Original Research Paper

Volume-10 | Issue-2 | February - 2020 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Ophthalmology

SMARTPHONES VERSUS OCULAR SURFACE – A PILOT STUDY

Dr M Yoga Priyanka Junior Resident, Department Of Ophthalmology, Alluri Sitaramaraju Academy Of Medical Sciences, Eluru , Andhra Pradesh - 534005, India.

Dr M S S Keerthi* Assistant Professor, Department Of Ophthalmology, Alluri Sitaramaraju Academy Of Medical Sciences, Eluru, Andhra Pradesh - 534005, India. *Corresponding Author

ABSTRACT

BACKGROUND: Smartphones have revolutionized human lives in ways that go well beyond communication. It's incontrovertible that smartphone technology has yielded many benefits for society at a high cost to mental, physiological and social lives. Our compulsivity to the use of smartphones is getting worse.

PURPOSE: To evaluate the impact of prolonged usage of smartphones on ocular surface and the tear film.

METHODS: 50 healthy medical students were enrolled in this study. Subjective symptoms and asthenopia symptoms were evaluated using the Ocular Surface Disease Index {OSDI} before and after smartphone use. The status of the tear film was evaluated using Fluorescein Break Up Time {FBUT}, Schirmer score and Keratoepitheliopathy {KEP}. All measurements were conducted at baseline and after 1hour usage of smartphones.

RESULTS: All parameters showed no significant difference at baseline. Scores of OSDI were increased and FBUT decreased significantly after one hour usage of smartphone.

CONCLUSION: Smartphone use aggravates subjective ocular symptoms and induces tear film instability causing Digital eye strain.

KEYWORDS : Smartphones, Fbut, Digital Eye Strain.

INTRODUCTION

Technological revolution has made the smart phones integral part of daily living with 84% of world population using it by the end of 2018. There's a steady global increase in Internet usage with 0.3% penetration in 1993 compared to 40.4% in 2014.[1]

Visual display terminals syndrome {VDT}is a constellation of symptoms of ocular as well as extraocular, associated with prolonged use of visual display terminals. An average person spends over 4 hours a day on their device.

A study reported two cases of transient monocular vision loss associated with smartphone use.[2] Excessive use also led to acute acquired comitant esotropia in adolescents.[3] A study including paediatric dry eye disease {DED} reported that the rate and mean time spent using smartphones were greater in DED than the non DED group.[8] Some studies reported the adverse effects of blue light emitted from smartphones on corneal epithelial cells causing deterioration of tear film and increased inflammatory markers and reactive oxygen species production on the ocular surface.

MATERIALS AND METHODS

A prospective, nonrandomized, pilot clinical study to evaluate the effects of smartphone usage on subjective symptoms and changes in the tear film and ocular surface.

TIME OF STUDY – June 2019 to September 2019.
PLACE OF STUDY – Department of Ophthalmology, ASRAM

INCLUSION CRITERIA -

Fifty healthy medical students

1. Willing to give consent
2. No H/o usage of any topical or systemic drugs
3. No H/o previous ocular surgeries

EXCLUSION CRITERIA –

1. H/o usage of treatment for ocular dryness
2. Pregnant

The study was conducted in accordance with the Declaration of Helsinki.

Written informed consent was obtained from all the subjects The protocol was approved by the Institutional Ethical Review Board.

METHODS –

For all the subjects

1. Same smartphone with a 5.8 inch light emitting diode {LED} screen from the same manufacturer {Iphone X}.
2. The illumination intensity was fixed at 80% of maximum brightness.
3. The distance between the screen of display and subjects was limited to constant value.
4. Room temperature and humidity were maintained at 28° Celsius and 40% respectively.

ASSESSMENT

Evaluation was performed on each individual by a single investigator before and after 1hour usage of the smartphone. Parameters of tear film and ocular surface were evaluated within 15 minutes in the following order:

Fluorescein break up time,
Keratoepitheliopathy score,
Schirmer test value.

Subjective ocular symptoms and asthenopia symptoms They were evaluated using the OSDI score before and after use for 1 hour.

THE OSDI QUESTIONNAIRE INCLUDED :

1) Ocular symptoms,
2) Vision related activities in daily living and
3) Environmental triggers.

Total OSDI score and each subscale score, ranging from 0 to 100 were analysed.

STATUS OF TEAR FILM

FBUT was evaluated 2 min after instillation of 2 mL of 0.5% fluorescein. Subjects were subsequently asked to blink several times. The time in seconds between the last complete blink and the appearance of the first corneal black spot was measured three times and the mean value was recorded.

The Schirmer test was performed after instillation of 0.5% proparacaine hydrochloride. A standard Schirmer test strip was then placed in the lateral canthus and value was recorded after 5 minutes. The length of strip wetting was measured using the millimetre scale.

Keratoepitheliopathy was scored by multiplying the area score by density score after staining with 0.5% fluorescein dye.

The staining area was graded on a numerical scale of 0-3, with
0 - no punctate staining;
1 - < 1/3rd;
2 - 1/3rd to 2/3rd

3 - > 2/3rd.

The staining density was graded on a numerical scale of 0-3, with
0 - No punctate staining;
1 - Sparse density;
2 - Moderate density; and
3 - High density with overlapping lesions.

STATISTICALANALYSIS

Statistical Package for the Social Sciences software version 24 was used for all statistical analyses. Data is represented as the mean +/- standard deviation. Wilcoxon signed rank test was used to assess changes in the various parameters before and after 1 hour. Differences were considered statistically significant at P value of <0.05.

RESULTS

TABLE 1

CHARACTERISTICS	SMARTPHONE USE { N = 50}
Age {y}	22.96 +/- 2.98
Sex {male/female}	25/25
FBUT {s}	6.06 +/- 1.92
Schirmer test {mm}	13.66 +/- 4.10
KEP {0-9}	0.26 +/- 0.05

50 healthy subjects were aged between 22.96 +/- 2.98 years {range 21 - 25 years} and were divided equally between males and females.

SUBJECTIVE OCULAR SYMPTOMS AND ASTHENOPIA

The total OSDI score at baseline was 15.08 +/- 8.83 which was increased to 17.63 +/- 7.74 at one hour {P < 0.01 vs baseline}.

The OSDI symptom, visual function and trigger scores increased to 7.80 +/- 3.22 {P <0.01 vs baseline}, 5.50 +/-3.49 {P=2.10 vs baseline} and 4.33 +/- 4.21 {P =0.32 vs baseline} at one hour.

The fatigue, burning and dryness scores at one hour were 1.50+/- 0.92 {P <0.01 vs baseline}, 0.48 +/- 0.73 {P < 0.01 vs baseline} and 1.56+/- 1.20 {O < 0.01 vs baseline}.

However blurred vision and dullness scores showed no significant changes related to smartphone use.

Status of the tear filmAt baseline FBUT was 6.76+/- 2.03 which was decreased to 6.06 +/- 1.92 {P <0.01 vs baseline}. However, no significant change was noted in the Schirmer test value, keratoepitheliopathy scores after smartphone use.

FIGURE 1

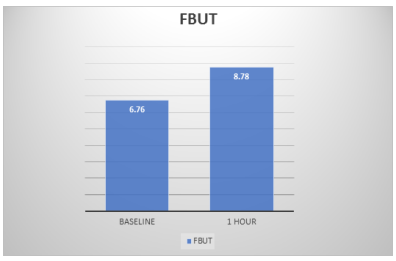
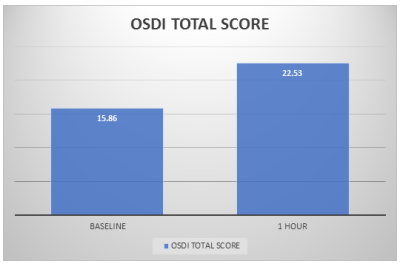


FIGURE 2



DISCUSSION

Computer vision syndrome {CVS} or Visual display terminal syndrome {VDT} constitutes an array of clinical symptoms related to prolonged, repetitive and uninterrupted viewing and usage of VDTs and it's peripherals. Almost 60 million people around the world suffer from CVS and 1 million new cases are estimated to occur annually.[4]

Visual display terminals demand prolonged near vision task with increased prevalence of asthenopia between 55% to 81% in VDT users. Compulsive sustained accommodative effort leads to increased innervation and onset of subjective visual fatigue which is temporary and is associated with near work induced transient myopia and development of permanent myopic changes among adult and early onset myopes.

Low relative humidity <40%, high temperature and air draft are associated with increased evaporation and disruption of the precorneal tear film producing hyperosmolarity and ocular discomfort.

In this study we investigated the influence of excessive smartphone usage on the tear film and ocular surface. The OSDI scores indicating dry eye severity significantly increased whereas as FBUT decreased after smartphone usage. We report after 1 hour higher total OSDI symptom, visual function and trigger scores with dry eye like symptoms such as irritation, burning and dryness with excessive smartphone use.

Uchino et al observed short tear break up time and increased corneal fluorescein staining despite normal lacrimation function in VDT users. Excessive evaporation of the tear fluid due to prolonged blinking intervals while gazing is considered as a causative factor in VDT associated dry eye.[5] Blinks are mandatory to maintain the physiologic milieu of tear on ocular surface along with its mechanical tear smearing action. Adequate functioning demands both appropriate frequency and completion of blinking action.[7,9]

High cognitive demand and attention to a visual task associated with VDT use causes increased number of partial blinks or blink clusters or flurries leading to spontaneous blink rate alteration.

Nakomori et al observed maximum blink interval increased with VDT use.[7,9] Chu et al has observed no significant change in blink rates between VDT and hard copy text presentation. However significant increase in incomplete blinks of 7.02% associated with VDT use compared to 4.33% with hard copy. This has been linked to the drying effect on ocular surface and lid wiper epitheliopathy.[6]

Wu et al has reported meibomian gland dysfunction in dry eye with VDT users correlated with working time of >4 hours per day. They also reported Inverse correlation with FBUT, positive correlation with fluorescein staining and No correlation with Schirmer volumes.[10] The severity of the symptoms after smartphone usage can be attributed to the smaller screen size and closer viewing distance. The optimal viewing distance for a mobile device is 36.2 centimetres which is shorter than the typical distance for reading books i.e 40 cm. This requires greater accommodation and convergence. Focusing on a smartphone screen may involve continuous accommodation efforts without blinking for an extended period. Excess smartphone use at close reading distance results in abnormalities of accommodation and convergence in adolescents which can manifest as esotropia.

Liquid Crystal Dispaly and Light Emitting Diode screens emanate large amount of blue light which causes excessive ROS production and damages photoreceptors, corneal and retinal pigment epithelial cells. Over exposure to blue light leads to oxidative damage, apoptosis and inflammation of the ocular surface resulting in dry eye.

CONCLUSION

Excessive smartphone use aggravated subjective ocular symptoms and asthenopia with compromised tear film stability causing Digital eye strain. In clinical practice, increased awareness of the tear film and ocular surface changes under smartphone use may enable clear understanding of the causes of ocular discomfort and management of ocular problems associated with excessive smartphone use.

Simple solution to Digital eye strain is 20-20-20 rule. Look 20 feet away for 20 seconds every day for every 20 minutes Learning to live with technology without surrendering to it maybe one of the biggest challenges we face in digital era.

REFERENCES

1. Consumer smartphone usage 2018
2. Alim-Marvasti A, Bi W, Mahroo OA, Barbur JL, Plant GT. Transient smartphone blindness; N engl J Med 2016;374
3. Lee HS, Park SW, Heo H; Acute acquired comitant esotropia related to excessive smartphone use. BMC Ophthalmol ;2016
4. Gowrisankaran S, Sheedy JE,. Computer vision syndrome : A review. Work read mass

2015
5. Uchino M, Yokoi N, Dogura M, Kawashima M, Komuro A, et al. Prevalence of dry eye disease and it's risk factors in visual display terminal users; Osaka study. Am J Ophthalmology 2013;156
6. Chu C, Rosenfield M, Portello JK, Benzoni JA, Collier JD, A comparison of symptoms after viewing text on computer screen and hard copy
7. Nakamori K, Odawara M, Nakajima T, Mizutani T, T subtotal K. Blinking is controlled primarily by ocular surface conditions. Am J Ophthalmol. 1997;124
8. Kim J, Hwang Y, Kang s, Kim M, Kim TS, Kim J et al. Association between exposure to smartphone and ocular health in adolescents. Ophthalmic Epidemiol 2016;23
9. Tsubota Nakamori K. Effects of ocular surface area and blink rate on tear film dynamics. Arch OPhthalmol 1995
10. Wu H, Dong N, Wang Y, Yang F, Lin Z, Shang X et al. Meibomian gland dysfunction determines the severity of the dry eye conditions in visual display terminal workers. PLos one. 2014.