ABSTRACT

One of the components of what has become known as Computer Vision Syndrome (CVS) is a complaint of dry eyes which is not present in other near work situations. The etiology of the dryness is believed to be decreased blink rate and/or a wide palpebral aperture while viewing a computer monitor. This study examined the first theory only, although if the first theory is disproven the second one gains more credence.

Methods: There were 31 subjects enrolled in this study. All initially filled out a questionnaire of symptomatology and underwent a series of refractive and ocular examinations in order to exclude those subjects with clinical dry eye or other related ocular conditions. In the second phase each subject read a selection for 10 minutes once from a computer screen and once from a printed page. This experimental phase was conducted in a standard classroom with standard lighting, without internal air conditioning or heating. The order of reading and selected tests was performed randomly during morning hours on consecutive days. The text and angle of gaze was uniform for both sessions, with each condition (computer screen or paper) having its own specific working distance and angle of gaze. The performance was filmed with an internet camera and later the amount of blinking was scored manually.

Results: The number of blinks per minute while reading from a computer screen was greater, on average (1.73 ±0.43) than reading from a printed page. However, this difference was only significant at the p=0.22 level. 18 subjects had a higher blink rate with computer work while 13 had a higher blink rate with a printed page. The subjects with the higher blink rate reading from a computer screen had a higher differential between the two scores.

Conclusions: No significant difference in blink rate was found between the blink rate when reading from computer screen as opposed to a printed page. Even the mildly significant result indicated the opposite. This would indicate that the theory that dry eye associated with computer work is not caused by excessive “staring” and lower blink rate. This gives indirect support to the theory that the height of the computer screen is a more important variable.

Keywords: blink rate, computer vision syndrome, dry eye, staring
various symptoms within CVS. This study focused on one aspect of CVS, the dry eye phenomenon.

Dry eye is classified as a disease with specific symptoms which arise from damage to the ocular surface, instability of the tear film and a hyperosmolaric change in the tear film content. Some of the basic methods of determining dry eye include: patient questionnaires, fluorescein tear break up time (FBUT), Keratometer tear break up time (KBUT), the presence of fluorescein staining, and the osmometer. The two basic suspected causes for the dry eye phenomenon during extended computer work are:

1. The increase concentration and interest provoked by this type of task induces a staring phenomenon and a reduction in the normal blink rate. This in turn causes increased tear film evaporation and degradation.

2. The angle of gaze used by most computer users, which is considerably more elevated than the angle of gaze in normal reading from a printed page, exposes more of the cornea to the drying effect of the atmosphere hence more tear film evaporation and degradation.

There have been previous studies somewhat similar to this one evaluating certain aspects of the dry eye/CVS problem. In 2006 Skotte, et al, evaluated the blink rate during various computer tasks using electrodes. While valuable, this study did not address the issue of whether the blink rate during computer use is reduced but rather what the differing blink rates were on different computer tasks. In 1991 Patel, et al, evaluated the change in blink rate and tear film stability during computer use as opposed to during concentration with an individual. Other studies have examined other differing aspects of computer use and dry eye symptoms. What the current study attempted is to compare two tasks of greater similarity in visual demand and conversation in that both tasks involved reading texts.

There are a number of visual factors specific to computer work including: less distinct borders to letters, lowered contrast, reflections from the screen surface, working distance and angle of gaze. The two main video display terminals (VDT’s) in use today are the cathode ray tube (CRT) screen and the Liquid Crystal Display (LCD) screen. A study comparing the two VDT’s found no difference in the Visual Acuity but the LCD screen was judged more visually comfortable and was preferred by the subjects.

Methods

This study was conducted on 31 subjects (13 male, 18 female) with an age range of 20-30. The subjects filled out a questionnaire as to general and ocular health status before undergoing a visual evaluation. The evaluation consisted of the following: near visual acuity (at 40 centimeters), cover test, near point of convergence and binocular accommodative facility. In addition the ocular health status was evaluated with a slit lamp examination and a Keratometer Tear Breakup Test (KBUT). The purpose of the pre-testing was not to disqualify any participants but rather to enable a better post-hoc evaluation of common factors in the eventual results.

In the second phase, each subject read two different selections of text for a period of ten minutes each. This was done during the morning hours with one section read from an LCD screen and other from a printed page. The order in which the portions were read was random and the sessions were done one day apart in order to eliminate any influence one type of task might have on the results in the other task.

The texts selected were judged to be of average difficulty for this age group. The background in both cases was white while the letters were black. The computer font was Arial (Hebrew) 12 (letter size of 3 millimeters) while the printed page font was Arial 8 (letter size 2 millimeters). The VDT was centered 20 degrees below the patients normal distance gaze level with the viewing distance to the LCD set at 60 centimeters and to the printed page, 40 centimeters. These parameters were set in order to insure identically sized retinal images in both cases. The same room was used for the entire study with fluorescent lighting and no air-conditioning.

The subjects were filmed using an internet camera and were unaware of the purpose of the study in order to minimize any possible voluntary or subconscious alteration of the natural blink rate. Since the level of interest and concentration was thought to be a factor, all subjects were quizzed on the topic after they finished reading with the afore-knowledge that correct answers would be rewarded. The video was then reviewed and tabulated manually.

Results

As can be seen in Graph 1 the total blink rate for reading from the LCD was 171.58 (17.15 blinks per minute) while reading from a printed page resulted in an average rate of 154.29 (15.42 blinks per minute). The average difference in the blink rate per minute
was 1.73 ±0.43. Analysis utilizing the t-test produced a value of p=0.22 which would indicate that this difference is not statistically significant. Interestingly enough, even this difference showed more rather than less blinking in the computer reading group.

The average blink rate for all subjects is shown in Graph 2 while the individual results are shown in Graph 3. An additional analysis of the data was performed by dividing the subjects into two groups:

1) Those with the higher blink rate during reading from a printed page
2) Those with a higher blink rate while reading from the computer screen

This analysis showed that for those subjects who showed a higher blink rate while reading from the VDT (Graph 3), the difference between the tasks was greater than for the other group (Graph 4). An attempt was made to explain this fact by some correlation with the pre-test data but no significant relationships were found.

**Discussion**

In this study we have found no statistically significant difference in the blink rate of normal subjects reading from a VDT as opposed to reading from a printed page. There are two possible explanations for this finding:

1. There is no real difference in the amount of concentration or interest factor in reading from a computer screen as opposed to the same task read from a printed page.
2. It is possible that the time factor selected for this study (10 minutes of reading) was insufficient to produce a difference that could possibly exist with longer periods of computer work.
Conclusions

The findings of this paper do not support the theory that dry eye during computer use is caused by an increased interest factor leading to staring. It has never been established that various tasks involving differing levels of concentration—solving math problems, conversation, editing, etc. produce differing levels of dry eye and so it would not seem logical that a different interest factor with computer use would cause a dry eye. If this theory for dry eye can be eliminated, it is obvious that the second theory (angle of gaze) becomes more significant.

One of the well known therapeutic suggestions given to computer users with dry eye is to make sure to blink more often.10,11 This study would suggest that such advice is of little use. It would seem appropriate to further study the angle of gaze theory with one possibility using an osmometer to measure the dryness of the eyes during computer use at various visual angles. An additional study could compare the amount of dry eye complaints with a laptop as opposed to a desktop computer.

References: