

# As Screen Time Soars, Eye Strain Becomes #1 Pain Point for Device Users

**#1** CONSUMER PAIN POINT IS EYE STRAIN

when asked about watching TV or using laptops and monitors for extended time<sup>1</sup>

CONSUMER PAIN POINTS BY DEVICE<sup>1</sup>



- People have been spending **13+ hours** per day on screens since COVID-19 emerged
- Eye strain has become the **#1** pain point for device users
- **59 percent** of people experiencing symptoms of digital eye strain.
- Eye strain and vision deterioration was the **#1** complaint for device users.



**2/3**

of adults experience the painful symptoms of eye misalignment: headaches, eye strain, and more.



**1 out of 10**

report their symptoms to their eyecare provider.

Population study, 2019-2020 (n=110,000)

- **WHAT IS THE IMPACT ON ADULTS? VISION COUNCIL DATA**

- Americans report experiencing the following symptoms of digital eye strain:

- 32.4 percent report experiencing eye strain
- 27.2 percent report experiencing dry eyes
- 27.7 percent report experiencing headaches
- 27.9 percent report experiencing blurred vision
- 35 percent report experiencing neck and shoulder pain



- **57% have 3 or more of these symptoms:**

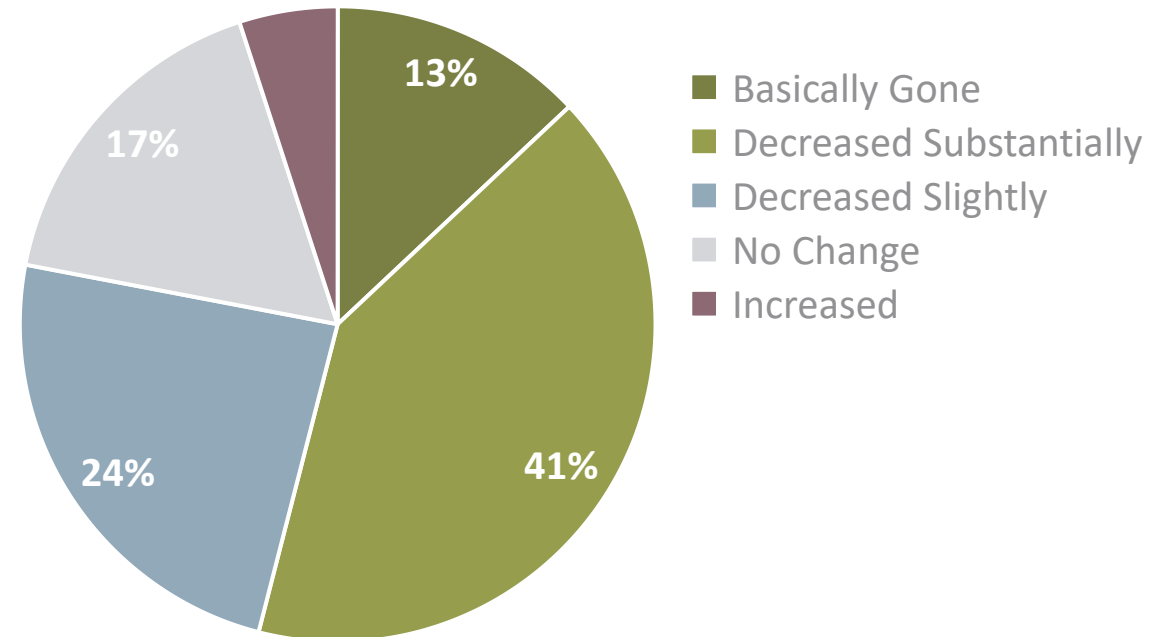
# Clinical Results: Chronic Daily Headache Study

## 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”

## How have your symptoms responded?

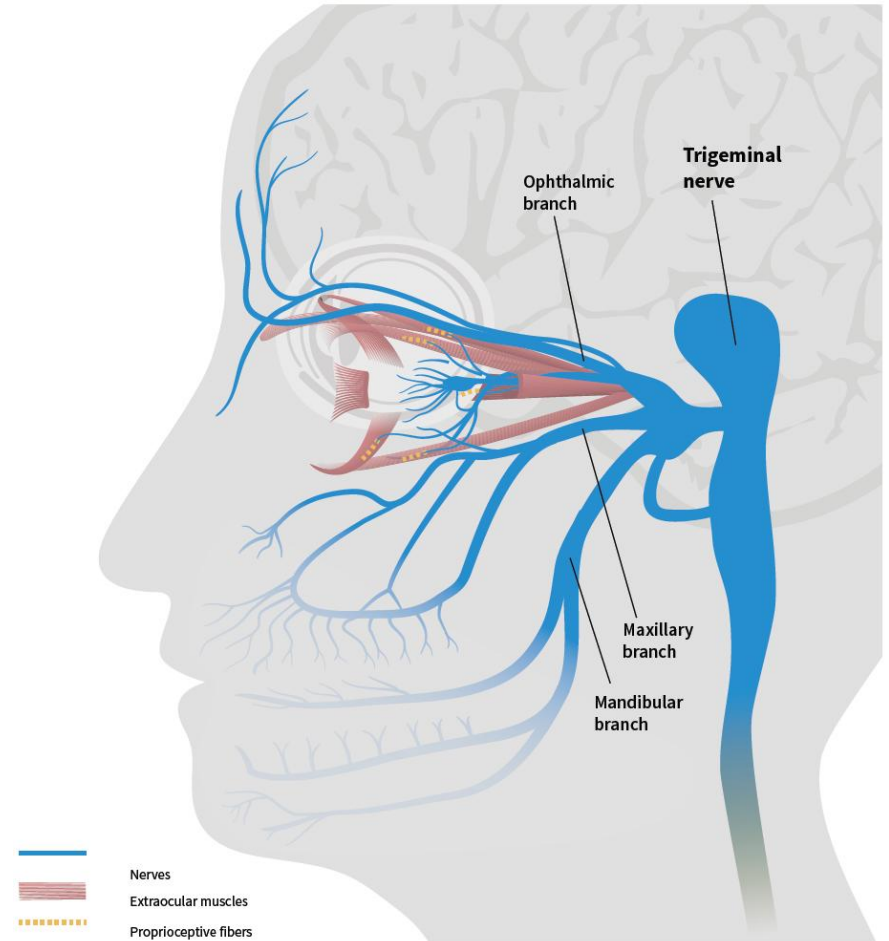
n=179



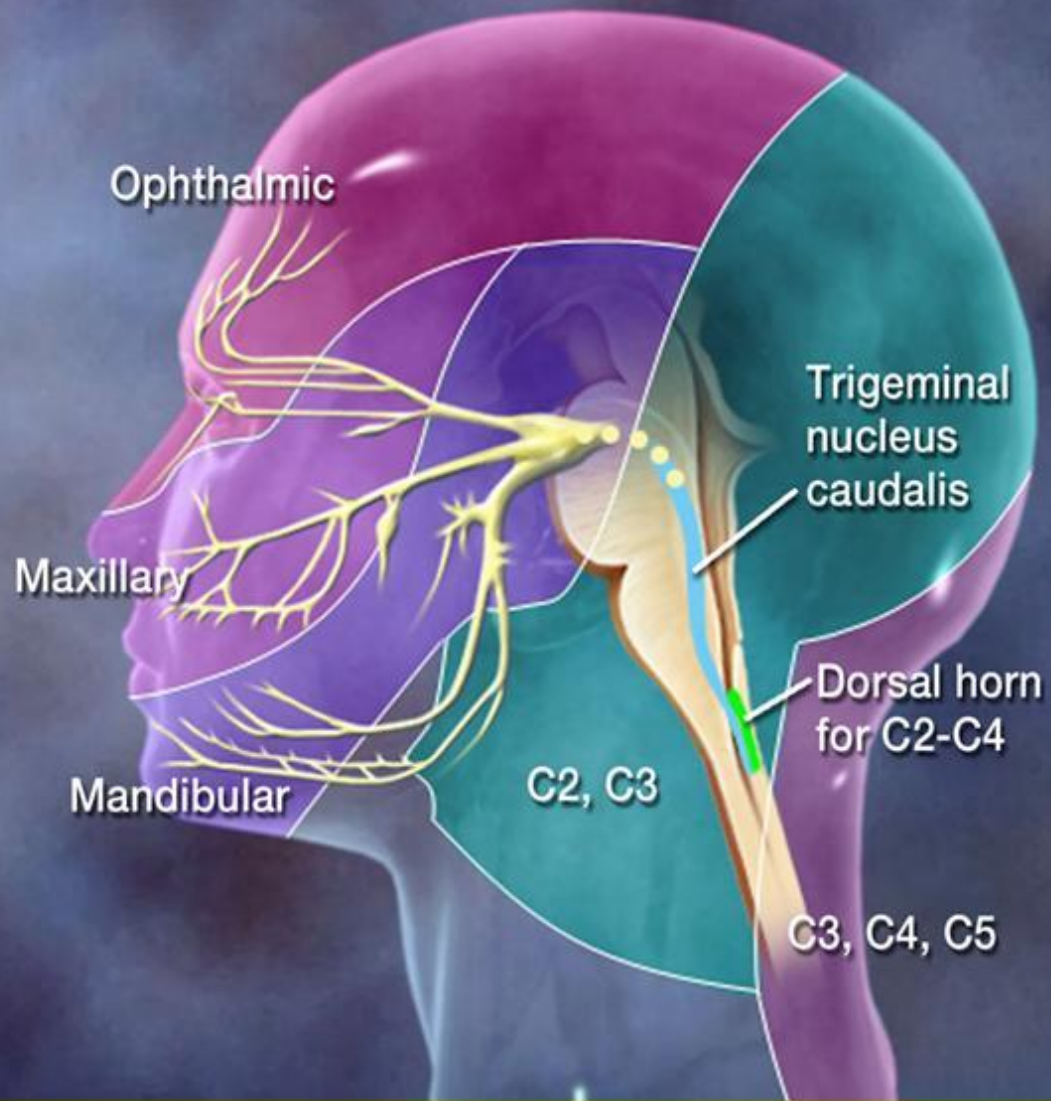
# Neurological Mechanism of Trigeminal Nerve Pain

# The Trigeminal Nerve

The largest nerve in the brain and the one responsible for the majority of head, face, jaw and neck sensations.







Trigeminal  
neuralgia  
vs  
Trigeminal  
Dysphoria

# Trigeminal neuralgia vs Trigeminal Dysphoria

- Trigeminal Neuralgia: characterized by sudden, brief, and excruciating facial pain attacks in one or more of the V branches, leading to a severe reduction in the quality of life of affected patients. Trigeminal neuralgia etiology can be classified into idiopathic, classic, and secondary.
- Trigeminal Dysphoria: 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 similar to the definition of ocular surface disease.



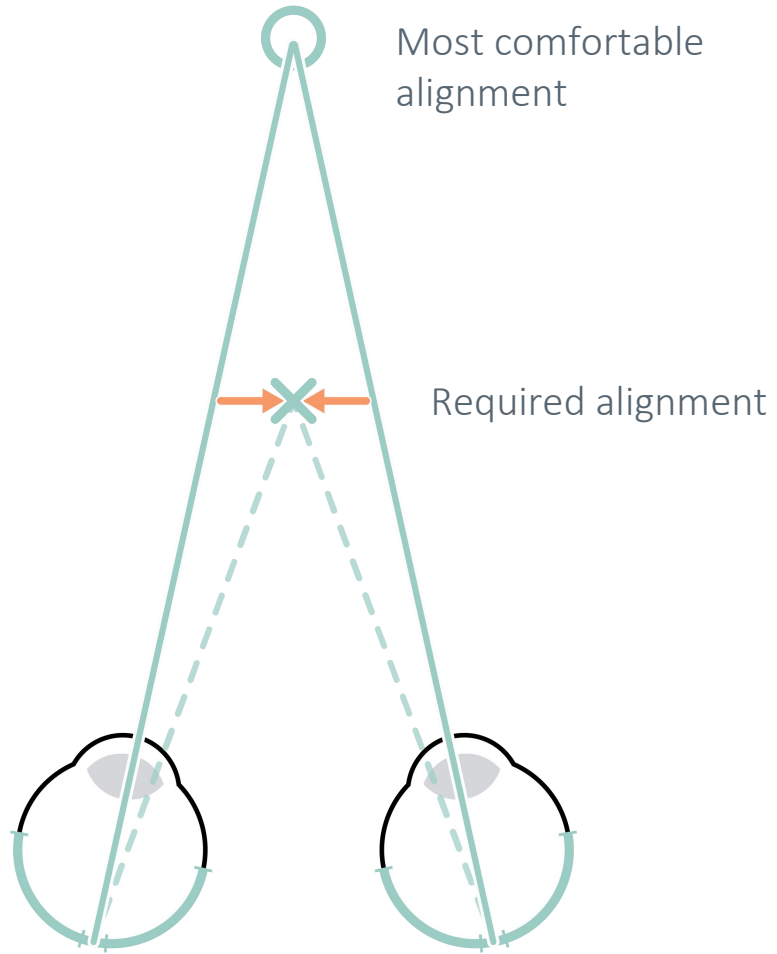
Misalignment



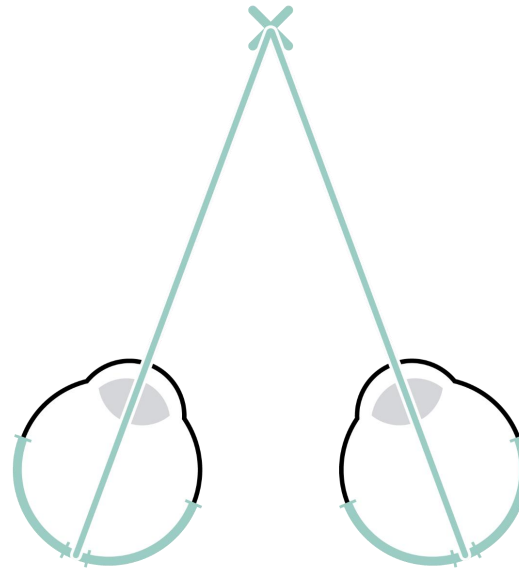
Compensation



Symptoms



Sustained effort to realign



Headaches



Dizziness



Dry Eye



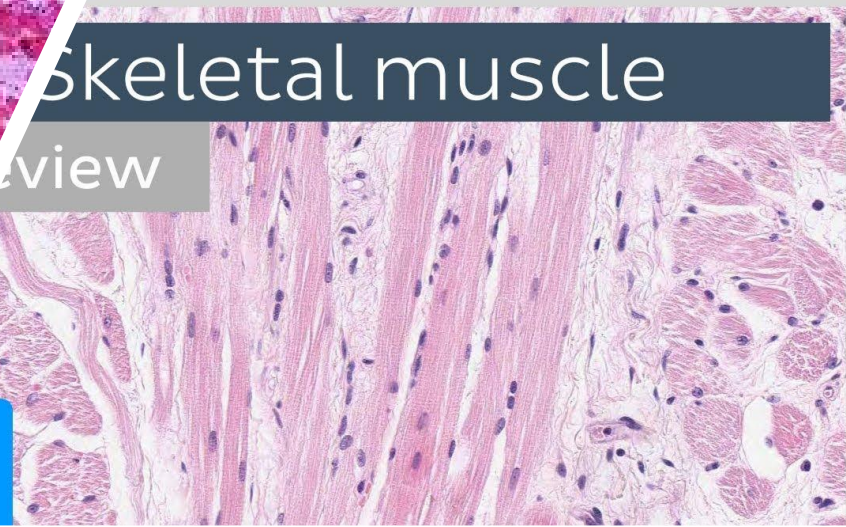
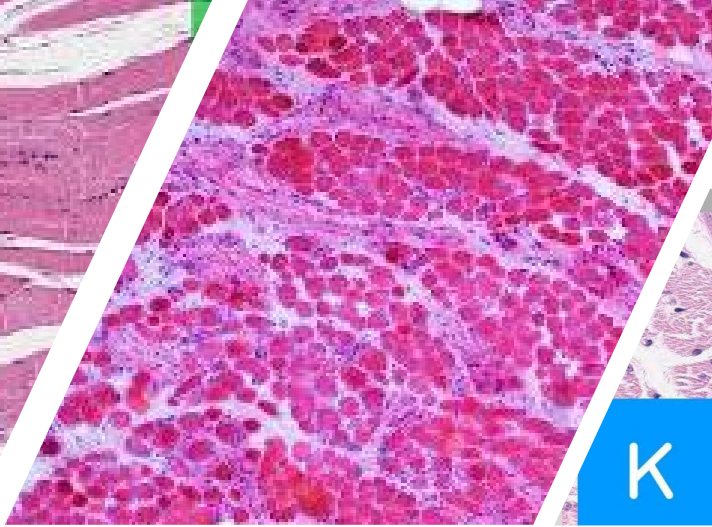
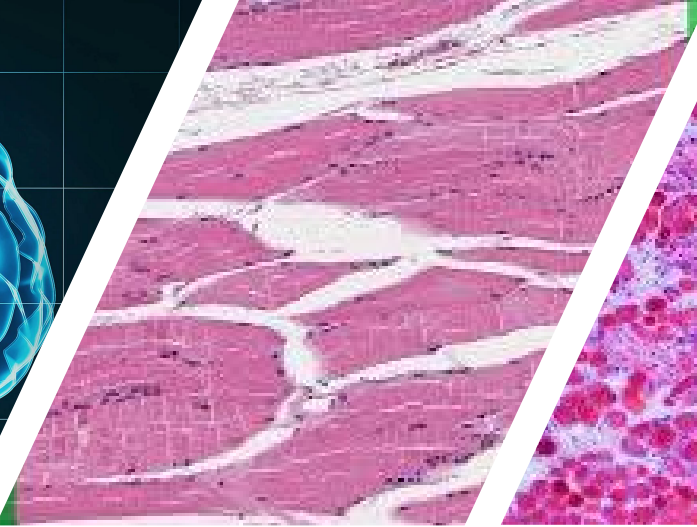
Eye Strain



Neck & Shoulder Pain



Light Sensitivity



Skeletal muscle

view

K

## Not “Tired Eyes”

- Anatomists state that the extrinsic muscles of the eye (striated) are 60 to 100 times as strong as need be, thus providing “a mechanism for prolonged activity without fatigue” (Walter B. Lancaster, M.D., physiologist).



smooth muscle

view

K

# Extra Ocular vs Skeletal Muscle

Attributes	Oculorotators	Limb skeletal muscle
Motor unit (muscle fibres/neuron)	10–20	100–2000
Maximum motor neuron discharge rates (Hz)		
Phasic (burst)	> 600	125
Tonic (sustained)	> 200	50
Time to peak contractile tension (msec)	4.5	15–35
Fibre types	6	3–4
Proprioceptors	Majority peculiar to the ORMs	Muscle spindles & tendon organs
Stretch reflex	Absent	Important feature
Mode of contraction	Twitch and tonic	Twitch
Fatigue resistance	High	Variable

**Table 1.** Some of the differences between the oculorotator muscles (ORMs) and ordinary skeletal muscle.

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# Proprioceptive Conflict

- Headache and neck pain
- Constant pressure or ache
- Dry eye sensation
- Fatigue
- Light sensitive
- Worse with increased usage of digital devices



# Most common complaint? “Tired Eyes”



In normal health, one does not experience eye fatigue or visual failure despite the execution of 170,000 saccades in the course of an ordinary day.



76 percent of workers say they feel tired at work, 53 percent feel less productive, and 44 percent have trouble focusing., OHS, 2017

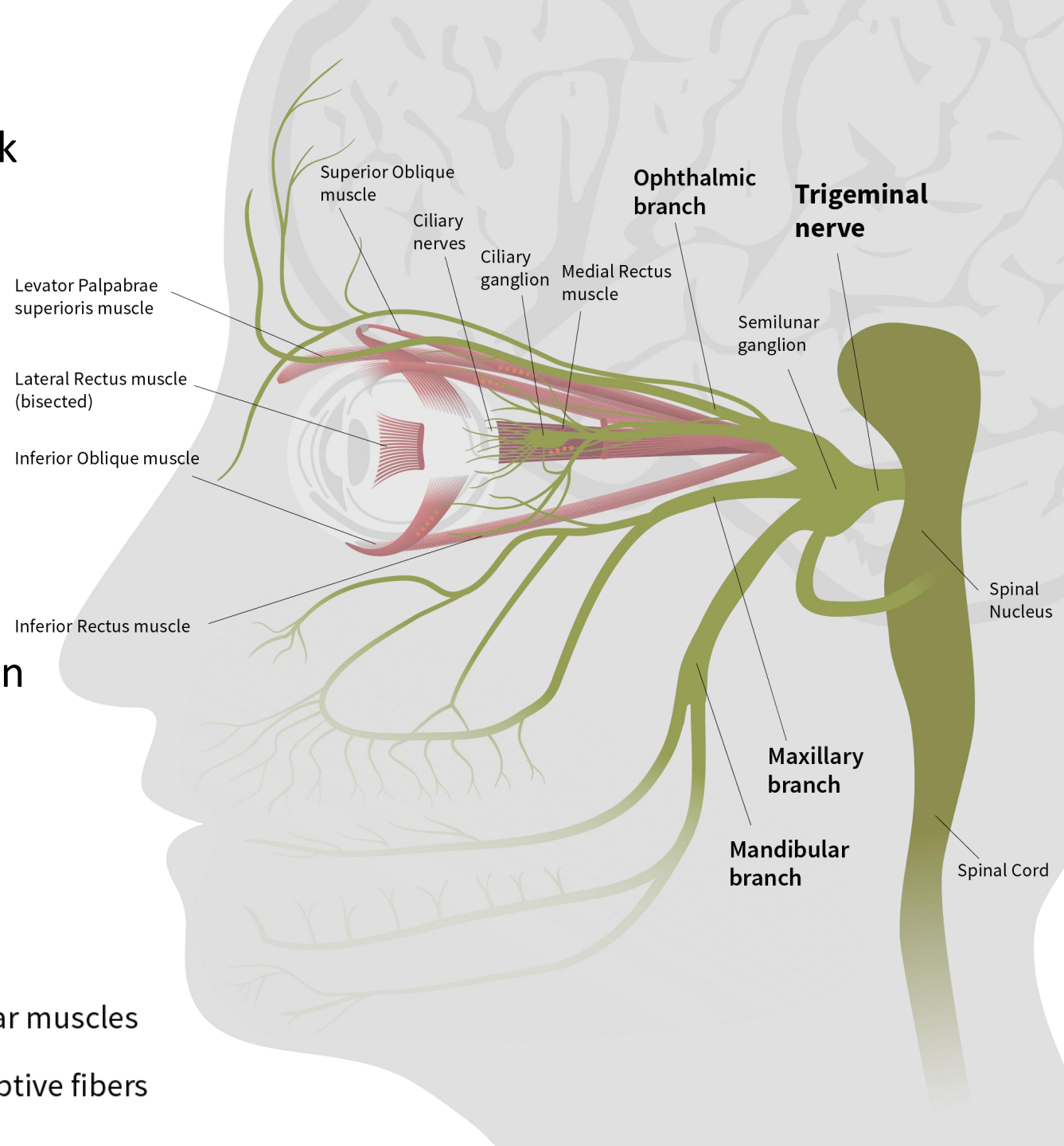


When an individual is suffering from an overload of cortical input, there is consequent stress. In extreme cases, our systems shut down.



So how can we reduce this overload or stress? **Prism** may be the solution

- Proprioceptive fibers innervating the extraocular muscles provide afferent feedback to the brain about the location of each eye.
- This feedback is required to avoid binocular misalignments.
- These proprioceptive signals are transmitted through the ophthalmic branch of the trigeminal nerve, which is responsible for detecting sensation and reporting pain.
- It appears that these signals play a large role in the stimulation of the trigeminal nerve, resulting in symptoms associated with **Trigeminal Dysphoria**.



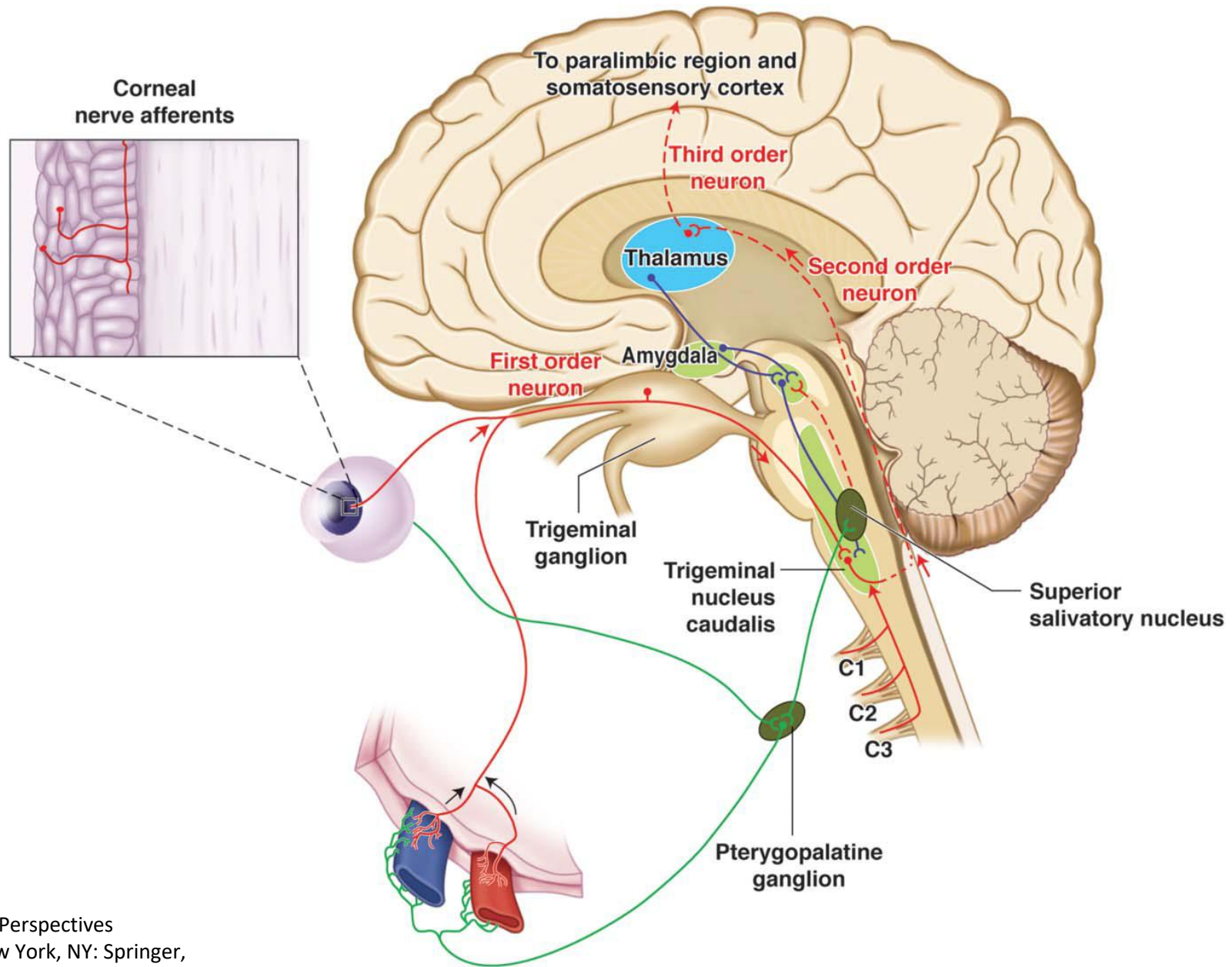
American Optometric Association (AOA Clinical Care Group). [The Effects of Computer Use on Eye Health and Vision](#). April 1997.

Leigh, R., Zee, D. *The Neurology of Eye Movements*. [The Ocular Motor Periphery](#).

Weir, C., *Journal of Neuro-Ophthalmology*. [Proprioception in Extraocular Muscles](#). Vol. 26, No. 2. 2006.

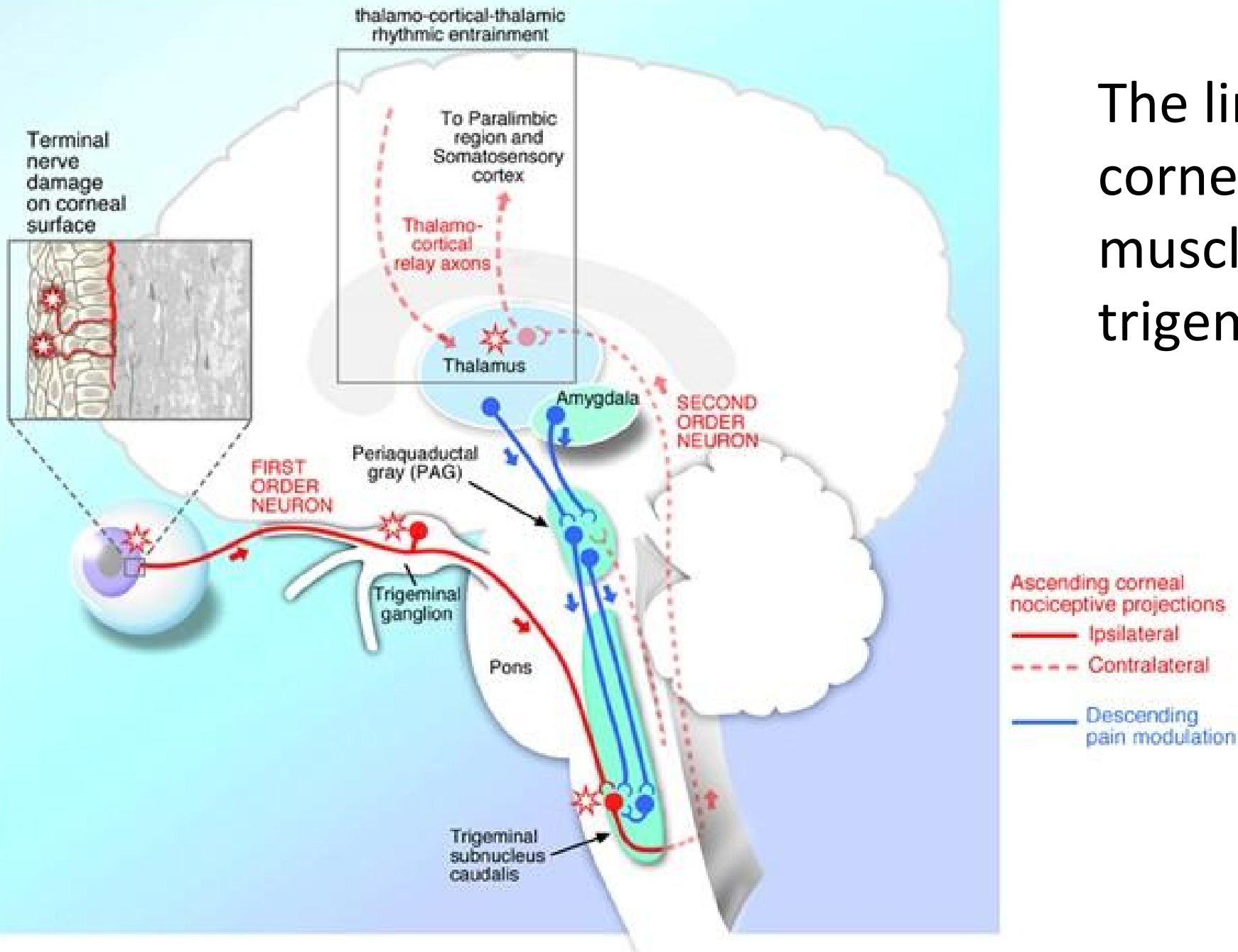
The Vision Council. [Digital Eye Strain](#). Accessed April 2018.





Digre K. A Case-Based Guide to Eye Pain: Perspectives From Ophthalmology and Neurology. New York, NY: Springer, 2018.

# The link between the cornea, extra ocular muscles and the trigeminal nerve



What tests do you routinely perform to determine if a patient may benefit from prism?

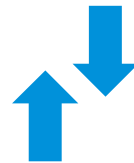


# Eye Misalignment as Previously Tested

- Cover test
- Phorias
- Fixation Disparity
- Percival's Criteria
- Sheard's Criteria
- Maddox Rod

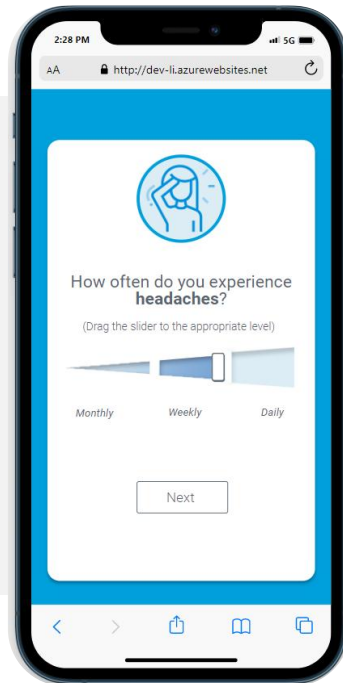


Now,  
NOW!



# The Process

Identify unmet need



Objective, Repeatable Measurement



Contoured Prism Lens





# The Measurement Device

Real-life measurement of Binocular Vision, taking into account:

- Heterophoria
  - Vergence conditioning
  - Binocular peripheral fusion
  - Fixation disparity
  
  - Accommodative convergence response
  - Alternating monocular central fixation
- Peripheral and central vision measure in objective, repeatable, accurate at both near (50 centimeters) and far (6 meters, simulating optical infinity).*

# Patient Results: Much More than Phorias

## DISTANCE MEASUREMENT

PUPILLARY DISTANCE 65.66mm  
MQI 1.00  
NEUROLENS # 0.16 $\Delta$  ESO  
VERTICAL 14.54 $\Delta$  L-HYPER  
VERTICAL MQI MEDIUM

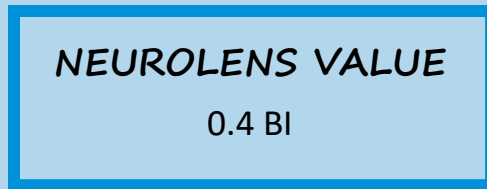
## NEAR MEASUREMENT

PUPILLARY DISTANCE 64.71mm  
MQI 1.00  
NEUROLENS # 3.84 $\Delta$  EXO  
VERTICAL 7.12 $\Delta$  L-HYPER  
VERTICAL MQI HIGH

AC/A Ratio 4.28  $\Delta$ /D

NEUROLENS VALUE

0.4 BI



# Small Prism Correction. Big Impact.

## Can small prism corrections improve visual comfort? Yes! Here is why.

Vivek Labhishetty BSc Optometry, MSc, PhD

### Background

DVS is an emerging public health concern where individuals experience a wide range of symptoms including headaches, eye strain, dry eye sensation and neck pain while navigating through their digital lives. Predictably, a growing trend in digital usage in the modern age has led to a steep acceleration of associated DVS symptomatology (Rosenfield, 2016); therefore, it is critical to understand, measure and treat this problem appropriately. DVS could be caused by both ocular and extraocular anomalies. While ocular anomalies include uncorrected refractive errors, eye misalignments or dry eyes, extraocular anomalies include muscle strains due to compensating postural changes. Uncorrected refractive errors are typically corrected using prescription lenses, dry eyes are treated with therapeutics, and compensating postural habits are corrected by employing occupational therapy or better ergonomic habits.

An often-overlooked cause of DVS related symptomatology is binocular vision disorders (BVD); for example, convergence insufficiency, where the patient typically presents with an eye misalignment (large exophoria at near compared to distance) coupled with other clinical signs such as reduction in near point of convergence (NPC). Typical treatment options for BVD involve prescription lenses, prisms or vision therapy (Scheiman et al., 2008). Lenses—especially plus lenses—are not commonly employed and are reserved for patients with heterophoria associated with a high AC/A. Prescription prism glasses, with horizontal and vertical relieving prisms, are offered to either patients with large phoria or in conjunction with vision therapy. The prism value prescribed is often based on fixation disparity analysis, Sheard's criterion or Percival's criterion. These glasses provide a constant prism correction to patients at all distances even though patients often present with varying amounts of misalignment at different distances.

Vision therapy is another commonly employed option for treating eye misalignment. The time course of the therapy and the treatment modality are decided based on the clinical (optometric) findings. The therapy, however, does not provide instant relief and is heavily reliant on the compliance of the patient over an extensive time course. Clinicians typically prescribe these treatment options only to symptomatic patients with large phoria. Clinicians tend to overlook patients with a smaller phoria and instead look for other causes for DVS.

There are several reasons why symptomatic patients with smaller phoria are not prescribed prisms or other corrective modalities to treat eye misalignments. One of the primary reasons is the inability to accurately measure smaller eye misalignments. As a result, only patients with a larger phoric posture are diagnosed and treated while individuals who could benefit from small prismatic corrections (less than 2PD) are overlooked. Clinicians have been testing phorias and fixation disparity subjectively for almost a century now, but it has been virtually impossible to accurately test prism in small increments of 0.10 PD for patients until the advent of the NeuroLens Measurement Device (nMD) in 2018. There is a need to recognize the functionality and application of small prism correction. This paper will demonstrate how prescribing small amounts of horizontal prism (less than 2PD) can relieve symptoms commonly related to DVS. So, what do we know about the relationship between small eye misalignments and DVS symptoms?

### Eye Misalignment and the Severity of Symptomatology

One of the common misconceptions with binocular vision disorders is that symptomatic patients tend to exhibit large phoria or fixation disparity coupled with other clinical signs. The assumption is that these large eye misalignments reflect a breakdown of the binocular vision system, especially the accommodation (focusing) and vergence (aligning) mechanisms. However, several studies have consistently reported evidence contrary to this belief.

No correlation between amount of misalignment and severity of symptoms. A patient with 1PD exophoria and a patient with 10PD exophoria could experience same severity of symptoms.

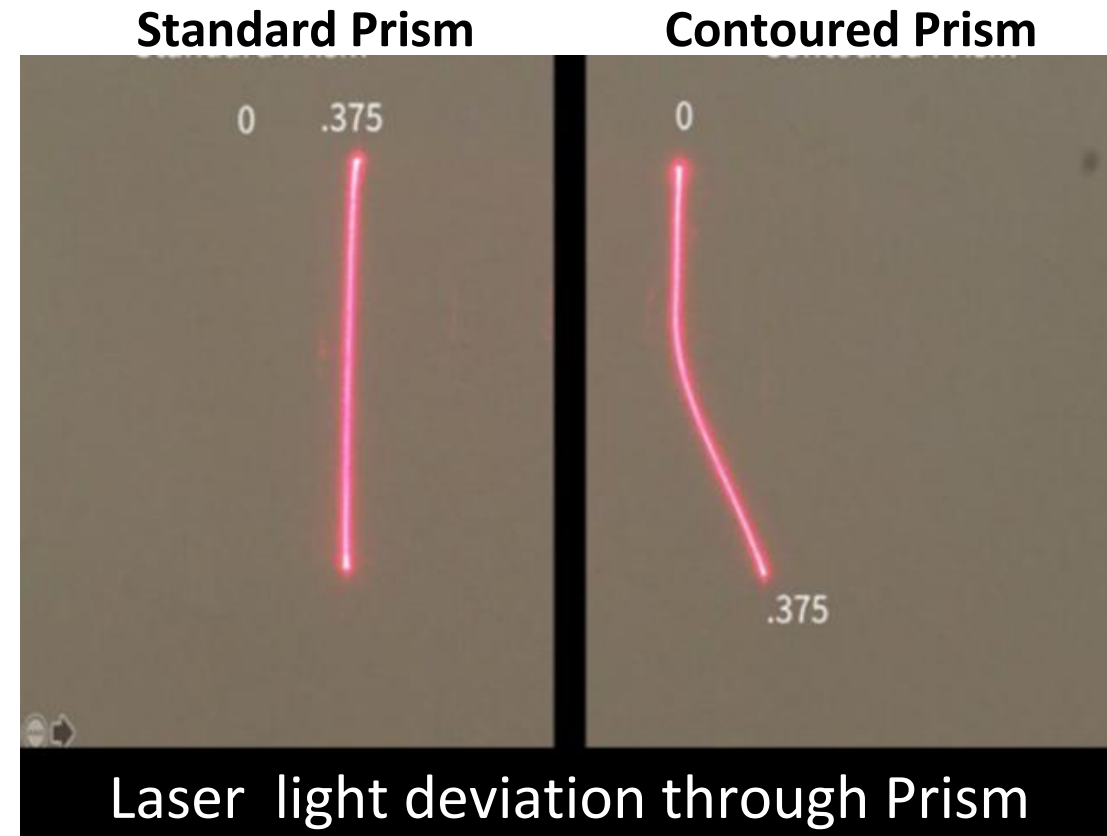
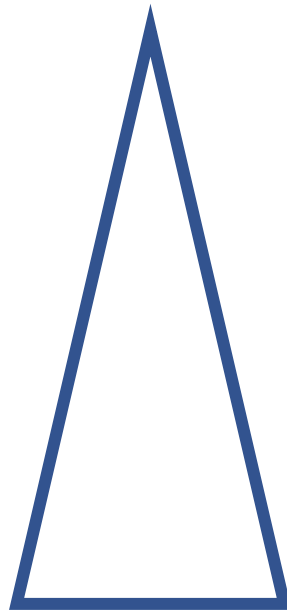
Small horizontal prism corrections (< 1PD) can provide significant relief in symptomatic patients.

Subjective clinical diagnostic tools limit our ability to accurately detect small eye misalignments.

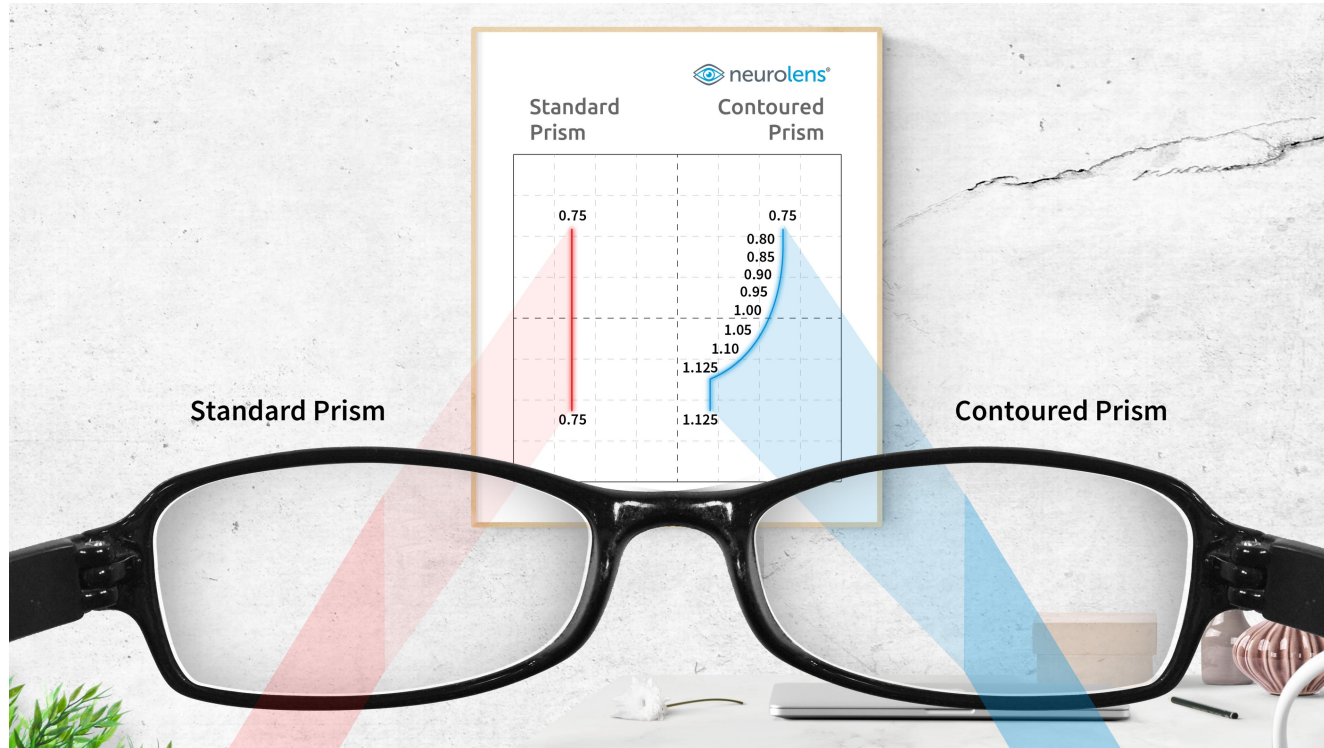
# Standard Prism and Contoured Prism

What is ***“Contoured Prism”***?

Why do we need ***“Contoured Prism”***?



# Advantages of Contoured Prism

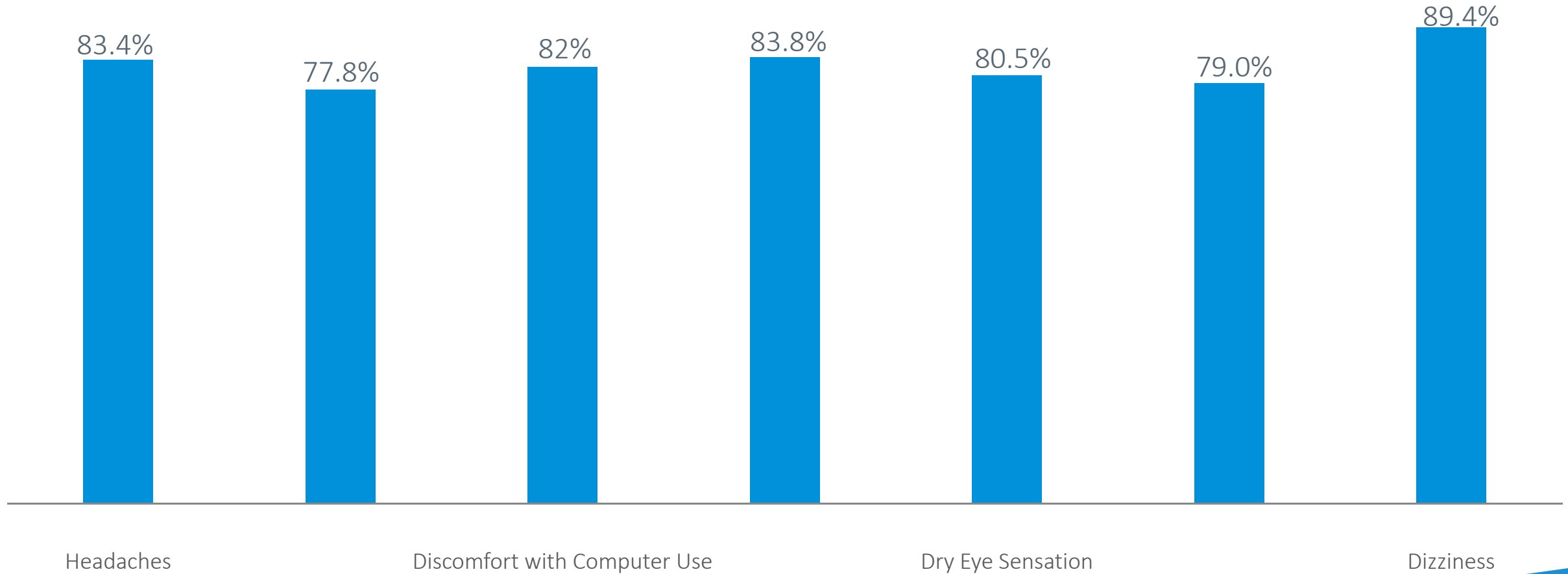


- Over 90% of patients experience a larger misalignment when fusing at near than at distance.
- Contoured prism increases in BI prism .75 PD as you progress down the lenses.
- Small prism prescriptions can yield profound symptom relief.



# Proven Symptom Reduction

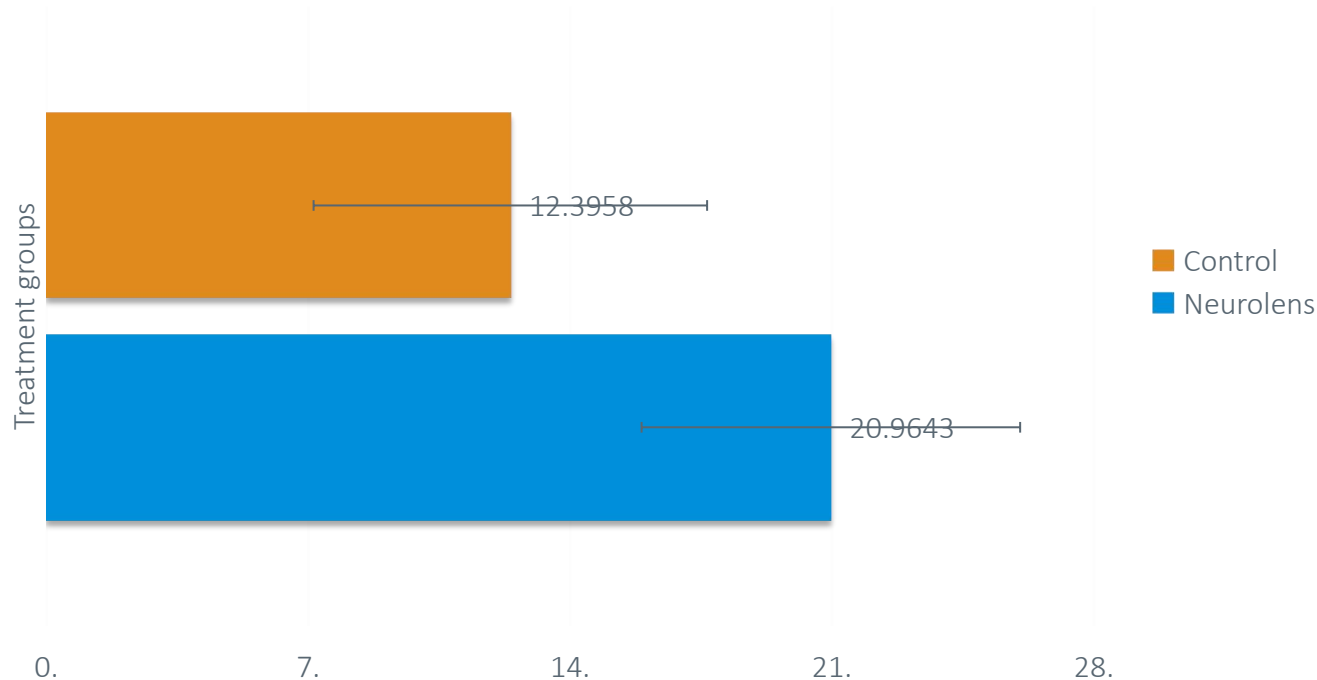
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# Neurolens Improves Reading Speed

## Reading Speed (words per minute)

change in the number of words read per minute



Parallel arm, double-blind study:  
evaluate reading speed at baseline  
and after seven days of lens wear

Control +12.39 words per minute,  
Neurolenses +20.96 words per  
minute (70% higher)

Statistically significant ( $F = 4.45$ ;  $p = 0.03$ )

# Do Patients “Eat” Contoured Prism? No!

After their first follow up at least one year after initial prescription, the average change in prism for NeuroLens patients was less than 1/3 PD.

- *45% had no change at all.*

After their second follow up at least one year after the first follow up, the average change in prism was much lower (about 1/10th PD).

- *Almost 60% had no change at all.*

## Prism Adaptation with NeuroLens

Vivek Labhishetty BSc Optometry, MSc, PhD

### Highlights

- Patients with no binocular vision dysfunction generally adapt to prisms, as they have a normally functioning vergence mechanism.
- Patients who are symptomatic are less likely to adapt to prism and will benefit from a prism correction.
- 6 out of 10 NeuroLens wearers did not show any significant sign of prism adaptation.
- The mean change in the NeuroLens prism prescription was less than 1/3rd of a prism diopter over time and the stability of the NeuroLens prism prescription improved over time.

### Abstract

An alignment response to an object of interest in the real world comprises of outputs from two components of the vergence mechanism, a fast (reflex) and a slow (adaptive) responding controller which have different temporal characteristics. Previous studies have reported that the strength/magnitude of the response of this slow adaptive component often correlates with the presence of symptomatology in patients with binocular vision dysfunction (BVD). Patients with no binocular vision dysfunction generally adapt to prisms, as these patients tend not to be symptomatic and have a normally functioning vergence mechanism. However, patients who are symptomatic are less likely to adapt to prism and will benefit from a prism correction. The combination of inconsistent clinical practices, inability to accurately measure and represent patients' symptoms, and variability in the individual's ability to adapt to a prism would leave the clinician with a lot of unanswered questions which make them hesitant to prescribe a prismatic correction to their patient. The NeuroLens process provides a simple, accurate and repeatable way to assess an individual's binocular vision which would ultimately help the clinician treat and diagnose that patient's condition with confidence. 6 out of 10 NeuroLens wearers did not show any clinically significant sign of adaptation to a NeuroLens correction. This is significantly lower than the adaptation frequency reported with standard prisms in the previous study (80%) implying that the NeuroLens process is more stable and effective than a standard prismatic correction calculated based on the traditional prescribing guidelines. The mean change in the prism prescription was less than 1/3rd of a prism diopter over time and the stability of the prism prescription improved over time.

### Vergence Mechanism and Prism Corrections

Optical prisms are one of the most commonly employed treatment modalities to correct binocular (vergence) dysfunctions involving eye misalignments, including heterophorias, fixation disparities and tropias. There is an inter-clinician variability in prism prescribing guidelines which is driven by factors such as clinicians' opinion or knowledge on prism corrections and binocular vision. There is anecdotal clinical evidence on the efficacy of prism treatment on patients with various binocular dysfunctions. Some clinicians also argue that prism corrections are not good given an individual's ability to adapt to prism corrections. This lack of consensus is coupled with a lack of evidence-based clinical standards on how to effectively use prisms to correct binocular dysfunctions<sup>1</sup>. There are three main reasons why a prism correction tends to be unstable: (i) individual differences in a person's innate ability to adapt to a prism; (ii) presence of a latent eye misalignment that may not have been detected during the initial eye examination; and (iii) our inability to measure an accurate and repeatable clinical parameter that assesses the vergence mechanism and consistently represents the symptomatology experienced by the patient.

The vergence system is unique, in terms of its cross-coupled relationship with the accommodative mechanism and its ability to adapt naturally. Broadly speaking, an alignment response to a stimulus in the real world comprises of outputs from two components of the vergence mechanism: a fast (reflex) and a slow (adaptive) responding controller.

# Patient Case Study #1



15 year old female

Complains of headaches, and dizziness. Convergence insufficient intermittent exotropia. Has worn glasses since age 11, which have helped, but still complains of headaches, and dizziness.

## Lifestyle Index:

Headaches	4
Neck Stiffness	3
Computer Discomfort	2
Tired Eyes	4
Dry Eye	1
Light Sensitivity	2
Dizziness	4

## **Rx (Single Vision):**

**+0.50-1.00x096**

**+1.00-1.25x090**

**1.6 BI NeuroLens**

*Measurement Device:*

*3.1 EXO Distance – 10.2 EXO Near*

*NL Value: 1.6 BI*

# Case History #1

## Lifestyle Index:

Headaches 4

Neck Stiffness 3

Computer Discomfort 2

Tired Eyes 4

Dry Eye 1

Light Sensitivity 2

Dizziness 4

FOR PATIENT USE

FOR OFFICE USE  
PT INITIALS / ID \_\_\_\_\_  
DATE \_\_\_\_\_

# Lifestyle Index

This questionnaire is meant to help your doctor understand what you're experiencing on a regular basis — **whether it's caused by your eyes, posture, stress, etc.** Your responses will help make sure you receive the best care possible.

How often do you experience any of these symptoms? Fill in applicable circle. For example:  1  2  3  4  5

**Headaches**

- You get headaches of any severity each week (even just a dull ache counts).
- Your headaches tend to get worse later in the day.

1 Never  2 Rarely  3 Sometimes  4 Very Often  5 Always

Additional notes: \_\_\_\_\_

**Stiffness / pain in neck / shoulders**

You experience stiffness/tension in your neck/shoulders when you work at a computer or read (this might even be from your posture).

1 Never  2 Rarely  3 Sometimes  4 Very Often  5 Always

Additional notes: \_\_\_\_\_

**Discomfort with Computer Use**

Your eyes get tired, burn, or get red easily when you work at a computer for long hours.

1 Never  2 Rarely  3 Sometimes  4 Very Often  5 Always

Number of hours per day using a digital device: \_\_\_\_\_

**Tired Eyes**

Your eyes feel increasingly fatigued/tired as the day goes on.

1 Never  2 Rarely  3 Sometimes  4 Very Often  5 Always

Additional notes: \_\_\_\_\_

**Dry Eye Sensation**

Your eyes progressively feel more dry/sandy/gritty while working at the computer or reading.

1 Never  2 Rarely  3 Sometimes  4 Very Often  5 Always

Additional notes: \_\_\_\_\_

**Light Sensitivity**

Bright / Strong lights (vehicle headlights, florescent lights etc.) bother you.

1 Never  2 Rarely  3 Sometimes  4 Very Often  5 Always

Additional notes: \_\_\_\_\_

**Dizziness**

You experience dizziness, motion sickness, or vertigo.

1 Never  2 Rarely  3 Sometimes  4 Very Often  5 Always

Additional notes: \_\_\_\_\_

**Additional Notes**

Any additional notes you'd like to add: \_\_\_\_\_

\_\_\_\_\_



## Patient #1

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Patient reports his glasses are MUCH clearer than before despite the exact same RX. She is making fewer mistakes when taking tests where answers are reports being able to read longer. Headaches have lessened significantly and she no longer experiences dizziness.

# Patient Case Study 2



42 year old female  
Headaches, light sensitivity, tired eyes, eyes never quite feel right, and vision has always seemed off. Frustrated with her eyes with dry eye sensation. Been to several other doctors, tried various dry eye treatments with little or no improvement.

**NL Measurement Device:  
3.40 EXO Distance – 9.48 EXO Near**

**Rx (Progressive):  
Plano with 1.50 Add OU  
1.5 BI**

## Lifestyle Index:

Headaches	4
Neck Stiffness	2
Computer Discomfort	3
Tired Eyes	4
Dry Eye	4
Light Sensitivity	4
Dizziness	

## *Patient Case Study 2*

Follow up report:

Patient reported back, relieved and thrilled with new correction. Reported only 1 headache in 14 days( previously Headaches almost daily). Vision seems “natural” and has more energy and concentration. Eyes feel much better! Needs fewer breaks. Feels like a weight lifted off her shoulders, “finally someone that listened and understood my problems”.

## Patient Case Study #3



37 year old male

Complains of eye dryness ever since having LASIK. “Wished I’d never had it.” Has seen 4 doctors and has treated his dry eye with “everything under the sun”. Convergence insufficient and exophoria. Has worn glasses since age 9, but could not wear contact lenses due to “immediate eye dryness”

### Lifestyle Index:

Headaches	3
Neck Stiffness	3
Computer Discomfort	5
Tired Eyes	4
Dry Eye	5
Light Sensitivity	1
Dizziness	2

### **Rx (Single Vision):**

**OD: +0.25 DS**

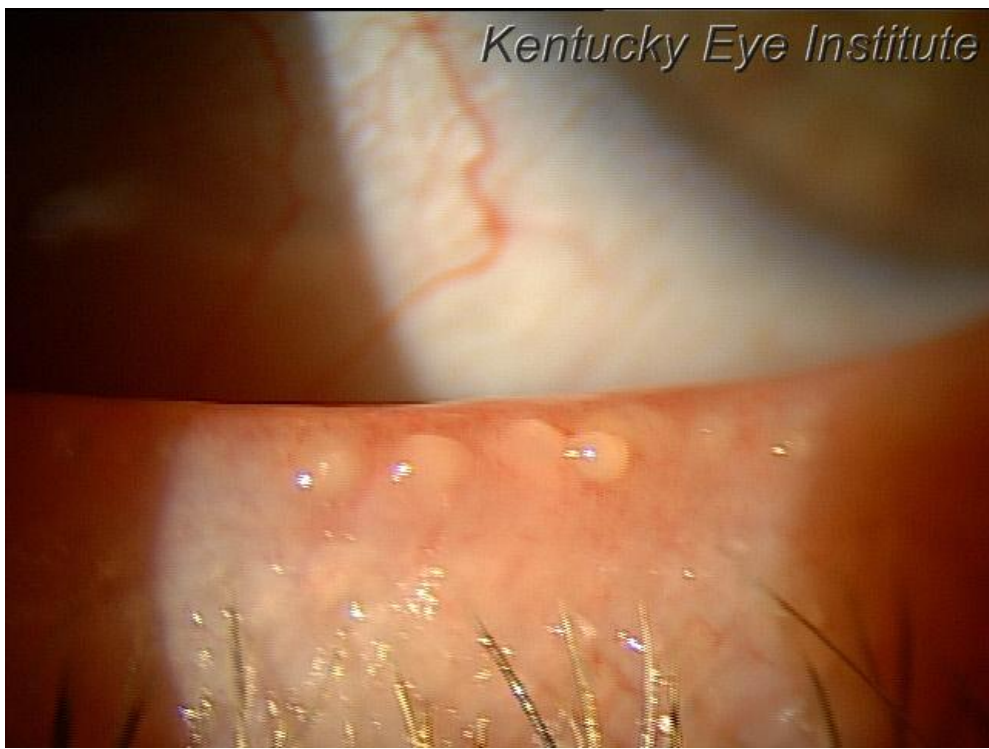
**OS: plano**

**1.3 BI Neurolens**

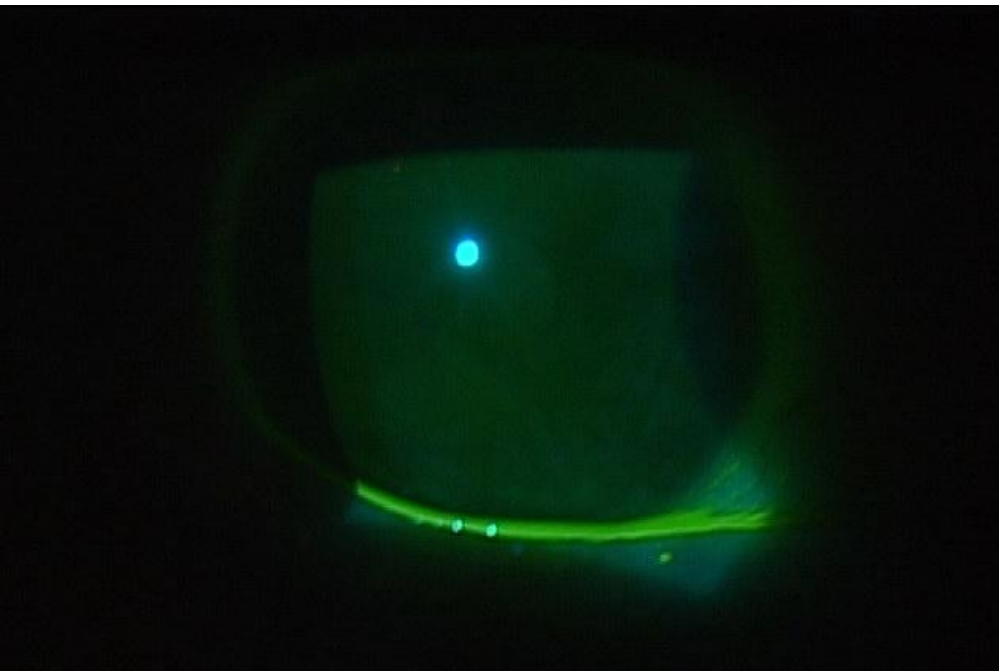
*NL Value: 1.3 BI*

### *Measurement Device:*

***3.8 EXO Distance – 9.1 EXO Near***



- Osmolarity 302 OD, 303 OS
- Eyelids- trace blepharitis/collarettes
- MGD Expression: 3- OU
- No corneal staining
- No conjunctival staining
- Ample break-up time (>10 Keratograph)
- Tear meniscus: relatively normal





## Patient #3

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Asked about his previous spectacles and if he still had them?

Returned with spectacles:

-4.50 DS OD, 1 BI

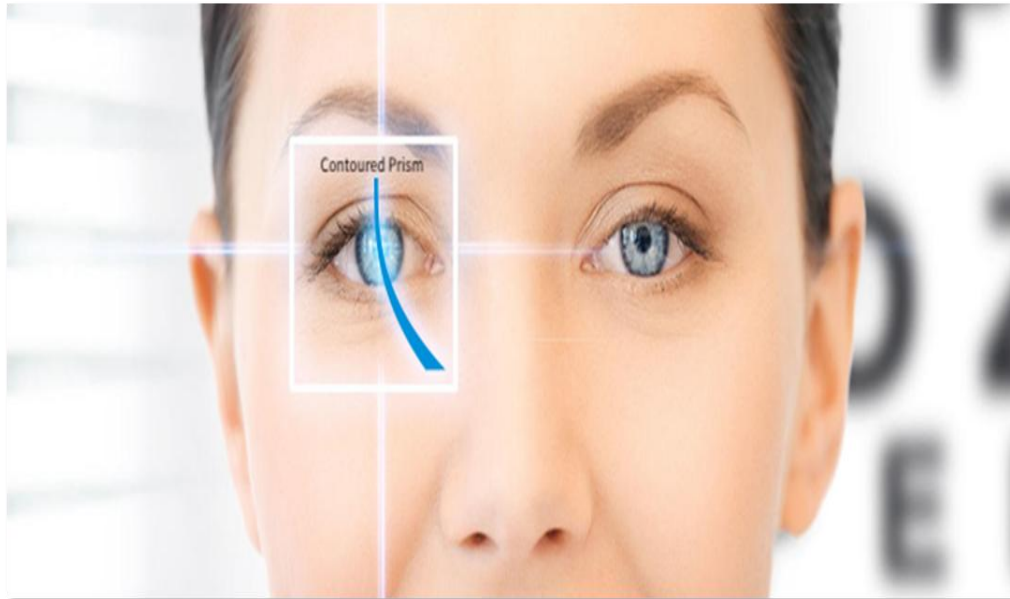
-4.50 DS OS, 1 BI

The patient had trigeminal dysphoria and previous glasses were somewhat compensating for it (i.e. he complained of dry eye prior to LASIK, especially at near)

When glasses were eliminated with LASIK, TD symptoms appeared. Also explains why he had such dryness with CL wear!

Patient now wears Plano Rx NL and has no symptoms

# Thank You!



- “Only a **small amount** of **Base-In prism** will produce a **noticeable change** in the relation of fusional demand and reserve so that the average patient may require very limited amounts to restore comfort.”

Irving Borish