Article ▸ Gunnar Optiks Study #2: Electromyography and Tear Volume

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ABSTRACT

Background: This study was conducted to study the difference between the classic Gunnar Optiks computer spectacles and control glasses with small changes in base curve or tint.

Methods: Twenty-nine subjects, ages 22-62, completed this study. The two control pairs of eyeglasses were in similar frames, and both sets of lenses were made of similar resin with antireflective coating. One control pair had gray-tinted (neutral density) lenses made with the same optical power as the Gunnar Optiks design. The other had the same yellow tint but a flatter base curve and less faceform than the Gunnar design. Under stressful conditions of glare and dry air induced by a fan, electromyography of the eyelid to quantify squinting and blinking experienced with each type of glasses and tear volume measurement using Zone Quick phenol red thread were recorded. Conditions were compared with a mixed-model analysis of variance or covariance.

Results: Statistical analysis revealed no significant difference between the Gunnar Optiks design and the control glasses under these conditions. There were no significant differences in squint power ($F=1.88$, $p=0.083$) and squint frequency ($F=2.065$, $p=0.057$) between the Gunnar Optiks design and the control eyeglasses with a neutral density tint or flatter base curve. There was significantly increased tear volume ($F=3.65$, $p=0.031$) and reduced blinking ($F=2.57$, $p=0.019$), but a lower blink rate is associated with dry eye.

Conclusion: The classic Gunnar Optiks design was not shown to fulfill their claims of reducing asthenopia due to normalization of blink rate or squinting.

Keywords: computer vision syndrome, dry eye, eyelid squint, low plus lenses, yellow filters

Introduction

The American Optometric Association (AOA) defines computer vision syndrome (CVS) as a complex of eye and vision-related problems that result from prolonged computer use.[1] Many treatments for CVS have been investigated, some of which are available over the counter. These remedies include homeopathic[2] and Ayurvedic[3] eye drops, yoga,[4] and topical warming pads.[5]

While computers have become ubiquitous for school, work, and play, the acknowledgement of CVS is not uniform. It should not come as a surprise that the ways in which eye care professionals treat CVS are variable. When presented with a patient with CVS symptoms, ophthalmologists will traditionally recommend artificial tears or pharmaceuticals, with less than half recommending optical intervention.[6]

While optometric vision therapy may be the treatment of choice for many patients with CVS, unfortunately, some patients are unaware of, or are disinterested in, that treatment modality. For these patients, passive optical treatments may be appealing; these are not new. Some readers may recall one of the first corporations to market low-powered plus lenses combined with light tint and an antireflective coating, the PRIO Corporation (now owned by Essilor), over twenty-five years ago.[7]

For those CVS sufferers who are emmetropic (or who are corrected to emmetropia with contact lenses), prescription computer eyeglasses may seem unnecessary. This is especially true of the younger pre-presbyopic population; enter companies like Gunnar Optiks. Over the years, the company website (http://www.gunnars.com/how-they-work/) claims that their "digital performance eyewear" is designed to deliver the following to the eyes: glare reduction, higher humidity, extraneous light diminution, screen magnification, and ultraviolet (UV) protection. This study is the second of three by the Vision Performance Institute to examine these claims in detail to see whether they can be verified.[8]

In a previous study,[9] the Grand Seiko WAM 5500 was used along with symptom surveys to see whether the Gunnar design had an effect on the signs and symptoms of CVS. As is typical of studies at the Vision Performance Institute, stressors were used to simulate CVS. This approach has the advantage of allowing subjects to participate without requiring them to be studied after many hours of computer work.

In this first study of the classic Gunnar Optiks design, glare and low-contrast font conditions were both used. With these stressors in place, the accommodative response and pupil size were measured five times per second, and symptoms were measured every ten minutes. The results of the first study showed no significant effect between the Gunnar design and placebo and led to the design of the second and current study of electromyography and tear volume.

Methods

Subjects were between the ages of 22 and 62, with a mean age of 31 years. There were 37 subjects who participated in this study from the Pacific University community. Twenty-nine of these subjects (17 male, 12 female) whose survey data sets were complete qualified for statistical analysis. The other 8 sets of data were incomplete and were not analyzed. To qualify for the study, all subjects had to have 20/20 acuity in both their right and left eyes either without correction or with contact lens correction. In addition, each subject's residual refractive error could not exceed 0.62 D spherical equivalent in either eye. Those wearing corrective spectacles only were not qualified as at the time, Gunnar Optiks eyewear was not made available in individual prescriptions.

After initial recruitment, qualification, and informed consent, each participant had two surface electrodes for electromyography (EMG) positioned on the lower orbicularis muscle of each eyelid. These were used to count the frequency and to time the duration of blinks with full eyelid closure and to quantify squinting for partial closure of the lids, as measured in millivolts. To simulate the average work environment, each subject was tested while scanning an electronic database on a desktop computer with a 50 cm working distance under the following conditions for 10 minutes apiece, with a two-minute break in between each (Table 1):

1) Control (no glasses, no stressors). Contact lenses were permitted if habitually worn.
2) Classic Gunnar Optiks spectacles (with original +0.50 D power) with a blowing fan directed toward the subject's face to cause dryness. This stressor method has been used in a previous study to simulate all-day computer use in a reasonable study period.[8]
3) Flatter (4D) base curve (BC) lenses identical to the Gunnar design, in an Izod frame, also with a blowing fan, as per #2 above.
4) Classic Gunnar Optiks spectacles with glare, caused by five 15W compact fluorescent lights (color temperature 6500 K), causing 300W incandescent-equivalent glare without significant heating of the air.
5) A neutral density (gray-tinted) pair of spectacle lenses, in a frame of Gunnar Optiks' design, also with the same glare as #4 above.
6) Classic Gunnar Optiks spectacles with no fan or glare stressors.
7) Clear (placebo) glasses, without tint or optical power, in a frame of Gunnar Optiks' design, with no stressors.

Table 1: Experimental Conditions

	Tint	Wrap
Gunnar Glasses w/Glare	Yellow	Yes
Gray Glasses w/Glare	Gray	Yes
Gunnar Glasses w/Fan	Yellow	Yes
Izod Glasses w/Fan	Yellow	No
Gunnar Glasses	Yellow	Yes
Clear Glasses	None	Yes
No Glasses	None	No

All but the first condition were randomized in a Latin-square order for each subject. Thus, each subject participated in all seven conditions: three with the classic Gunnar design, three with slightly modified Gunnar-like specs (except for the single variable of tint color, base curve, or power), plus the control condition. Tear volume measurements using Zone Quick phenol red cotton threads were used to test one eye for dryness both before and after the conditions with the blowing fan stressor and the control conditions.

Table 2: Mean Scores for Each Condition

Condition	log EMG Power	Average Blink Power (amps)	Blink Frequency per minute	Average Blink Duration (msec)	Average Squint Power (amps)	Squint Frequency per minute	Log Average Squint Duration (sec)
Gunnar Glasses w/ Glare		13.828	18.767	52.900	12.855	1.617	2.380
Gray Glasses w/Glare	log EMG Power		16.917	50.800	13.130	1.388	2.250
Gunnar Glasses w/Fan		13.408	20.216	53.900	13.249	1.931	2.220
Izod Glasses w/Fan	Average Blink Power	13.657	19.831	52.600	13.301	2.796	2.332
Gunnar Glasses	4.712	13.700	21.224	53.700	13.348	3.198	2.238
Clear Glasses	4.591	13.445	23.616	52.500	12.483	2.429	2.225
No Glasses	4.782	13.813	22.705	54.480	13.092	1.806	2.223
ANOVA F for Condition	1.883	1.146	2.573	0.402	1.351	2.065	1.370
P	0.083	0.335	0.002	0.877	0.238	0.057	0.229

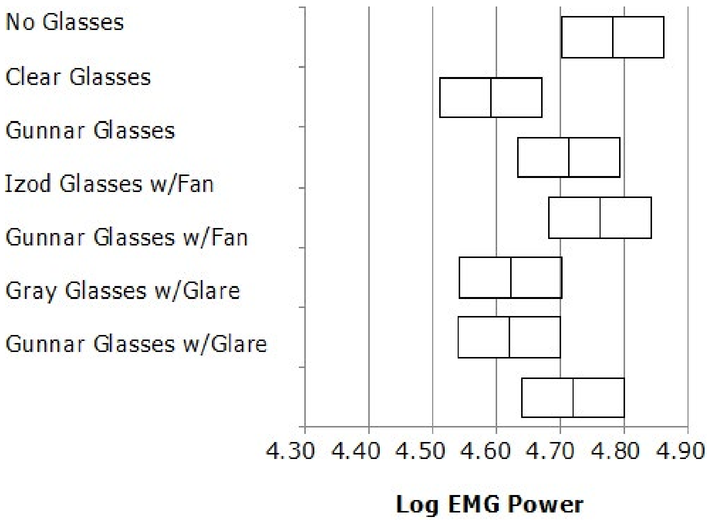

Figure 1. *Effect of condition on mean log orbicularis EMG power, which quantifies squinting. Non-overlapping bars indicate statistical significance at an unadjusted p<0.05 (Overall condition F=1.88, p=0.083).*

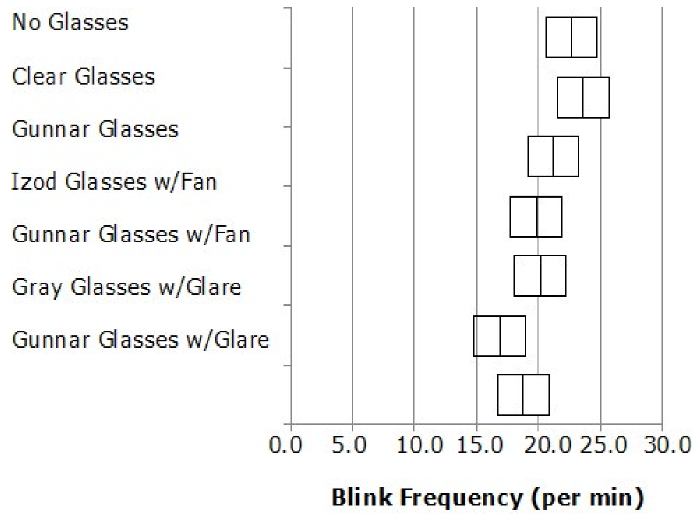

Figure 2. *Mean blinks per minute for each condition. Non-overlapping bars indicate statistical significance at an unadjusted p<0.05 (Overall condition F= 2.57, p=0.019).*

Statistical Methods

Conditions were compared with a mixed model analysis of variance or covariance. In the case of EMG, blink and squint measures during the initial 30-second period of each condition were used as a covariate. During this period, the subject did not wear any of the spectacles. Left and right eyes were treated as a random variable. EMG power and squint duration were log transformed to better represent a normal distribution.

Graphs were prepared to compare means. Confidence intervals were constructed such that non-overlapping confidence intervals were significantly different at an unadjusted p<0.05. This was accomplished by constructing the 84th percent confidence interval around each mean.[1] In constructing this confidence interval, the standard error for a single mean (SE) was estimated using the standard error of the differences (SED) in the following formula: SE = SED/(square root of 2). The standard error of the differences between means yields the same results as provided in the least squared difference t-test (SPSS version 17; SPSS Inc. Chicago, Illinois).

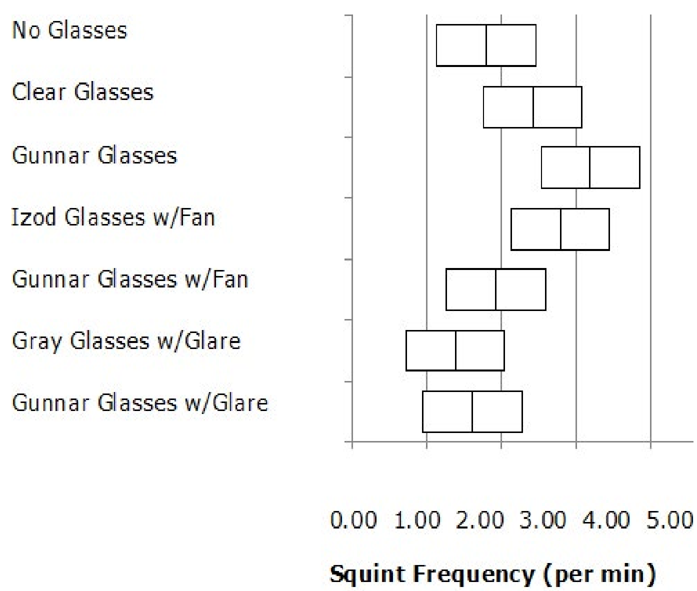

Figure 3. *Mean squint frequency by condition. Non-overlapping bars indicate statistical significance at an unadjusted p<0.05 (F=2.065, p=0.057).*

Results

Thirty-seven (37) subjects met the study inclusion and exclusion criteria and completed the tear film, EMG, squint, and blink portions of the study. Of these, 29 completed the entire study. Questionnaires were based on internal and external symptom factors identified by Sheedy et al.[10]

In short, statistical analysis revealed no significant difference between the Gunnar Optiks design and the control glasses under these conditions. There were no significant differences in squint power (F=1.88, p=0.083) and squint frequency (F=2.065, p=0.057) between the Gunnar Optiks design and control eyeglasses with a neutral density tint or flatter base curve. There was significance in tear volume (F=3.65, p=0.031) and reduced blinking (F=2.57, p=0.019), but a lower blink rate is associated with dry eye. Further details follow.

EMG, Squint, and Blink Analysis

When comparing the conditions, only blink frequency per minute had an overall significant F in the ANCOVA (Table 2). Figures 1-3 represent comparing means for blink frequency, orbicularis EMG squinting power, and squint frequency. Figure 1 shows how strongly subjects squinted during the experiment, as measured by orbicularis EMG. Note that the classic Gunnar Optiks design did not significantly reduce EMG power. Figure 2 shows that blink rate was highest with no glasses or with clear (placebo) glasses and was lowest under glare conditions with tinted glasses of yellow or gray color. Figure 3 shows squint frequency, which was not significantly different with the Gunnar design glasses.

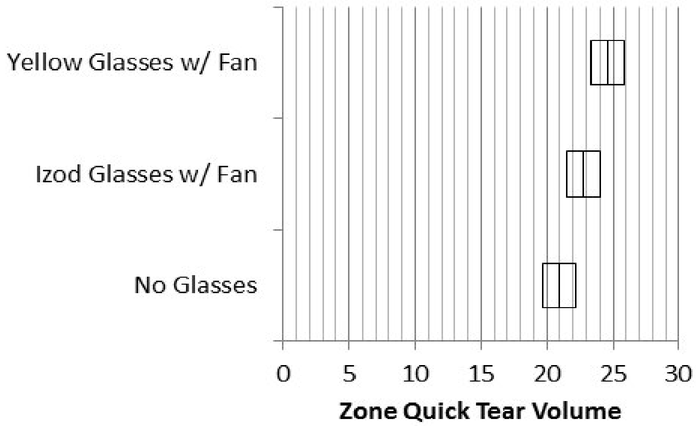

Figure 4. *Zone Quick tear volume under various conditions. Non-overlapping bars indicate statistical significance at an unadjusted p<0.05 (F 3.65, p=0.031).*

Tearing

There was a significant effect of tear volume by condition. There was no statistical difference between tears generated under fan conditions for the Izod glasses (22.01 mm, 1.06 SE) and the Gunnar yellow glasses (23.95 mm, 1.95 SE; Figure 4, p=0.13). There was a significant difference between Gunnar yellow glasses and the no-glasses condition. Note that tear volume is measured after 15 seconds from insertion of the phenol red cotton threads in the lower lid, as directed by the Zone Quick manufacturer. There was an almost 3 mm difference between the control condition (without glasses) and the fan. We interpreted the (almost) 24 mm tear volume with the Gunnar glasses as reflex tearing due to the fan alone.

Discussion

As per the company website (http://www.gunnars.com), "Gunnar is the only patented computer eyewear recommended by doctors to protect and enhance your vision. Gunnar computer glasses minimize eye strain while improving contrast, comfort, and focus when staring at a digital screen." Gunnar Optiks has in the past made claims that their "digital performance eyewear" delivers the following to the eyes: glare reduction, higher humidity, extraneous light diminution, screen magnification, and ultraviolet (UV) protection. This study is the second of three to examine these claims in detail to see whether they can be verified.[8]

The original claims of Gunnar Optiks cannot be substantiated based on the results of this study. For example, a low blink rate is associated with dry eyes when reading.[10] This study found that the classic Gunnar Optiks design did create wetter eyes, though they actually decreased blink rate, even with a blowing fan stressor. In fact, blink rate was lowest under glare conditions with Gunnar glasses as measured by orbicularis EMG, even under the stressor condition of a blowing fan. It is likely that the statistically-higher tear volume was due to reflex tearing under these conditions.

Also, patients were found to squint just as strongly with or without the Gunnar glasses under these conditions, measuring the orbicularis contraction power with electromyography (EMG). The Gunnar Optiks design did not significantly reduce squinting more than neutral density tint did, even under glare.

Subjects did prefer the Gunnar design to no glasses at all. This replicates the finding of the first study[9] in which 59% of the subjects preferred the original +0.50 D power Gunnar design. This preference did not increase compliance with wearing the Gunnar glasses among emmetropes or contact lens-corrected participants.

Conclusion

In summary, this study found scientific evidence for changes in tear volume, though not electromyography of the eyelid (squinting and blinking), with the classic Gunnar design eyewear. Despite the yellow tint apparently increasing glare and not improving contrast sensitivity, previous studies have shown subjective preference for the Gunnar design.[9] This preference may simply be due to the placebo effect, but it is still real to these subjects.

While not encouraging to the notion that the original Gunnar design helps to prevent CVS, these results are tempered by the lack of evaluation of a large group of potential subjects: corrective spectacle wearers. In addition, since this study, there have been significant changes in the Gunnar design, including the lens power (which was reduced from +0.50 D to the proprietary +0.20 D over habitual prescription). The authors advise clinicians to prescribe OTC "digital performance eyewear" with caution and to remind patients of the time-honored advice: *caveat emptor*.

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