



EFFECTS OF VIDEO DISPLAY TERMINALS ON PRECORNEAL TEAR FILM SECRETION AND ACCOMMODATION OF THE EYE.

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ABSTRACT Computers have become indispensable in the workplace. This has brought about the development of a number of health concerns including visual problems termed as Computer Vision Syndrome.¹⁻⁴ This study evaluates the effect of VDT use on tear film dynamics and accommodation of the eye.⁵⁰ VDT workers and 50 appropriately matched individuals were selected. The spontaneous blink rate and near point of accommodation (NPA) was measured. The Schirmer's test was used to measure the secretion of the tears. There was a significant decrease in the spontaneous blink rate during VDT work and also in the strength of accommodation giving rise to symptoms of asthenia. Many of the potential eye problems related to VDT use can be reduced or eliminated by appropriate placement of the VDT, proper workplace design and regular professional eye care.

KEYWORDS : Computer Vision Syndrome, Accommodation, Tears Secretion.

INTRODUCTION:-

In modern life computers have become indispensable in any workplace and also for the pursuit of leisure activities. This has brought about the development of a number of health concerns including ocular discomfort, musculoskeletal strain and stress related disorders.¹⁻² Since computer video display terminal (VDT) work is such a high visually demanding task, visual problems and symptoms have also increased in proportion with studies indicating that the prevalence of visual symptoms occur in 55-81% of VDT workers.³ The complex of eye and vision problems - eyestrain, headache, blurred vision dryness, irritation etc. related to near work experienced during computer work has been termed Computer Vision Syndrome by the American Optometric Association.⁴ In the light of increasing incidence of computer vision syndrome this study was undertaken to evaluate the effect of computer VDT use specifically on the tear film dynamics and inadequacy of accommodation of the eye which in turn was responsible for the ocular symptoms of asthenopia.

MATERIAL AND METHODS:-

This cross sectional study was carried out in South India. 50 computer VDT workers were selected as the subjects. The classification of VDT work was based on the study done by H Nakaishi and Y Yamada (1996) who in turn based their study on the recommendation of the National Academy of Science, USA.⁵ All the selected subjects worked on their computers for more than 4 hours daily.

The controls were 50 appropriately matched individuals who used computers rarely, on an average of less than an hour daily.

All volunteers were in the age group of 22-35 years to exclude any possibility of presbyopia influencing the accommodation.

Informed consent was taken from each individual before the study after explaining the aims and procedure.

Care was taken to match the working environment as far as possible.

Exclusion criteria were any systemic disease that could affect the eye and people with prescribed glasses or contact lenses.

A questionnaire was first administered to the individual with personal and work related details.

A general examination was done. Cranial nerves III to VII were tested and the corneal and conjunctival reflexes were also tested.

Both the groups were subjected to a routine eye examination including direct ophthalmoscopy. Both distant vision (Snellen's chart) and near vision (Near Vision Card, Faculty of Ophthalmologists London) was recorded.

The spontaneous blink rate was counted 2 times in the cases with a stop watch. The first count was done while the subject was answering

questions in the questionnaire and the second count was done while doing VDT work. The number of blinks were counted for 2 minutes and calculated for one minute. In the controls the spontaneous blink rate was counted only once.

The Schirmer's test was used to measure the secretion of the tears. Contact care tear strips with graduations from 0-35mm were used. The strips were gently introduced into the lower conjunctival sac of both eyes without touching the cornea. The subject was instructed to gently close eyes and after five minutes the strips were gently removed and the amount of wetting was measured directly from the strip. A measurement of below 10mm was taken as inadequate secretion of the tear film. This test has a sensitivity of 79% and a specificity of 97%.⁶ The Near point of accommodation (NPA) was measured using the Royal Air Force (RAF) ruler both before and after work. The push-up method of measuring was done and both eyes were tested simultaneously thus testing binocular accommodation. A NPA reading of above 10cms was taken as defective accommodation for the tested age group of 20-36 years.

All the tests were carried out between 9.30 - 11.00 am at the start of the working day. The measurement of accommodation was repeated between 4.30 - 6 pm at the end of the working day.

The data was collated and statistical analysis was done using SPSS17. 't-test' was used with significance at $p < 0.05$.

RESULTS

All volunteers were in the age group of 22-35 years with a mean age of 27.03 to exclude any possibility of presbyopia influencing the accommodation.

The subjects worked on an average of 6.18 hours per day at a VDT and were in the occupation for an average of 3.86 years. All of them worked on a standard 14 inch monitor and the average eye to monitor distance was 51.1 cms. 60% worked with the top of the monitor screen placed above eye level while the rest worked at eye level.

Table 1. Comparison of parameters between cases and controls

	Cases	Controls
No. of Subjects	50	50
Mean spontaneous blink rate (per minute)	Normal - 20.46 VDT work - 19.16	Normal - 20.17
Mean Tear secretion (mm)	Right eye - 19.74 Left eye - 15.28	Right eye - 20.96 Left eye - 20.52
Mean Near point of accommodation (cm)	Day beginning - 8.62 Day ending - 9.92	Day beginning - 7.94 Day ending - 8.12

The statistical results showed a significant decrease in the spontaneous blink rate during VDT work in the cases ($p < 0.0003$). The strength of accommodation was also decreased significantly ($p < 0.015$) in the VDT users at the end of the working day than non-users.

Table 2. Effect of years in service on the parameters in cases.

	Mean Blink Rate(per minute)			Mean tear secretion (mm)		Near point of accommodation (cm)		
	Normal	During VDT work	Difference	Left	Right	Day Beginning	Day end	Difference
≤ 4 years in service	20.87	19.76	1.11	20.74	20.14	7.69	8.71	1.02
> 4 years in service	19.79	18.18	1.61	18.11	16.89	10.16	11.63	1.47

All the parameters showed a bigger deterioration in those workers who were doing VDT work for more than 4 years than those who were relatively new at their job.

DISCUSSION

Spontaneous blinks arise from the activity of a central pattern generator that does not require sensory stimuli.⁶ The main function of the spontaneous blink rate is the refreshing, cleaning and replenishing of the normal pre corneal tear film layer of the eye. Most of the studies agree on a mean rate of 12.55 blinks/minute as the normal rate.⁷ Visual tasks, the cognitive state and emotional factors modify the rate of spontaneous blinking. Most studies also agree that working at a VDT, being a high visually demanding task leads to significant decrease in the spontaneous blink rate.⁸⁻¹¹ Patel 1991 showed in their study that an average 5- fold decreases in blink rate occurred during VDT work.⁹

The conclusion of all these studies is that VDT use can cause a decrease in the spontaneous blink rate which in turn causes higher rate of evaporation of tears causing dryness and irritation of eyes.

Studies carried out on the effect of prolonged VDT use on the precorneal tear film have reported that the probability of developing dry eye was more in the VDT workers than non VDT workers.^{5,12} The main cause of dry, irritated eye in VDT work is mainly due to –

1. Decreased frequency of blinking⁸
2. Increased rate of tear evaporation.¹³
3. Improper screen placement leading to an increase in the Ocular Surface Area (OSA).¹⁴

The ocular surface area (OSA) is the total surface area of eye that is exposed to the external environment. A larger OSA induces eye irritation and eye fatigue. Decreased tear secretion without any keratoconjunctival lesions, as seen in VDT workers were given the term “Intermittent dry eyes” coined in 1955 by the Japan Dry Eye Research group.¹⁵

Various studies have linked the cause of asthenopia in VDT workers to excessive strain on the accommodation system of the eyes. Diminished power of accommodation and removal of the near point of accommodation,¹⁶ decrease in fusional convergence,¹⁷ and prolonged contraction time¹⁸ have all been reported which increases with the number of hours of work.

The findings in our study on the spontaneous blink rate, precorneal tear film and accommodation support previous studies with respect to the increased prevalence of adverse effects on the visual system in VDT workers.

CONCLUSION:-

Using VDTs demands a prolonged near vision task and the symptoms associated with its use such as blur, dryness and asthenopia are significantly more when compared to similar task without using VDTs. Many of the potential eye problems related to VDT use can be reduced or eliminated by appropriate placement of the VDT, proper ergonomic workplace design and regular professional eye care of the workers. It is imperative to create awareness among the VDT workers regarding the symptoms of ocular fatigue and give advice to take breaks often, to blink and use lubricating drops if required to reduce discomfort.^{1,4,19}

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