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To study the effect of screen time on dry eye disease indicators, corneal endothelium and morphology of meibomian gland

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Abstract
Background: Dry eye disease (DED) is one of the most frequently established diagnosis in ophthalmology. Dry eye is heterogeneous, multifactorial disease characterized by loss of homeostasis of the tear film accompanied by combination of ocular symptoms in which tear film instability and hyperosmolarity, ocular surface inflammation, damage and neurosensory abnormalities play etiological role. The two main categories of DED are evaporative dry eye and aqueous deficient dry eye.
Aims and Objectives: To study the effect of screen time on dry eye disease indicators, corneal endothelium and morphology of Meibomian gland
Materials and Methods: A prospective observational study conducted for One year with total 80 number of patients with inclusion criteria Patient aged 18-60 years of either sex with History of visual display terminal with division in two groups (Group A:->6 hours per day & Group B:- <2 hours) with certain exclusion criterias as systemic disease, trauma etc. Data like name, age, sex, Schirmer's test, Tear film breakup time (TBUT), Ocular Surface Disease Index (OSDI), corneal endothelium and Meibomian gland morphology would be recorded.
Result: My study stated that Positive association of screen time on dry eye disease indicators with significant Deviation from the normal morphology of meibomian gland was observed more in group A as compared to group B with Corneal endothelial cell density in both Group A and Group B were within normal limit.
Conclusion: Average screen exposure time is positively correlated with significant deviation in morphology of meibomian gland such as atrophy and screen induced dry eye disease mainly through impaired blinking patterns which Changes in parasympathetic signalling.

Keywords: Signalling, mainly, morphology

Introduction

The term "digital addiction" refers to the worldwide issue of excessive electronic screens use (ESU). The current digital era has completely changed how information is produced, shared, and presented. Electronic gadget viewing has been linked to a number of illnesses, including anxiety, depression [11], decreased outdoor activity [12], obesity, headache, neck/back pain, sleep disturbances [13] and dry eye disease owing to decreased blink rate during ESU and meibomian gland dysfunction [14].

Among the most common diagnosis in ophthalmology [1], dry eye disease (DED) is becoming more and more of a public health concern due to its often- underappreciated effects. Significant impairment to visual function is caused by this condition, which may have an influence on quality of life [2, 3] and productivity at work [4].

Due to a chronically fragile tear film that frequently separates into dry areas between blinks, exposing the corneal and conjunctival epithelium to the atmosphere, dry eye causes pain and impaired vision. Inflammatory damage to the cornea and conjunctiva can result from its prolonged burning or irritating symptoms if treatment is not received[5].

Aqueous deficient dry eye and evaporative dry eye are the two basic types of dry eye disease. Meibomian gland dysfunction (MGD), insufficient blinking effort, and lid disorders are among the conditions associated with evaporative dry eye. On the other hand, conditions affecting the ocular surface include prolonged contact lens wear, topical drug use with preservatives, and immune-related ocular surface disorders (e.g., atopic keratoconjunctivitis). Based on epidemiological studies, DED is primarily evaporative in nature [15] and is frequently linked to MGD. Meibomian lipids are vital for preserving the integrity and health of the ocular surface. It has been shown that changes in the lipid phase that indicate MGD are more common in DED patients than discrete changes in the aqueous phase.

Given that DED has been demonstrated to have less corneal nerves [17, 18] and recent data shows in patients with neurotrophic keratopathy the presence of neurotrophic factors in every layer and notable alterations in every layer, including the endothelium was observed [19]. There has also been evidence of a notable change in the properties of corneal endothelial cells as well as endothelial cell loss in eyes with moderate to severe dry eye disease [20]. The relationship between digital screen use and the risk of dry eye disease has already been the subject of several published clinical studies. Given the background information linking screen time to both meibomian gland dysfunction and dry eye disease, this study aimed to shed additional light on the morphological alterations in the meibomian glands and their impact on corneal endothelial cell density as well as the etiopathogenesis of DED.

Aim: To study the effect of screen time on dry eye disease indicators, corneal endothelium and morphology of meibomian gland.

Objectives

1. To assess the effect of screen time on dry eye disease indicators (Schirmer Test, Tear film breakup time [TBUT] and OSDI score)
2. To study the effect of screen time on the morphology of meibomian gland by meibography.
3. To analyze the effect of screen time on corneal endothelial cell density by clinical specular microscopy.

Materials and Methods

Prospective observational research is the study design.

1. **Study Setting:** Participants in the study were patients receiving care at the Ophthalmology outpatient department (OPD) of Subharti Medical College in Meerut, Uttar Pradesh.
2. **Study Period:** From February 2023 to March 2024, the study was carried out for a year with approval from the CPC and Ethics Committee.
3. **There were eighty cases in the sample:** Two patient groups were established: Group A consisted of forty patients who had used screens for at least six hours a day on average for at least a year. Group B: 40 patients who, for at least a year, used screens for no more than two hours a day on average.

Inclusion criteria

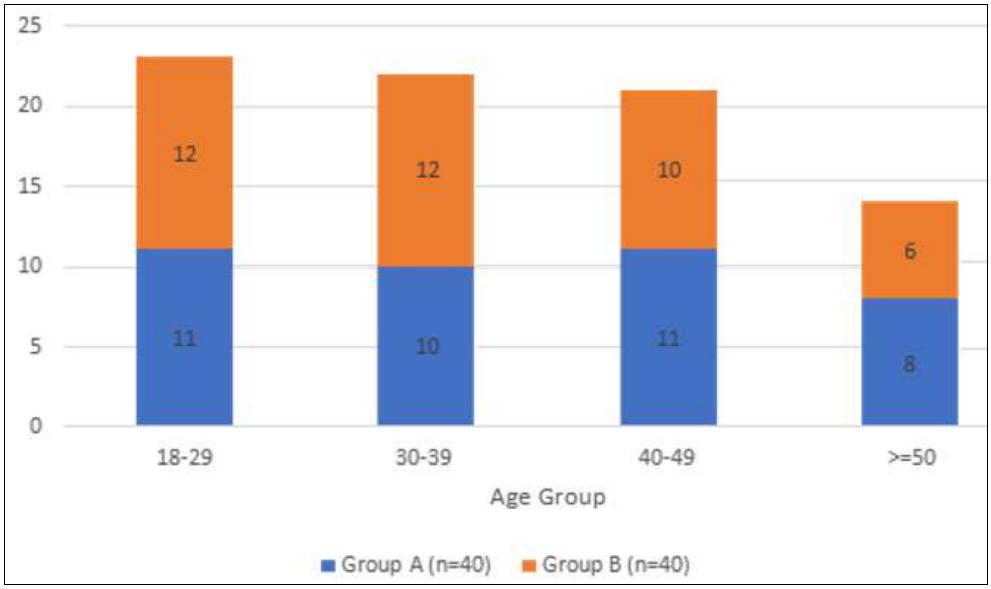
1. Patient aged 18-60 years of either sex.
2. History of long-term usage of smartphones/visual display terminal
3. All patients who visited eye OPD with no history of treatment for dry eye disease.

Exclusion criteria

- History of eye trauma.
- Any pre-existing ocular condition like glaucoma, uveitis, any ocular allergy, pterygium or blepharitis, ocular infections, disorder of eyelids and nasolacrimal pathway and corneal diseases.
- Patients taking any of these medications- antihistamines, antidepressants, oral contraceptive pills, nasal decongestants, sildenafil citrate, anticholinergic drugs, anti-hypertensive medications and oestrogen therapy.
- Patients using contact lenses
- Facial nerve and Trigeminal nerve paresis/paralysis
- Patients who have undergone any Ocular surgery/Refractive surgery

Systemic conditions including (Sjogren's syndrome, hormone replacement therapy, rheumatoid arthritis, diabetes mellitus, and systemic lupus erythematosus)

Results and Observation



Graph 1: Distribution of the studied subjects on the basis of their age

Group A's age ranges from 18 to 58 years old, with a mean of 38.08±10.7 years. Group B's age ranges from 18 to 59 years old, with a mean of 36.98±10.61 years.

The mean Schirmer's test score of Right eyes in a Group A and Group B is 13±5.38 and 14.55±3.31, respectively. The p-value for the comparison between Group A and Group B is 0.0500, suggesting a borderline significant difference in the Schirmer's test.

Table 1: Comparison of Schirmer's test (mm/5min) of Right eye

Groups	>=10 Normal	7-9 Mild	5-7 Moderate	<5 Severe	Total
Group A	29	6	4	1	40
Group B	37	3	0	0	40
P-value	0.0500				

Table 2: Comparison of Schirmer's test (mm/5min) of Left eye

Groups	>=10 Normal	7-9 Mild	5-7 Moderate	<5 Severe	Total
Group A	30	7	2	1	40
Group B	38	2	0	0	40
P-value	0.0814				

The mean Schirmer's test score of Left eyes in Group A and Group B is 13.25±5.21 and 15.03±3.44, respectively the p-value for the comparison between Group A and Group B is 0.0814.

Table 3: Comparison Mean± SD of TBUT (Seconds)\ values of Right eye

Groups	Mean	SD
Group A	10.68	4.33
Group B	14.75	3.78
P-value	< 0.0001	

The mean TBUT's score of Right eyes in a Group A and Group B is 10.68±4.33 and 14.75±3.78, respectively and which shows a significant p value of <0.0001.

Table 4: Comparison Mean± SD of TBUT (Seconds) values of Left eye

Groups	Mean	SD
Group A	11.10	4.48
Group B	14.88	3.85
P-value	0.0001	

The mean TBUT's test score of Left eyes in a Group A and Group B is 11.10±4.48 and 14.88±3.85, respectively and shows a significant p value of <0.0001.

Table 5: Comparison Mean± SD of OSDI values

Groups	Mean	SD
Group A	23.84	15.51
Group B	13.11	8.81
P-value	0.0003	

The mean OSDI's test score of in Group A and Group B is 23.84±15.51 and 13.11±8.81, respectively and which shows a significant p value of <0.0003. There is a substantial difference in the OSDI scores between Groups A and B, as indicated by the p-value of 0.0007 for the comparison.

Table 6: Comparison of Endothelial Cell Density (cells/mm2) of Right eye

Groups	2000-2250	2251-2500	2501-2750	2750-3000	>3000
Group A	2	7	10	10	11
Group B	0	4	9	11	16

In Group A, mean endothelial cell density is 2805.73 cells/mm2 with a standard deviation of 377.67. In Group B, mean endothelial cell density is 2943.70 cells/mm2 with a standard deviation of 326.25. The p-value is 0.0843.

Table 7: Comparison of Endothelial Cell Density (cells/mm2) of Left eye

Groups	2000-2250	2251-2500	2501-2750	2750-3000	>3000
Group A	2	5	11	10	12
Group B	1	2	5	11	21

In Group A, mean endothelial cell density is 2832.68 cells/mm2 with a standard deviation of 383.10. In Group B, mean endothelial cell density is 3008.30 cells/mm2 with a standard deviation of 318.46. The p-value is 0.0287, indicating that there is a statistically significance.

Discussion

This study was carried out at department of ophthalmology at Netaji Subash Chandra Bose Subharti medical college, Meerut. The purpose of the study is to study the effect of screen time on dry eye disease indicators, corneal endothelium and morphology of meibomian gland in patients attending ophthalmology outpatient department in Chhatrapati Shivaji Subharti hospital, Meerut. 80 patients split up into two groups

- **Group A:** 40 Patients with average screen usage more than or equal to 6 hours/day for minimum duration of 1 year.
- **Group B:** 40 Patients with average screen usage less than or equal to 2 hours/day for minimum duration of 1 year.

In our study, female dominance is measured as the male to female ratio in Group A being 1:1.5, and in Group B being 1:1.2 In the group A, 70% and group B 25% of individuals have an OSDI score equal or greater than 13, with a significant p-value of <0.0007 and this score is indicative of DED in asymptomatic patients. The mean OSDI test scores in Groups A and B are 23.84±15.51 (range 4.16 to 64.58) and 13.11±8.81 (2.08 to 43.75) respectively, with a significant p-value of <0.0003. Similar positive results were found in study of Yousef Shanti *et al.* [8] in 2020, which shows in the specific DED group, the average OSDI score for the group without dry eye was 11±14. Abnormal TBUT (≤ 10 seconds) is the most common DED sign, Right Eye mean TBUT for Groups A and B is 10.68±4.33 and 14.75±3.78, respectively range (4 second to 20 seconds), with a significant p value of less than 0.0001. For Left Eye mean TBUT for group A is 11.10±4.48, while Group B's score is 14.88±3.85 range of score (5 seconds to 20 seconds) significant p value < 0.0001. In another study also which was done by Sánchez-Valerio MD *et al.* [7] in 2020 a significant correlation was seen between excessive screen

usage time measured in hours per year and TBUT showed a significant negative correlation (p<0.001) (rho −0.463). Only 12.5% of patients in Group B have dry eye illness compared to 47.5% in Group A, which have more screen time. Conversely, The Schirmer's test findings between Group A and Group B showed a marginally significant difference in the right eye, while the left eye showed a negligible difference. The p-value for the comparison between Group A and Group B is 0.0500 and 0.0814 right and left eye respectively. Only 7% of patients in group B have dry eye illness compared to 25% in group a which have more screen time. The Meibomian gland morphology changes revealed a positive predominance in group A; the two groups differed significantly, as indicated by the p-value of 0.0297 when comparing Groups A and B. In the group A, 40% and group B 11.25% have altered morphology. The mean endothelial cell density in Group A is 2805.73 (SD 377.67) and 2832.68(SD 383.10) cells/mm2 for right and left eye respectively. Group B exhibits a mean endothelial cell density of 2943.70 (SD 326.25) and 3008.30 (SD 318.46) cells/mm2 along with a 318.46 standard deviation. The endothelial cell density of the left eye demonstrated a positive connection between DED and a decrease in corneal ECD. (p-value of 0.0287). In patients with dry eyes, Ahmad Kheirkhan *et al*. [20] in 2015 linked a decrease in corneal endothelial cell density. They found a correlation between the clinical severity of the disease and the corneal ECD reduction in DED. Our research indicates that patients who use screens excessively have a higher risk of acquiring dry eye illness. Additionally, a favourable association is also established for meibomian gland morphological changes and reduced corneal endothelial cell density in moderate to severe Dry eye disease patients.

Conclusion

Our research indicates that patients who use screens excessively have a higher risk of acquiring dry eye illness. Average screen exposure time is positively correlated with significant deviation in morphology of meibomian gland such as atrophy and screen induced dry eye disease mainly through impaired blinking patterns which Changes in parasympathetic signalling. This highlights the necessity of defining DED by combining clinical indicators and symptoms.

Conflict of Interest

Not available

Financial Support

Not available

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