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Original Research Paper

Ophthalomology

COMPARATIVE ANALYSIS OF TEAR FILM IN DIGITAL SCREEN USERS VERSUS NON-USERS.

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ABSTRACT **Background-** Dry eye disease is the most frequent ophthalmologic disorder seen in routine clinical practice. The prevalence estimates for the general population vary greatly, from 5% to 50%. It is one of the major contributors to lower quality of life among the young population and may have an adverse effect on mental health. **Aim-** The study aims to compare tear film among digital screen users and non-users. **Material and Methods-** This was a cross-sectional study conducted on 150 patients who were divided into 2 groups. One group was of digital screen users and the other was of non-users. The patients were selected based on inclusion and exclusion criteria and the study was started after getting ethical clearance. A thorough history was taken and the OSDI questionnaire was filled followed by an examination on IDRA. The values of NIBUT, Interferometry, tear meniscus height, and meibomian gland loss were calculated and analysis was done using STATA and SPSS software. **Findings-** In our study, we found that the tear film in users was not as healthy as compared to non-users. In our study, we also found that out of 75 users, more than half of users were having a severe form of DED. It was seen that the values of mean NIBUT, Interferometry, and tear meniscus height were lower in the user group than in non-users and users have more meibomian gland loss in comparison to non-users. The study has a p-value of 0.001. **Conclusion-** The study concludes that the symptoms and signs of DED are more common among digital screen users than non-users. The main reason behind this is improper knowledge about what measures can be taken to prevent this and long continuous screen hours.

KEYWORDS : Dry eye disease, OSDI, NIBUT, Interferometry, Tear meniscus height, meibomian gland loss.

INTRODUCTION

One of the most frequent ophthalmologic disorders seen in routine clinical practice is dry eye disease (DED). [1] The revised definition of DED, which was published in the 2017 report by the Tear Film and Ocular Surface Society (TFOS) Dry Eye Workshop (DEWS II), as it is an ocular surface disorder in which multiple pathological events, such as tear film instability, hyperosmolarity, inflammation, and neurosensory abnormalities, lead to the loss of the homeostasis of entire system. [2] It is a chronic illness that places a significant financial strain on sufferers and society as a whole. [3]

Dry eye prevalence estimates for the general population vary greatly, from 5% to 50%, which is probably a result of different definitions of DED.[2]

Given the severe consequences of dry eye, it's critical to comprehend the causes of this condition. Because dry eye can be caused by a variety of different circumstances, it can be challenging to pinpoint its etiology. Eye dryness is increasingly prevalent in older postmenopausal women and is getting more frequent as the life span of people increases. [4,5] Intrinsic risk factors for DED include increasing age, female sex, having eye conditions, and having some underlying autoimmune and systemic illnesses. [2] Wearing contact lenses, environmental variables (such as low humidity or airflow on the eye), topical or systemic drugs, poor hygiene for the eyelids and eyelashes, and trends in eye beauty are examples of extrinsic risk factors for DED. [2,6,7]

Additionally, the number of people who are utilizing computers and screen-equipped gadgets including laptops, tablets, and smartphones are increasing every day. [8,9] The use of computers and other screens-on gadgets reduces the amount of eye blinks, which causes incomplete blinking, tear evaporation, and ultimately dry eye disease. [2,10] Evaporative dry eye disease is the most prevalent kind, and computer use is especially significant in this group. [11]

The American Optometry Association has defined computer vision syndrome, often known as digital eye fatigue, as an eye and vision issue experienced by frequent computer, tablet, and cell phone users. [12] The most typical symptoms are eye tiredness, headaches, impaired vision, and dry eyes. Additional symptoms include headaches and neck pain. [13]

Eye dryness is a highly prevalent eye condition today, because of its symptoms and its impact on daily activities. Dry eye irritation and soreness are known to lower quality of life and may have an adverse effect on mental health. [14,15] Discomfort and visual abnormalities might make reading or driving difficult. [16,17] Furthermore, dry eye may affect work productivity, which has ramifications for personal success and the economy. [18] Due to the rising expenses of treatment, it has also emerged as a significant public health issue. [4]

In recent years, many advances in imaging techniques and devices for the examination of the ocular surface have been developed and come to the market. These devices offer the advantage of providing automated results of the examined tests, thus avoiding observer bias; moreover, since most of these examinations are non-invasive, they do not alter the results of subsequent tests, representing useful screening tools for discriminating healthy subjects from patients affected by or at risk for DED. [19]

One of them is IDRA which is used in this study. IDRA helps in a quick detailed examination of tear composition and type of DED. With IDRA we can assess 9 parameters but we used only 4 parameters in our study. [20] In this study, we aim to compare the tear film in digital screen users with non-users.

MATERIAL AND METHODS

The study was a cross-sectional study conducted on patients who attended Ophthalmology OPD of a tertiary care hospital in the rural area of Panipat. The study was conducted on 150 patients who were randomly taken for the study and divided into two groups 75 each- the first group of patients were digital users and the second were non-users. The study was conducted for a period of 4 months from June 2023 to

September 2023 after getting clearance from the institutional ethics committee.

Inclusion Criteria

1. Both males and females were taken between age of 20-40 years.
2. Computer users should have a history of computer use >2 hours per day at least for a year.
3. Patients who gave consent.

Exclusion Criteria

1. Patients with corneal opacity/dystrophy/degeneration.
2. Patients with any active eye disease like uveitis/corneal disease/infection/discharge.
3. Patients with keratoconus/ pterygium.
4. Patients who had a history of use of medications causing DED.
5. Patients with a history of systemic illness/LASIK.
6. Patients using contact lenses.

A detailed history was taken from all patients to rule out other causes and after that patients will be divided into divided into 2 groups. The first group was digital screen users and the second was non-user.

As DED is mostly a subjective diagnosis so they were first asked to fill ocular surface disease index (OSDI) questionnaire. It consists of 12 items that assess symptoms, functional limitations, and environmental factors related to dry eye. Patients were asked to mark their responses on a scale of 0 to 4 in which 0 corresponds to symptom is present "none of the time" and 4 corresponds to symptom present "all of the time." The final score ranging from 0-100 was calculated where scores 0-12 correspond to normal, 13-22 correspond to mild DED, 23-32 corresponding moderate DED, and greater than 33 corresponding severe DED.

After this, the subjects underwent visual acuity examination, and slit lamp examination followed by IDRA (SBM Sistemi, Turin, Italy), an all-in-one device that allows the automated measurement of (i) Non-invasive breakup time (NIBUT) (ii) Interferometry (lipid layer thickness) (iii) Tear meniscus height (iv) Infrared meibography (to evaluate meibomian gland loss).

NIBUT was measured to check the stability of the mucin layer by projecting grids on the cornea and the time between the last complete blink and the appearance of the first discontinuation on tear film was measured by machine. Patients were categorized based on this as follows-

- More than 10 seconds (Normal patient)
- 6 seconds to 10 seconds (Moderate DED)
- Less than 6 seconds (Severe DED)

Interferometry was done to check the quality and quantity of lipids in the tear film. The machine measures the lipid layer thickness of the patient and then compares that with the reference grading scale and classifies patients into-

- More than 80 nm (Normal patient)
- 60 to 80 nm (Moderate DED)
- Less than 60 nm (Severe DED)

Tear meniscus height depend on tear secretion rate and stability. This method is better for measuring volume as other methods also produce reflex secretions. On the machine, the user marks two points one at the eyelid border and the other at the tear film border, and the height is measured. According to height classification was done-

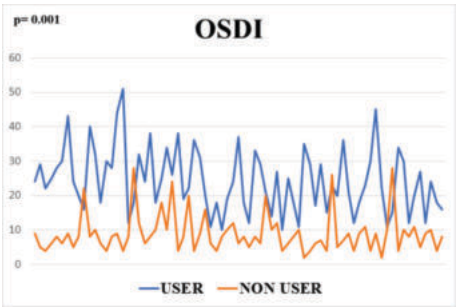
- 0.22 mm to 0.44 mm - Normal eye
- 0.16 mm to 0.22 mm - Moderate DED
- Less than 0.16 mm - Severe DED

Infrared meibography was done to check the loss of meibomian glands it helps in diagnosing meibomian gland dysfunction. According to, the amount of loss classification is as follows-

- Up to 25% Gland loss - Grade 1
- 25% to 50% Gland loss - Grade 2
- 50% to 75% Gland loss - Grade 3
- More than 75% Gland loss - Grade 43

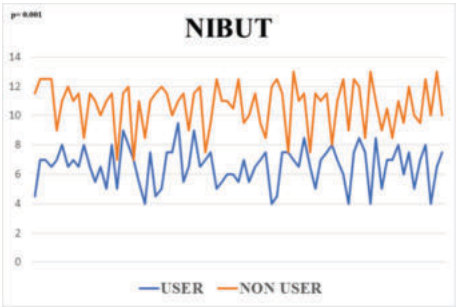
After doing the work-up the data was collected and compiled in a Microsoft Excel spreadsheet and was analyzed using STATA and SPSS software.

RESULTS



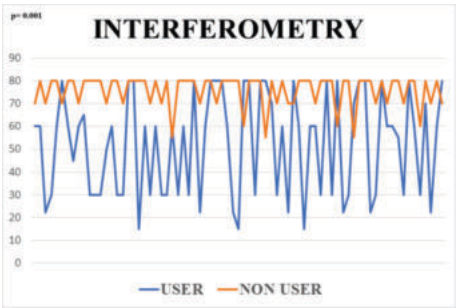
Line Chart 1: Comparison of OSDI Scores

The line chart shows that the OSDI scores were higher among users as compared to non-users. It shows that the symptoms of DED are more common among users than among non-users. The mean OSDI among users was 48.1 and that among non-users was 13 with a p-value of 0.001.



Line Chart 2: Comparison of NIBUT

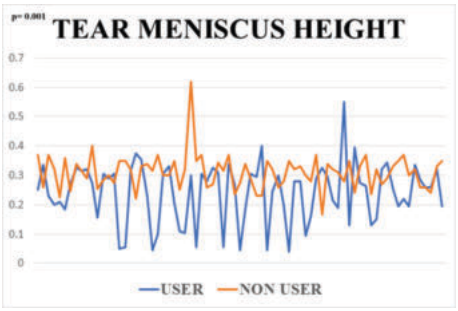
The line chart shows that users have a significantly low NIBUT in comparison to non-users which states that among users the tear film breaks early and they have signs and symptoms of DED. It was seen that the mean was 6.58 seconds among users and that among non-users was 10.69 seconds which is statistically significant (p=0.001).



Line Chart 3: Comparison of Interferometry (Lipid Layer Thickness)

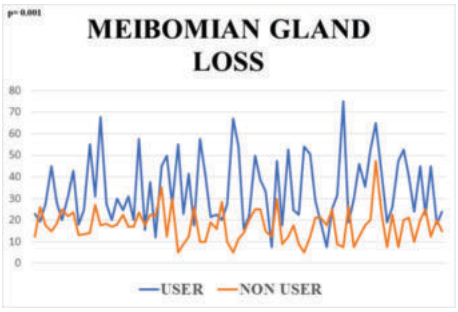
The line chart shows that users have a significantly less thickness of the lipid layer in comparison to non-users which states that among users the lipid layer is thin and hence the stability of tear film decreases which leads to evaporative DED. It was seen that the mean value of lipid layer thickness

was 52.23 mm among users and 75.66 mm among non-users which is statistically significant (p=0.001).



Line Chart 4: Comparison of Tear Meniscus Height

The line chart shows that users have a significantly less tear meniscus height in comparison to non-users which states that among users there are more chances of aqueous deficient DED. The mean value of tear meniscus height was 0.24 mm among users and 0.31 mm among non-users.



Line Chart 5: Comparison of Meibomian Gland Loss

The line chart shows that users have significantly more meibomian gland loss as compared to non-users which is a risk factor for the development of DED. The meibomian gland loss was 34% among users and 18% among non-users with a p-value of 0.001.

DISCUSSION

In our study, we found that the tear film in users was not as healthy as compared to non-users. In our study, we also found that out of 75 users, more than half of users were having a severe form of DED. It was seen that the mean value of NIBUT among the user group was 6.58 seconds and that among non-users was 10.69 seconds which shows that digital screen has a significant (p=0.001) impact on the breakup time of tear film. The mean value of interferometry was 52.23 mm in users and 75.66 mm in non-users which shows that lipid layer thickness is less among users and hence evaporation is more leading to unstable tear film. The mean value of tear meniscus height was also less among users (0.24 mm) in comparison to non-users (0.31 mm). It was found that meibomian gland loss was also more common among users (34%) than among non-users (18%). It shows that the prevalence of DED among digital users is more than that among non-users as only a few numbers of non-users have DED. Hagan et al in their study also found that computer operators had a high prevalence of DED. [21] They found that 68% of men and 73% of women reported dry eye symptoms. Similarly, Asiedu et al 19 in a study reported a prevalence of 44.3% in their study. [22]

We also found that there was a significant increase in symptom severity with an increase in the duration of screen use per day with a p-value of 0.001. It was also noted that people with symptoms of DED had a significant impact on work productivity of people in comparison to asymptomatic people. [23] Stress, fewer effective work hours, poor visual functions, and a possible increase in errors together results in reduced productivity. This has a huge economic impact and also affects an individual's life.

Subota K et al in their study found that, when one's degree of concentration or attention rises, the average blink rate considerably decreases. While reading a book, the average blink rate drops from 22 per minute to 10 per minute and while using a digital screen it drops to 7 per minute. [24] Longer intervals of eye-opening and a greater gaze angle when looking at a digital screen cause faster tear loss, which makes the dry eye condition worse because evaporation is the primary method of tear removal and when we don't blink and make a larger angle the evaporation rate increases.

It seems that when we use the computer monitor or any digital screen in an ergonomic position, which is one arm's length away or 40 inches away with a downward look of at least 14 degrees helps to reduce the evaporation rate of tears. To accomplish this, position the display so that the top line of the screen is below eye level. [25] Avoid glare from windows, overhead lighting, and screen reflections. Dust should not be present on any monitor or screen because it might reduce screen clarity and produce glare. Avoid blowing cold air directly into your face or putting the air conditioner up too high.

CONCLUSION

Study concludes that symptoms and signs of DED are more among digital screen users than non-users. The main reason behind this is improper knowledge about what measures can be taken to prevent this and long continuous screen hours. So, to decrease the number the patients were advised to go through eye exams frequently so that refractive errors may be corrected, the right glasses for computer use can be prescribed, and dry eyes can be detected. The usage of anti-glare computer screens and anti-reflective eyewear was recommended for all of the patients. Patients were also advised to blink more frequently to at least 10 consecutive blinks every 30 minutes to rehydrate the eyes and reset focus and prevent dry eyes. The use of preservative-free tear supplements was also recommended to patients who spend a lot of time on digital screens. All of these steps can reduce the number of cases of DED following digital screen use.

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