kept data for 90 days on these patients, and we had 81.6% positive response among patients wearing the contoured lenses (Figure 1).[1] Of these patients, 54% reported their headaches were substantially reduced or gone. In my experience, this does not typically happen in headache medicine. Also, from those 179 patients, we had 50% of patients report nearly a 50% decrease in their headache medications—an impressive number for this population. Many migraine headache patients are young, reproductive-age females[2] who prefer not to be on medications, therefore a nonpharmacologic treatment is especially beneficial in this group.

TREATMENT WITH CONTOURED PRISM LENSES: DR. KRALL

When you look from one place to another, your eyes move about 90%, and your head follows. If the position of your eyes isn't aligned to the next target, one eye is telling your head to turn one amount, and the other is telling your head to turn another amount. Soon there's a disconnect in the back of your head, along with the stimulation of your trigeminal nerve, and the combination of those things causes symptoms of visually induced trigeminal dysphoria: headache, eye strain, neck tension, dry eye feeling, etc.[3,4]

When we understood that the misalignment between the eyes

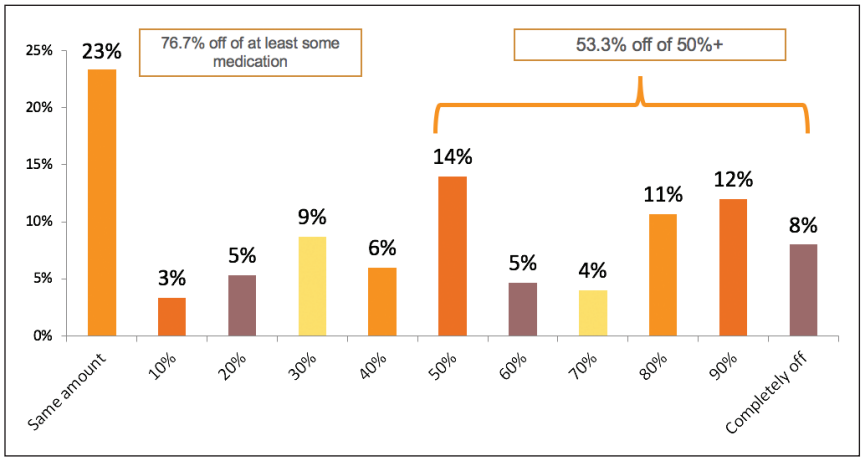


Figure 3. Headache medication usage after 90 days of wearing contoured prism lenses.

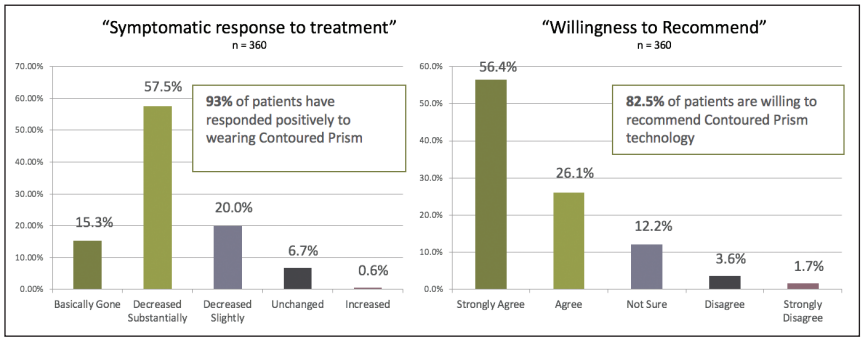


Figure 4. Chronic Daily Headache Study patients' survey responses.

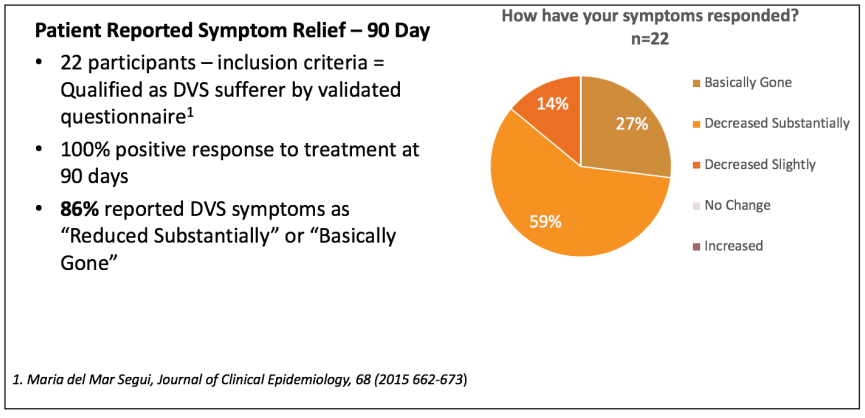


Figure 5. Clinical results of the Digital Vision Syndrome Study.

was the cause of these symptoms and the need to correct the problem at both distance and near was the solution, we developed a lens with contoured prism (Figure 2). While standard prism lenses only address eye misalignment at a single distance, this technology uses a contoured prism and provides effortless eye alignment at all distances by gradually increasing the prism from distance to near, which relieves over stimulation of the trigeminal nerve.[5]

Another important finding of the Chronic Daily Headache Study is that patients stopped taking many of their medications (Figure 3) within 90 days of wearing the contoured lenses. Nearly 30% of the patients stopped needing 90% of their medications; 50% stopped taking more than 50% of their medications.[1]

SURVEY DATA

Based on the positive results of the Chronic Daily Headache Study, we conducted a survey of 360 patients fitted with contoured lenses and found that 82% would recommend the contoured lenses to their friends and family, despite the out-of-pocket cost. Participants completed surveys at 90 days and 1 year after receiving their contoured prism lenses (Figure 4).[6] The survey included only one question: "Would you recommend this to your friends and family?" The response was greater than 90%.

The participants were given two pairs of glasses fitted with the contoured prism lenses (a pair for close work and a pair for wearing in the sun). If they needed their lens changes when they stopped taking some of their medications, we changed their lenses.

In addition to the Chronic Daily Headache Study, we initiated a Digital Vision Syndrome (DVS) Study.[7] The American Optometric Association (AOA) defines DVS, or computer vision syndrome, as the physical eye discomfort felt by many individuals after 2 or more hours in front of a digital screen. The perceived causes of this, according to the AOA, include poor lighting, harsh glare on the screen, improper viewing distances, and poor posture.[6,8] This population group (n = 22; ages 17 to 51 years) had less severe symptoms, and yet we achieved the same type of response. Nearly 60% of the participants reported their symptoms resolved completely when reading, working on the computer or doing daily activities; 27% said they decreased substantially (Figure 5).[6]

THE TECHNOLOGY BREAKDOWN

The lenses are created based on results from an eye tracking device that can accurately and objectively measure the degree of eye misalignment at distance and near taking into account the following: heterophoria, vergence conditioning, binocular peripheral fusion, fixation disparity, accommodative convergence response and alternating monocular central fixation.[5]

The device measures eye misalignment by providing a real-life simulation of how the eyes work together to see both near (50 cm) and far (6 m, simulating optical infinity).[5]

During the measurement, patients focus on a single point while a dynamic display of rotating planets and stars activates peripheral and central vision to measure distance and near eye alignment (Figure 6). The measurement device isolates peripheral and central vision to provide a comprehensive assessment of the patient's eye alignment and synchronization.[5]

- Patients focus on a single point while a dynamic display of rotating planets and stars activates peripheral and central vision to measure distance and near eye alignment.
- The measurement device isolates peripheral and central vision to provide a comprehensive assessment of the patient's eye alignment and synchronization.
- **Measurement Device Value:** unique single measurement of total misalignment at distance and near, providing a prescriptive range for contoured prism prescription.

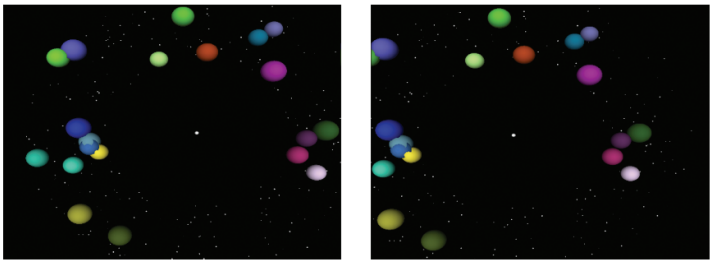


Figure 6. During the eye measurement, patients focus on a single point of a dynamic display to measure distance and near eye alignment.

From this assessment a unique, single measurement of functional misalignment at distance and near, providing a prescriptive range for contoured prism prescription, is generated. The contoured prism lenses offer a solution potentially for all of these patients who have been suffering for years with no result in all the treatments they've tried.[6,9] These implications are far reaching, considering the direct and indirect socioeconomic costs of headache to society are estimated at $14 billion per year.[2]

The measurement device is unique in several facets: it's 100% objective, and it's fast and efficient for a team to operate and to perform.[10,11] The device allows us to showcase the patients' results in real time. The device does not, however, measure well esotrope or exotropes. It also does not currently measure vertical misalignments, but I believe this may change in the future. Contraindications for use of this technology include a lack of binocular vision, such as suppression in one eye; inability to achieve binocular fusion; severe strabismus or palsy resulting in greater than 10 prism diopters (D) of misalignment in one eye; greater than 20.00 D of eye misalignment; or greater than 4.00 D of astigmatism in either eye.[12]

This measurement devices works best on patients who are able to sit still and focus on the target. Therefore, in my experience, it is difficult to use in some young children.

COMBATING SYMPTOMS OF DIGITAL EYE STRAIN

Current solutions for eyestrain involve patients making changes in their daily digital habits or environment. These include limiting screen time, increased blinking, and adopting the 20-20-20 rule of taking a 20-second break every 20 minutes to look at something 20 feet away.[8] Investing in an ergonomic chair, proper lighting, adjusting the computer screen angle, and antiglare screens, etc., are also often suggested.[8,13]

There are also other lens technologies aimed at helping digital eye strain. These are designed to cut glare, block blue light from penetrating our eyes, and prevent vision fatigue when staring at digital devices. Marketed as computer eyewear, these lenses are built for the mid-distance range at which we typically view a digital screen, and they can be purchased with or without a prescription. The lenses and filters are customized to reduce blurriness and pixilation, decrease brightness, and minimize glare during prolonged use of devices.[14]

CONCLUSION

Based on the research results, we believe this new measurement tool and contoured prism lens technology are more effective than current treatments for computer vision syndrome that primarily address a lack of near focusing power or an attempt to block certain wavelengths of light. ■

1. Chronic Daily Headache Study. eyeBrain Medical Inc. Data on File.
2. Rizzoli P, Mullally WJ. Headache. *Am J Med.* 2018;131:17-24.
3. Digre KB. More than meets the eye: the eye and migraine—what you need to know. J Neuro-Ophthalmol. 2018; 38: 237-243.
4. Weir C. Proprioception in extraocular muscles. *J Neuro-Ophthalmol*. 2006;26:123-127.
5. eyeBrain Medical Inc. Data on File.
6. del Mar Segui M. A reliable and valid questionnaire was developed to measure computer vision syndrome at the workplace. *J Clin Epidemiology*. 2015;68: 662-673.
7. Digital Vision Syndrome Study. eyeBrain Medical Inc. Data on File.
8. American Optometric Association. Computer Vision Syndrome. www.aoa.org/patients-and-public/caring-for-your-vision/protecting-your-vision/computer-vision-syndrome Last updated 2019. Accessed June 27, 2019.
9. Ackerman R, Krall J, Vance Thompson V, et al. A new treatment for computer vision syndrome. eyeBrain Medical Inc. Data on File.
10. Karpecki PM. The dry eye misalignment. *Review of Optometry*. Updated Aug. 15, 2018. https://www.reviewofoptometry.com/article/the-dry-eye-misalignment. Accessed May 20, 1019.
11. Thompson V. Eye pain and strain that masquerade as dry eye. *Cataract & Refractive Surgery Today*. February 2019. https://crstoday.com/articles/2019-feb/eye-pain-and-strain-that-masquerade-as-dry-eye/. Accessed May 20, 2019.
12. User's manual measurement device, Model SightSync System. Neurolens 2017. eyeBrain Medical Inc.
13. The Vision Council. Digital Eye Strain. https://thevisioncouncil.org/content/digital-eye-strain. Last updated 2019 . Accessed May 20, 2019.
14. The Vision Council. Eyes overexposed: A look at the digital device dilemma. 2016 Digital Eye Strain Report. https://visionimpactinstitute.org/wp-content/uploads/2016/03/2016EyeStrain_Report_WEB.pdf. Updated 2016. Accessed May 22, 2019.

MY EXPERIENCE TREATING PATIENTS WITH VISUALLY INDUCED TRIGEMINAL DYSPHORIA

A new technology resolves symptoms initially thought to be dry eye disease.

BY JACLYN A. MUNSON, OD, FAAO

My experience treating trigeminal dysphoria began in 2018 during my mentorship with Paul Karpecki, OD, FAAO, and Jeffrey P. Krall, OD. The evolving, shared philosophy and protocol for preventing, treating, and managing ocular surface disease includes analysis for the presence of biofilm, inflammation, meibomian gland obstruction, and tear film toxicity affecting the structure and function of ocular physiology.[1] The mindset when treating these four categories continues to prove most successful when analyzed as a whole system, avoiding the less than ideal thought to delineate these categories and treat individually. A new concept worthy of inclusion in the paradigm: *trigeminal dysphoria*.[2,3,4] Trigeminal dysphoria is a condition that triggers "dry eye like" symptoms referred to as "phantom dry eye, or pseudo dry eye." Thought to be caused by an underlying eye misalignment, it is now understood that trigeminal dysphoria elicits similar symptoms and presents like our more formal definition of ocular surface disease.[3,5]

Research has shown that the trigeminal nerve, in addition to responding to corneal sensitivity and answering the question, "How do my eyes feel?" also exhibits a response to proprioceptive cues and awareness of alignment or misalignment between the eyes eliciting the response, "When my eyes are pointing here, how do they feel?"[3] I was keenly aware of the neuromuscular responsibilities of the motor cranial nerves (CN) associated with eye movement (CN III, IV, V, VII, VIII),[3,6] and the vision performance difficulties and symptoms that occur when these unions fail to synchronize.[3]

However, I previously gave little credit to the sensory component of CN VI and its role in vision performance. Since my mentorship, I now understand how deeply the sensory fibers of the trigeminal nerve descend into the neck and shoulders. The compensatory neck and head movement required to stabilize our eyes and compensate for the underlying eye misalignment we postulate is the causation of the hypersensitization of the ophthalmic branch of CNV.[3]

At times, the whole trigeminal complex becomes up-regulated and the patient experiences global symptoms that may be described as headaches, jaw ache, neck tension, dizziness, dry eye, and light sensitivity.[5,7]

Eyestrain is a common condition that occurs when eyes become tired from intense use, such as while driving long distances, staring at computer screens and other digital devices, or reading without pausing to rest the eyes.[8] According to the Vision Council, the symptoms of digital eye strain, listed by increasing prevalence, include eyestrain, dry eyes, headaches, blurred vision, and neck/shoulder pain when using digital devices, while reading, or doing detail work.[9]

About 80% of American adults report using digital devices for more than 2 hours per day, and nearly 67% use two or more devices simultaneously.[9] Nearly 59% of this population report symptoms of digital eye strain.[9]

This percentage represents a larger group than the reported prevalence of dry eye disease, which ranges from 5 to 50%.[10] Adding to this dilemma is the fact that the use of digital technology has increased rapidly since 2000 (Figure).[11-13] The functional capacity of our visual neurol-ogy either exceeds the expectation of a visually demanding lifestyle or symptoms occur from an unmet expectation.[14] That's the reason I believe the lifestyle index, a detailed patient questionnaire created by the experts who pioneered the contoured prism lenses, is so effective.[2]

In my experience, using the questionnaire has opened a neutral platform for focused conversations with patients who may never thought to mention eye strain and headaches to their eye care provider. Twelve months ago, I made the decision to include this technology to our menu of diagnostics. Since then, we have noted streamlined clinic flow, more efficient differentials, and have experienced some of my favorite clinical memories as we offer relief to patients in this capacity.

The likely candidate for contoured prism has a positive cover test, normal osmolarity scores, and positive lifestyle index results. In my practice, all adults older than 18 years who score positive

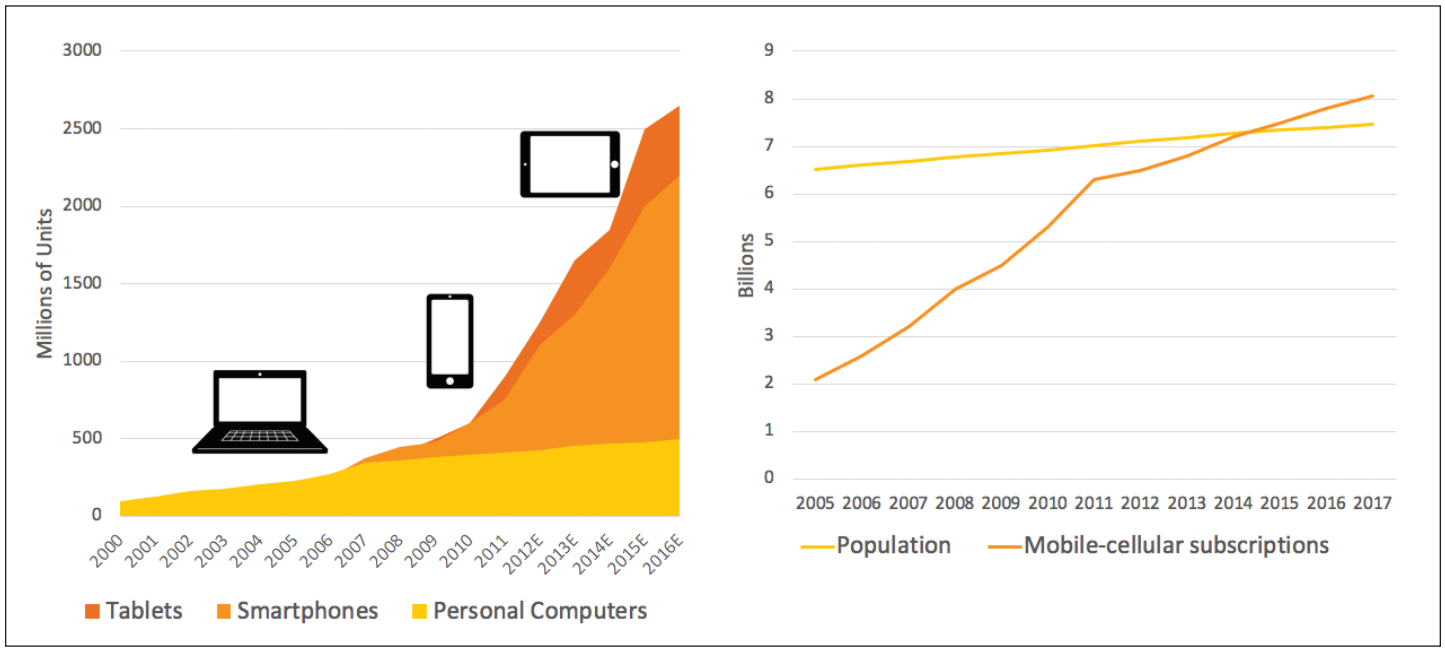


Figure. In 2017, the number of SIM mobile phone connections (nearly 8 billion) exceeded the global population (7.6 billion).[12,13]

on their questionnaire will experience the measurement technology to identify a potential underlying eye misalignment. Based on results from the on chair-side refraction combined with objective data from the measurement device, custom contoured lenses are prescribed. We repeat an objective and subjective analysis 3 weeks after the therapeutic lenses have been revealed to the patient. Most often we clinically note reduction of their misalignment and subjectively measure reduction of their symptoms.[15]

I find this technology especially helpful for our adult head and brain injury survivors.

Prism lenses are not indicated for patients with hyperopia is greater than +6. 00 D, myopia greater than -9.00 D of SE correction at distance, or BCVA of 20/80 or worse in either eye. Additional contraindications for this technology include severe strabismus or palsy resulting in greater than 10 prism D of misalignment in one eye; greater than 20.00 D of eye misalignment; or greater than 4.00 D of astigmatism in either eye. This measurement device and therapy is also not meant for patients with physical tremors or muscle spasms that prevent sitting still.[15] However, the therapeutic lens technology may be utilized by other means for this group of patients.[15]

PEDIATRIC PATIENTS

The culture of my practice shares a preventive mindset with our patient base. We have many pediatric patients in our ocular surface disease program, and we are always on the lookout for vision concerns that may affect future success in academics and athletic performance. The Vision Council reported that more than 70% of American adults claim their children experience the following symptoms after being exposed to 2 or more hours of screen time: headaches (8.8%); neck/shoulder pain (5%); eye strain, dry or irritated eyes (9.1%); reduced attention span (15.2%); poor behavior (13.3%); and irritability (13.5%).[11]

We educate parents on the risk factors, and my team performs an alignment analysis and lifestyle index survey on every patient younger than 18 years. This alignment analysis is especially helpful for children who complain of headaches and those who are showing signs of avoidance of visual tasks. It is a wonderful feeling to offer parents a noninvasive, drug-fee solution to their children's headaches and related problems such as digital eye strain.[3]

CONCLUSION

Just as we analyze the structure and function of a patient's meibomian glands, or the structure and function of an optic nerve with retinal imaging and electroretinogram technology, my clinic has seen the benefits of objectively measuring and treating eye misalignment in a new functional capacity.

In our practice, patients often report spending thousands of dollars out of their pocket each year to reduce their symptoms of dry eye, headaches and neck/shoulder pain. They have utilized other treatments, including massage, chiropractic care, nerve blocks, and acupuncture—each of these supportive ancillary treatments are helpful, but reduce only the symptoms rather than the cause. Patients report that their symptoms return within 2 to 3 days after the ancillary treatments are offered. In my practice, this misalignment technology allows us to arrive at a potential root cause solution in patients with dry eye like symptoms caused by trigeminal dysphoria.[3]

Unmet visual neurology demands produce unspoken symptoms, and we have found in our practice that many patients do not always know to share these symptoms with us. I anticipate the incidence of reporting these symptoms related to trigeminal dysphoria will increase as further education, prevention, and knowledge is

TALKING TO PATIENTS

Patients want relief. My team explains this technology to adult and pediatric patients by comparing it to things they are familiar with in daily life. For example:

AUTOMOBILES: We expect our vehicles to have aligned tires, which result in efficient fuel mileage, and a smoother, more pleasant driving experience. The steering wheel is steady. Imagine your eyes as the tires. Imagine your neck as the steering wheel. We have confirmed your eyes suffer a misalignment and your daily visual demands trigger these specific symptoms. New therapeutic lens technology offers relief, relaxation, and down regulation of the nerve that aches, providing a smoother, more efficient experience as you use your eyes every day.

ORTHOTICS: Our elderly population best understands the comparison to orthotics. An arch support, for example, customizes foot posture and walking pattern so the rest of your body will stand in proper alignment and be more relaxed in its natural physique.

ORTHODONTICS: When our teeth are out of alignment, we are less efficient chewers. We may have pain and poor digestion of nutrients. Braces train the neuromuscular junctions in the mouth to realign the teeth and jaw. Contoured prism lenses are a similar compensatory modality to realign and train the neuromuscular junctions of your brain and your eye muscles to relax.

promoted. With access to this measurement and lens technology, now more than ever, we are able to approach this specific problem with a preventive mindset and eduate patients and providers regarding the effects of the digital demands in their life and how to combat the symptoms.[12] ■

1. Jones L, Downie DE, Donald Korb D, et al. TFOS DEWS II management and therapy report. *Ocul Surf.* 2017;15(3):575-628.
2. del Mar Segui M. A reliable and valid questionnaire was developed to measure computer vision syndrome at the workplace. *J Clin Epidemiology.* 2015;68: 662-673.
3. Digre KB. More than meets the eye: the eye and migraine—what you need to know. *J Neuro-Ophthalmol.* 2018; 38: 237-243.
4. eyeBrain Medical Inc. Data on File.
5. Thompson V. Eye pain and strain that masquerade as dry eye. *Cataract & Refractive Surgery Today.* February 2019. crstoday.com/articles/2019-feb/eye-pain-and-strain-that-masquerade-as-dry-eye/. Accessed May 20, 2019.
6. Huff T, Daly DT. Neuroanatomy, Cranial Nerve 5 (Trigeminal). StatPearls [Internet]. Last Update: April 8, 2019. Accessed May 15, 2019. https://www.ncbi.nlm.nih.gov/books/NBK482283/.
7. Karpecki PM. The dry eye misalignment. *Review of Optometry.* Updated Aug. 15, 2018. www.reviewofoptometry.com/article/the-dry-eye-misalignment. Accessed May 20, 1019.
8. Mayo Clinic. Digital eye strain. www.mayoclinic.org/diseases-conditions/eyestrain/symptoms-causes/syc-20372397. Accessed June 28, 2019.
9. The Vision Council. Digital Eye Strain. https://thevisioncouncil.org/content/digital-eye-strain. Last updated 2019. Accessed May 20, 2019.
10. Stapleton F, Alves M, Bunya VY, et al. TFOS DEWS II Epidemiology Report. *Ocul Surf.* 2017; 15(3):334-365.
11. The Vision Council Shines Light on Protecting Sight – and Health – in a Multi-screen Era. www.thevisioncouncil.org/blog/vision-council-shines-light-protecting-sight---and-health-multi-screen-era. Last Updated Jan 7, 2019. Accessed May 20, 2019.
12. DataReportal. Digital 2016: Global digital overview. datareportal.com. Accessed July 2, 2019.
13. The World Bank. Mobile cellular subscriptions. 2005-2017. Accessed July 2, 2019.
14. Ackerman R, Krall J, Vance Thompson V, et al. A new treatment for computer vision syndrome. eyeBrain Medical Inc. Data on File.
15. User's manual measurement device, Model SightSync System. Neurolens 2017. eyeBrain Medical Inc.

VISUALLY INDUCED TRIGEMINAL DYSPHORIA: A POTENTIAL LEADING SOURCE OF HEADACHES, EYESTRAIN, AND DRY EYE SENSATION

Release Date: Aug 1, 2019
COPE Expiration Date: July 11, 2022

INSTRUCTIONS FOR CREDIT

To receive credit, you must complete the attached Posttest/Activity Evaluation/Satisfaction Measures Form and mail or fax to Evolve Medical Education LLC; 353 West Lancaster Avenue, Second Floor, Wayne, PA 19087; Fax: (215) 933-3950. To answer these questions online and receive real-time results, please visit evolvemeded.com and click evolvemeded.com/online-courses/1914Supplement1. If you are experiencing problems with the online test, please email us at support@evolvemeded.com. Certificates are issued electronically; please be certain to provide your email address below.

Please type or print clearly, or we will be unable to issue your certificate.

Name _____ ❑ OD ❑ non-OD participant

Phone (required) _____ ❑ Email (required) _____

Address _____

City _____ State _____ Zip _____

License Number _____

OE Tracker Number _____

DEMOGRAPHIC INFORMATION

Profession
___ OD
___ NP
___ Nurse/APN
___ PA
___ Other

Years in Practice
___ > 20
___ 11-20
___ 6-10
___ 1-5
___ <1

Patients Seen Per Week (with the disease targeted in this educational activity)
___ 0
___ 1-15
___ 16-30
___ 31-50
___ 51+

Region
___ Northeast
___ Northwest
___ Midwest
___ Southeast
___ Southwest

Setting
___ Solo Practice
___ Community Hospital
___ Government or VA
___ Group Practice
___ Other
___ I do not actively practice

Models of Care
___ Fee for Service
___ ACO
___ Patient-Centered Medical Home
___ Capitation
___ Bundled Payments
___ Other

LEARNING OBJECTIVES

DID THE PROGRAM MEET THE FOLLOWING EDUCATIONAL OBJECTIVES?	AGREE	NEUTRAL	DISAGREE
Describe the optical neurological mechanism triggering headaches and how it relates to neck pain/tension and eye fatigue	_____	_____	_____
Explain how trigeminal dysphoria is a condition resulting from a misalignment in the visual system that causes stimulation of the trigeminal nerve, triggering patient symptoms	_____	_____	_____
Identify insights into how to identify and treat patients suffering from a misalignment in their vision	_____	_____	_____

POSTTEST QUESTIONS

1. Based on a recent Vision Council report, what percent of patients indicated they have symptoms of digital eyestrain?

a. 80%
b. 67%
c. 59%
d. 50%

2. The proprioceptive feedback from each our eyes sends its signal through what division of our trigeminal nerve?

a. Ophthalmic division
b. Maxillary division
c. Mandibular division
d. None of the above

3. The sensitivity of our cornea is innervated by which cranial nerve?

a. Optic nerve
b. Trigeminal nerve
c. Facial nerve
d. The ocular motor nerve

4. The symptoms of asthenopia include:

a. Neck/shoulder pain
b. Dry eye sensation
c. Headaches
d. Dry eye
e. All of the above

5. The symptoms of trigeminal dysphoria include:

a. Headaches
b. Neck pain
c. Dry eyes
d. Tired eyes
e. All of the above

6. The AOA definition of digital vision/computer vision syndrome includes physical eye discomfort felt after 2 or more hours in front of a digital screen. Perceived causes are:

a. Poor lighting
b. Harsh glare on the screen
c. Improper viewing distance
d. All of the above

7. According to the AOA, current solutions for people who suffer from digital vision syndrome or computer vision syndrome include:

a. Blink more
b. 20-20-20 rule
c. Antiglare screens
d. Proper lighting
e. All of the above

8. According to the Vision Council, computer eyewear can be:

a. Purchased only with a prescription
b. Purchased only without a prescription
c. Customized to decrease brightness and minimize glare
d. Designed for use at near distance

9. Which one of the following describes a contraindication for contoured prism technology?

a. BCVA of 20/80 or better in either eye
b. Positive result on the lifestyle index
c. Hyperopia greater than +6. 00 D
d. Age younger than 18 years

10. Which statement best describes contoured prism technology?

a. A way to address misalignment of the eyes at distance, intermediate and near
b. The same as standard prism
c. Only used for children
d. Only used for adults

ACTIVITY EVALUATION

Your responses to the questions below will help us evaluate this CE activity. They will provide us with evidence that improvements were made in patient care as a result of this activity.

Rate your knowledge/skill level prior to participating in this course: 5 = High, 1 = Low _____

Rate your knowledge/skill level after participating in this course: 5 = High, 1 = Low _____

This activity improved my competence in managing patients with this disease/condition/symptom _____ Yes _____ No

I plan to make changes to my practice based on this activity? _____ Yes _____ No

Please identify any barriers to change (check all that apply):

_____ Cost
_____ Lack of consensus or professional guidelines
_____ Lack of administrative support
_____ Lack of experience
_____ Lack of time to assess/counsel patients
_____ Lack of opportunity (patients)
_____ Reimbursement/insurance issues
_____ Lack of resources (equipment)
_____ Patient compliance issues
_____ No barriers
Other. Please specify: _____
_____
_____

The design of the program was effective for the content conveyed. ___ Yes ___ No

The content supported the identified learning objectives. ___ Yes ___ No

The content was free of commercial bias. ___ Yes ___ No

The content was relative to your practice. ___ Yes ___ No

The faculty was effective. ___ Yes ___ No

You were satisfied overall with the activity. ___ Yes ___ No

Would you recommend this program to your colleagues? ___ Yes ___ No

Please check the Core Competencies (as defined by the Accreditation Council for Graduate Medical Education) that were enhanced through your participation in this activity:

_____ Patient Care
_____ Practice-Based Learning and Improvement
_____ Professionalism
_____ Medical Knowledge
_____ Interpersonal and Communication Skills
_____ System-Based Practice

Additional comments:

_____

_____ I certify that I have participated in this entire activity.

This information will help evaluate this CE activity; may we contact you by email in 3 months to see if you have made this change? If so, please provide your email address below.

_____

MODERN**OPTOMETRY**