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# **Original Research Article**

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# Evaluation of impact of computer usage on various tear parameters in normal healthy tertiary hospital based population in Uttarakhand, India

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# **ABSTRACT**

**Background:** Computers have become an integral part of routine day to day life. Increased usage of computers lead to dry eye due to reductions in the blink rate and its amplitude. The purpose of the study was to analyse changes in the lower tear meniscus by optical coherence tomography (OCT) and to correlate them with other subjective tear parameters.

**Methods:** In this study 203 normal healthy subjects of age below 40 years with refractive errors were enrolled in this random prospective cross-sectional study. The subjects with computer usage for three hours or more in a day were considered as computer users and rest as nonusers. All subjects underwent routine ophthalmological examination along with dry eye work up. Fourier domain -OCT system (RT-Vue software version 4.7; Optovue, Inc., Fremont, CA) was used to measure lower tear meniscus height (TMH) and tear meniscus area (TMA) in all subjects.

**Results:** Males and females were 116 (57.14%) and 87 (42.85%) respectively with mean age of 34.38 years. Out of 203, 84(41.37%) were computer users and 119 (58.62%) were computer non-users. The mean  $\pm$ SD of Schirmer's in computer users and non-users were 21.64 $\pm$ 5.68mm and 20.03 $\pm$ 4.97mm respectively and the difference was non-signicant (p=0.07). The mean $\pm$ SD value of tear film break up time (TBUT), slit lamp based TMH and OCT based TMH in computer users were 10.87 $\pm$ 1.59 sec, 582.14 $\pm$ 176.41mm and 236.49 $\pm$ 91.00 $\mu$ m which were having statistically significant differences (p=0.005, 0.001 and 0.024) respectively as compared to computer non-users.

**Conclusions:** TBUT, OCT based TMH and TMA are significantly influenced by computer usage in normal healthy individuals.

Keywords: Computer vision syndrome, Tear meniscus, Tear film break up time

# **INTRODUCTION**

With the invention of the microchip and the computer, technology has taken a major leap in last century. Excessive use of computers have led to an increase in health-related problems in video display terminal (VDT) users particularly, younger students.<sup>1</sup>

Computer vision syndrome (CVS) refers to ocular and extra-ocular symptoms including eye strain, diplopia, fatigue, irritation, redness, burning and blurring of vision and non-ocular symptoms of headaches, shoulders, neck and back pain associated with prolonged computer usage.<sup>2</sup> CVS is growing public health problem worldwide.<sup>3</sup>

Prolonged VDT tasks reduce blink rate, amplitude and quality leading to tear film instability. Therefore, dry eyes is common entity after prolonged computer usage and the prevalence ranges from 30% to 68.5%. According to the National Institute of Occupational Safety and Health, CVS affects 90% of the people who spend three hours or more a day at a computer.

Due to hydrophobic surfaces of cornea and lower eyelid tear meniscus has a concave air-tear interface. Some investigators have shown that both tear meniscus heights (TMH) are decreased in dry eye subjects as compared to normal. But the interaction between blink process and tear film parameters appears to be complex and tear meniscus status is not clear in dry eye subjects post computer tasks. A pre-existing dry eye condition might be exacerbated by computer usage. Tear menisci decreases in dry eye and its examination may be helpful in diagnosis of dry eye. TMH can be considered as the measurement of tear volume. Repeatability of tear meniscus variables measurements by optical coherence tomography (OCT) had been verified previously by Shen et al.7 Recently, OCT, has provided a non-invasive technique to measure TMH in shorter duration of time with improved sensitivity.8

It is speculated that lower tear meniscus changes predominantly due to partial blink while working and placement of desktop monitors at primary gaze. In this study we decided to evaluate changes in the lower tear meniscus by OCT and to correlate various tear meniscus variables with other tear parameters.

#### **METHODS**

This was a prospective observational case series in a tertiary care centre Himalayan Institute of Medical Sciences, Swami Rama Himalayan University, Dehradun, Uttarakhand, India over a period of six months from June 2014 to December 2014. After obtaining the formal written approval from ethical committee, the study was conducted as per declaration of Helsinki.

Written and informed consent was obtained from all the subjects before including them in the study.

#### Inclusion criteria

The normal healthy 203 subjects of age below 40 years with refractive error but no other ocular complaints were included in this study.

# Exclusion criteria

Cases with history of intraocular or refractive surgeries, contact lens users, eyelid pathologies, conjunctival disorders, people with prosthetic eyes, abnormal nasolacrimal drainage apparatus, permanent or temporary occlusion of lacrimal puncta, history of systemic illness like diabetes, hypertension, collagen

vascular disorders or any use of systemic medications were excluded from the study. Patients within >40 years of age were excluded from study to rule out other confounding factors of dry eye due to older age.

All included patients were interviewed for the computer usage, and those with history of computer use for  $\geq 3$  hours a day were considered as computer users and other were considered as computer nonusers.

patients underwent routine ophthalmologic examination including best corrected visual acuity (BCVA) and intraocular pressure measurement. Slit-lamp bio-microscopy of ocular adnexa involving lid surface, lid position and meibomian gland, TMH measurement and anterior segment was done. Schirmer's test I was done for all the subjects, along with tear film break up time (TBUT) and posterior segment evaluation. Schirmer's test I was performed by placing a Schirmer's strip (Whatman filter paper no.41 5x 35 mm) at the junction of the mid and the lateral third of lower eyelid. After 5 minutes, wet Schirmer strip was removed and measured. TBUT was recorded in seconds, from the time of eyelid opening to the appearance of first black spot in between two blinks. TMH was measured in mm on slit lamp from the centre of lower lid to upper limit of tear lake.

In addition OCT imaging of tear meniscus was done before Schirmer's and TBUT to avoid their influences on tear meniscus. The same examiner performed all tests.

# Imaging procedure

Fourier -domain (FD-OCT, RT-Vue software version 4.7; Optovue, Inc., Fremont, CA) system with a corneal adaptor module (CAM) operated at an 830-nm wavelength and had an axial resolution in the tissue of 5 μm. CAM was used for telecentric scanning for anterior segment imaging using a wide-angle adaptor lens which was placed in front of the retinal objective lens of OCT to focus the beam on the anterior segment. The wide-angle lens provides a scan of upto 6mm and a transverse resolution of 15 µm. For concurrent video-imaging and for fixation of the contralateral eve lights were used to illuminate the anterior segment. Dim lit room with temperature between 21-25°C with regulated humidity were used for all tests to avoid reflex tearing. No topical eye drops were used at least 2 hrs before testing to negate the effect of medication on tear film. Patients were instructed to gaze straight ahead at the fixating target within the OCT system. Subjects were instructed to blink and then keep the eyes open for the duration of a 3second count. Images were taken at 2 seconds after blink to avoid the effects of delayed blinking. The CL-cross line OCT pattern was used to scan the lower tear meniscus with its horizontal line on lower lid margin and vertical on inferior cornea at 6'0 clock hour.

One or more images were taken until a good quality scan, showing the concave profile of the tear meniscus from the inferior lid margin to the corneo conjunctival surface, were captured (Figure 1A). The lower tear meniscus of the right eye in each subject was imaged by vertical scans centered on the inferior cornea and the lower eyelid using an FD-OCT system with a corneal adaptor. Patients were refrained from putting any topical drops for 2 hours prior to their measurements. The lower TMH and depth were measured with a computer calipers. The cross-sectional area was calculated using a two-triangle approximation. All of the computer caliper measurements were made by the first author.

All measurements such as tear meniscus cross-section area (TMA) and TMH were taken from the inferior tear meniscus because of less visualisation and retention of upper tear meniscus due to hinderance by eye lashes.

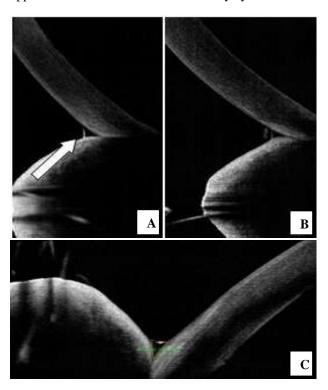


Figure 1: Concave tear meniscus and its height (TMH), tear meniscus area (TMA).

The analysis included 90°clockwise canvas rotation, to obtain a vertical visualization of the anterior segment section, and a change in the image size, so that the height of each image measured 40 mm (10x magnification in comparison to the original 4-mm long vertical scan obtained by the instrument).

The OCT images were exported for computer calipers measurements of lower TMH and TMA. The TMH was manually calculated by joining the points corresponding to the upper corneomeniscus junction to the lower eyelidmeniscus junction with the "measure tool" as shown in

Figure 1B. Area was measured by plotting the two lines joining the TMH and area within the plotted line was TMA as shown in Figure 1C. Cross-sectional OCT images of lower tear meniscus, TMH and TMA were processed and calculated with integrated analysis custom software in µm and mm² respectively.

# Statistical analysis

Data were initially entered into an excel spreadsheet and then transferred to SPSS software (Statistical Package for Social Sciences, version 22, Inc, Chicago, IL). To avoid statistical complications from correlation between both eyes, measurements from only right eye of each patient were evaluated. Data were expressed in terms of means±standard deviations. The change in tear variables in different groups was compared by using Independent t-test. When data was not normally distributed Mann-Whitney U-test was used to compare the values. P value lower than 0.05 was considered statistically significant.

#### **RESULTS**

203 normal healthy patients were included in the study with 116 (57.14%) males and 87 (42.85%) females with mean age of 34.38 years with range of 16-40 years.

Out of 203, 84 (41.37%) were computer users and 119 (58.62%) were computer non -users. The age range of computer users was 16-40 years with average age of 31.13 years. 36 were females and 48 were males among computer users. Computer non-users were 19-40 years with average age of 36.88 years. Among computer users 45 (53.57%) were students, teachers and engineers by profession and 39 (46.42%) were electricians, shopkeepers, and sales men (Table 1).

**Table 1: Characteristics of computer users.** 

Characteristics	N (%)
Age range	16-40 (34.38)
Males	48 (57.14%)
Females	36 (42.85%)
Occupation	
Engineers, students, teachers	45 (53.57%)
Shopkeepers, electricians, sales men	39 (46.42%)

The mean±SD of Schirmer's in computer users and nonusers were 21.64±5.68mm and 20.03±4.97mm respectively and the difference was non-signicant (p=0.07).

The mean  $\pm SD$  value of TBUT, slit lamp based TMH and OCT based TMH in computer users were  $10.87\pm1.59$  sec, $582.14\pm176.41$ mm and  $236.49\pm91.00$   $\mu m$  with statistical significant differences of p=0.005,0.001 and 0.024 respectively as compared to computer non user (Table 2).

Table 2: Change in tear variables in computer users and non-users.

Tear variables	Computer user	Computer non user	P-value
Schirmer (mm)	21.64±5.67	20.03±4.79	0.07
TBUT (sec)	10.87±1.58	10.26±1.58	0.005
TMH slit (µm)	582.14±176.48	504.2±173.39	0.001
TMH oct (µm)	236.49±91.08	252.07±100.41	0.024
TMA Oct (mm <sup>2</sup> )	0.021±0.02	0.024±0.03	0.43

TBUT- Tear film break up time; TMH-Tear meniscus height; TMA- Tear meniscus area.

#### **DISCUSSION**

Dryness of eyes is a common problem worldwide and one of the frequent reasons for ophthalmic consultations. The personal computers and internet role has increased tremendously in our day to-day life. In this cyber era people spend more time in front of the computers at work, home, and even at school and most of the jobs are now computer dependent. Prolonged computer usage is often accompanied by dryness of eyes. 12 CVS has now become a significant public health problem by adding to the burden of dry eye in the community. This study demonstrated that computer usage showed its impact on the various tear parameters like Schirmer's, which was higher among computer users as compared to nonusers which can be explained by the reflex tearing. The reflex tearing in dry eye population accounts for higher baseline meniscus measurements. Local anaesthesia might alter the tear system, including tear secretion and drainage, possibly resulting in the conflicting results in Schirmer's test. This observation was consistent with Bhargava et al who stated that duration of computer usage per day may be significantly associated with increased dry eye symptoms with relatively normal Schirmer's test but deranged TBUT, conjunctival impression cytology. 10 Unló et al compared the diagnostic value of Schirmer's test, TBUT and dry eye questionnaire (OSDI) in computer users with dry eye. The authors found nonsignificant correlation between OSDI scores and Schirmer's scores but significant correlation between OSDI and TBUT scores. 13 A study by Biswas et al found that TBUT and Schirmer's was abnormal in 40% computer users and was significantly more than the control group. 14 TBUT was significantly increased in the computer users as compared to nonusers which is in

accordance with various studies by Yagizi et al, Bhargava et al and Unlo et al. 9,10,13

In the current study slit lamp based TMH was significantly higher in computer users as compared to non users which is quite contradictory but can be explained by the fact that slit lamp bright light can lead to reflex tearing. Pallikaru et al hypothesized that the increase in tear meniscus volume was compensated by an increase in output resulting from blinking. Tear meniscus measurements made by slit lamp, especially for the lower tear meniscus is a one-time snapshot during the interblink period, have been used to evaluate the tear system for a long time. The tear meniscus keep on changing from time to time and is affected by many factors like tear secretion, lid length, location of the punctum and the grey line that limits the anterior extension of tears on lid margin, palpebral aperture and lacrimal drainage.

On OCT tear meniscus studies, TMH among computer users was 236  $\mu m$  which was significantly low as compared to nonusers which was not in accordance to Bagheban et al (Table 3). 11

In the present study the tear variables were measured by OCT from the lower tear meniscus because it act as a good predictor of dry eye and had improved sensitivity and specificity as compared to the superior meniscus as concluded by Shen et al. Quantification of the upper meniscus has been limited by several factors, including eyelashes that block the view of the tear meniscus, rapid movement and twitches of the upper eyelid and smaller meniscus volumes as compared with the lower meniscus.<sup>20</sup>

Table 3: Comparison of tear variables among computer users in literature.

Tear variables	Yazici et al <sup>11</sup>	Bhargava et al <sup>12</sup>	Bagheban et al <sup>13</sup>	Present study
Schirmer's (mm)	20.6±12.5	24.64±8.62		21.64±5.67
TBUT (sec)	13.2±3.8	11.26±1.68		10.87±1.58
TMH OCT(µm)			297.6±20.7	236.49±91.08
TMA(mm <sup>2</sup> )			$0.036 \pm 0.005$	0.021±0.02

TBUT- Tear film break up time; TMH-Tear meniscus height; TMA- Tear meniscus area.

# **CONCLUSION**

TBUT may hold good diagnostic accuracy, may detect early dry eye changes, when used in combination with tear meniscus parameters for diagnosis of dry eye in computer users. TBUT is affected significantly among computer users which shows that tear film become unstable by usage of computers. Schirmer's test shows inverse relationship in computer users. OCT based TMH and TMA reduces significantly in computer users as compared to nonusers.

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# **REFERENCES**

- 1. Portello JK, Rosenfield M, Chu CA. Blink rate, incomplete blinks and computer vision syndrome. Optom Vis Sci. 2013;90:482-7.
- 2. Blehm C, Vishnu S, Khattak A, Mitra S, Yee RW. Computer vision syndrome: A review. Surv Ophthalmol. 2005;50:253-62.
- 3. Miljanović B, Dana R, Sullivan DA, Schaumberg DA. Impact of dry eye syndrome on vision-related quality of life. Am J Ophthalmol. 2007;143:409-15.
- 4. Cardona G, García C, Serés C, Vilaseca M, Gispets J. Blink rate, blink amplitude, and tear film integrity during dynamic visual display terminal tasks. Curr Eye Res. 2011;36:190-7.
- 5. Apostol S, Filip M, Dragne C, Filip A. Dry eye syndrome. Etiological and therapeutic aspects. Oftalmologia. 2003;59:28-31.
- 6. Harrison WW, Begley CG, Liu H, Chen M, Garcia M, Smith JA. Menisci and fullness of the blink in dry eye. Optometry & Vision Science. 2008;85(8):706-14.
- 7. Shen M, Wang J, Tao A, Chen Q, Lin S, Qu J, et al. Diurnal variation of upper and lower tear menisci. Am J Ophthalmol. 2008;145:801-6.
- 8. Le Q, Jiang C, Jiang AC, Xu J. The analysis of tear meniscus in soft contact lens wearers by spectral optical coherence tomography. Cornea. 2009;28(8):851-5.
- 9. Yazici A, Sari ES, Sahin G, Kilic A, Cakmak H, Ayar O, et al. Change in tear film characteristics in

- visual display terminal users. Eur J Ophthalmol. 2015;25(2):85-9.
- Bhargava R, Kumar P, Kaur A, Kumar M, Mishra A. The Diagnostic Value and Accuracy of Conjunctival Impression Cytology, Dry Eye Symptomatology, and Routine Tear Function Tests in Computer Users J Lab Physicians. 2014;6(2): 102-8.
- 11. Bagheban AA, Kangari H, Hosseini S, Rahmani S. Lower tear meniscus in computer reading task with and without soft contact lens. J Paramedical Sci. 2014;5(3). ISSN 2008-4978
- 12. Shantakumari N, Eldeeb R, Sreedharan J, Gopal K. Computer use and vision-related problems among university students in Ajman, United Arab emirate. Ann Med Health Sci Res. 2014;4:258-63.
- 13. Unlü C, Güney E, Akçay Bİ, Akçalı G, Erdoğan G, Bayramlar H. Comparison of ocular-surface disease index questionnaire, tear film break-up time, and Schirmer tests for the evaluation of the tear film in computer users with and without dry-eye symptomatology. Clin Ophthalmol. 2012;6:1303-6.
- Biswas NR, Nainiwal SK, Das GK, Langan U, Dadeya SC, Mongre PK, et al. Comparative randomized controlled clinical trial of a herbal eye drop with artificial tear and placebo in computer vision syndrome. J Indian Med Assoc. 2003;101:208-9,212.
- 15. Palakuru JR, Wang J, Aquavella JV. Effect of blinking on tear volume after instillation of midviscosity artificial tears. Am J Ophthalmol. 2008;146:920-4.
- 16. Golding TR, Bruce AS, Mainestone JC. Relationship between tear-meniscus parameters and tear-film breakup. Cornea. 1997;16:649-61.
- 17. Lamberts DW, Foster CS, Perry HD. Schirmer test after topical anesthesia and the tear meniscus height in normal eyes. Arch Ophthalmol. 1979;97:1082-5.
- 18. Doughty MJ, Laiquzzaman M, Button NF. Videoassessment of tear meniscus height in elderly Caucasians and its relationship to the exposed ocular surface. Curr Eye Res. 2001;22(6):420-6.
- 19. Burkat CN, Lucarelli MJ. Tear meniscus level as an indicator of nasolacrimal obstruction. Ophthalmology. 2005;112:344-8.
- 20. Shen M, Li J, Wang J, et al. Upper and lower tear menisci in the diagnosis of dry eye. Invest Ophthalmol Vis Sci. 2009;50:2722-6.

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