Eye care when using video display terminals

DSC Lam, W Cheuk, ATS Leung, DSP Fan, HM Cheng, SJ Chew

Objective. To examine the scientific data in the literature regarding eye problems and possible damage during the use of computer video display terminals.
Data sources. *Medline* and non-*Medline* literature search and personal experience.
Study selection. Studies that provided evidence-based information about eye damage and eye care during the use of video display terminals were selected.
Data extraction. Data were extracted independently by multiple observers.
Data synthesis. Most studies have shown that the levels of ionizing and non-ionizing radiation that are emitted by video display terminals are not harmful to the human eye. Eye complaints associated with the use of video display terminals include the McCollough effect, accommodative spasm, 'dry eyes', and eye strain. Ergonomic considerations and good visual hygiene can help alleviate symptoms.
Conclusion. There is currently no convincing evidence that shows that using video display terminals is harmful to the eye.

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Key words: Computer terminals; Electromagnetic fields; Eye diseases/etiology; Occupational diseases; Radiation injuries

Introduction

In this age of information and advanced technology, the use of computer video display terminals (VDTs) has become widespread. The concern about the potentially harmful effects of VDTs on the human eye, however, has continued since the introduction of computers to the general population in the early 1980s. Although there is no good scientific evidence that computer use damages the eye, the use of VDTs has always been associated with various eye symptoms. Such symptoms may arise from pre-existing minor eye problems that surface when the visual task is demanding, as is the case when working with VDTs. In addition, inadequate awareness of VDT ergonomics and poor visual hygiene may contribute to ocular fatigue and other eye symptoms during VDT use. This review highlights the potential problems and attempts to clarify misconceptions related to VDT use, and makes practical suggestions of methods that can be used to keep the eyes trouble-free during intensive computer work.

Department of Ophthalmology and Visual Sciences, The Chinese University of Hong Kong, Prince of Wales Hospital, Shatin, Hong Kong
DSC Lam, FRCS, FRCOphth
W Cheuk, MB, BS
ATS Leung, FRCS
DSP Fan, MB, ChB
Singapore Eye Research Institute, Singapore National Eye Centre, 11 Third Hospital Avenue, Singapore 168751, Singapore
HM Cheng, * OD, PhD
SJ Chew, FRCS, FRCOphth

* Current address: Harvard Medical School, 25 Shattuck Street, Boston, Massachusetts, MA 02115, United States

Correspondence to: Dr DSC Lam

Does using video display terminals harm the eye?

The fear of exposing the eyes to radiation is of special concern to VDT users, because VDTs emit radiation of wavelengths that span the electromagnetic spectrum. The radiation emitted includes ionizing (eg X-rays) and non-ionizing (eg ultraviolet) radiation. In 1976, Zaret reported several cases of cataracts that he attributed to radiation effects from VDTs.[1-4] His findings, however, were not substantiated by others who examined the same cases; the radiation levels at the patients' workplaces were also found to be within the normal range.[5] Cumulative evidence from both experimental and epidemiological studies suggests that the levels of ionizing or non-ionizing radiation that are emitted from VDTs are not harmful.[7-14] In fact, the amount of ultraviolet radiation produced by VDTs is only a small fraction of that produced by an average fluorescent light. Studies have so far failed to demonstrate that the ultraviolet radiation emitted from a VDT can cause any deleterious changes to the human

crystalline lens. A prospective cohort study of 1300 office workers over a 6-year period concluded that VDT usage is not associated with diseases of the eyelids, cornea, aqueous humour, anterior chamber, iris, pupil, optic nerve head, or vitreous humour.[15] This conclusion is consistent with the findings from various other, smaller-scale studies.[13,14,16]

A study has suggested that exposing the eyes to non-ionizing radiation, especially that of very low and extremely low frequencies, is harmful.[17] Although VDTs have been found to be a significant source of non-ionizing radiation,[18] little is known regarding the effect of the long-term low-level exposure of the eyes to this type of radiation. There may also be a long latency between the exposure and the onset of any noticeable change.[19] This issue might be resolved in the future if good data of the effects of long-term exposure are available. However, given the fact that people have long been using various electrical appliances that also emit non-ionizing radiation (eg motors and incandescent lights), the potential significance of the non-ionizing radiation from the VDTs is minimal.

Ocular discomfort from using computers

The use of VDTs is a visually demanding task that involves sustained periods of intensive close-screen work. Hence, complaints and symptoms related to visual fatigue such as sensitivity to glare, and aching or sore eyes are frequently encountered by physicians. Some types of transient aberration in visual performance following VDT use are well documented. Some individuals report that black and white objects appear tinged with colour after viewing VDTs for 1 hour or longer. The colours seen are usually complimentary to those shown on the VDT. This phenomenon is known as the McCollough effect and is thought to be due to the adaptation of cortical neurons that are responsive to specific colour and form.[20] Another complaint is accommodative spasm—a transient refractive error due to spasm of the ciliary muscle—which is considered to be a possible cause of functional myopia in VDT users.[21,22] Although these symptoms are usually transient and would not lead to any organic disease, they can be very distracting and even affect the productivity of VDT users.

The use of VDTs is also associated with a reduced frequency of eye blinking and consequently an increased rate of tear evaporation,[23] which can lead to 'dry eyes' and associated symptoms such as ocular discomfort, fatigue, and blurred vision. The Box shows practical guidelines that may improve visual comfort for VDT users.

Guidelines for users of video display terminals

(1) Maintain a working distance of 50 to 70 cm
(2) Ensure that the top of the video display terminal is slightly below eye level
(3) Blink the eyes regularly to minimise excessive tear evaporation
(4) View distant objects regularly to relax accommodation (for 30 seconds every 30 minutes)
(5) Maximise contrast between the screen, the displayed text/graphics, and the surrounding environment
(6) Place reference material as close to the screen as possible to minimise head turning
(7) Use single-vision spectacles instead of bifocals or trifocals
(8) Wear rigid rather than soft contact lenses
(9) Individuals prone to migraines may require polarised, tinted, or dark glasses
(10) Regularly clean the screen with an antistatic cloth to improve visibility

Ergonomic factors

The ambient lighting and the brightness and contrast of the VDT have been shown to be very important in maintaining visual comfort.[24] To minimise reflections and glares, VDTs should be placed away from windows and overhead lights. It is recommended that the text-character brightness be three times greater than that of the background, which in turn should be three times brighter than the ambient lighting.[25] The VDT screen should also be cleaned regularly using an antistatic cloth to improve visibility.

The position of the VDT display should be slightly further away than the normal reading distance (ie 50-70 cm). This distance enables the user to achieve physiological resting (tonus) states of accommodation and vergence.[26] The reference material should be placed as close to the screen as possible so as to reduce head and eye movements and focusing/accommodative changes, and the top of the screen should be placed at or slightly below eye level because a slightly downward gaze position is more comfortable. In this position, the aperture of the palpebral fissure is reduced and the exposed ocular surface area is smaller; as a result, the rate of tear evaporation is decreased.[23] In addition, a reduction in the vertical saccade rate plays a role in alleviating visual fatigue.[27]

Visual hygiene

The visual demands from prolonged VDT use amplify eye strain, especially in eyes that contain small refractive errors.[28] Consequently, individuals who normally

do not wear spectacles may need corrective lenses during VDT use. Regular short breaks are important because a stationary body, head, and eye position can lead to fatigue. Furthermore, looking out of a window at a distant object can help relieve accommodation. In a room without a view, looking at objects reflected in a mirror helps to alleviate eye strain, because the viewing distance is doubled in a mirror.

Individuals who use contact lenses should blink more frequently to prevent the eyes from drying. Wearing rigid rather than soft contact lenses is preferred, because hard lenses can correct more astigmatism and may increase tear circulation. A more comfortable alternative to wearing bifocals, trifocals, or reading glasses may be single-vision spectacles. Patients who report a correlation between migraines and the use of VDTs may consider using polarised, tinted, or dark glasses. There have been no reports of flicker-induced epileptic seizures, probably because of the high refresh rates of modern VDTs.

Conclusion

There is currently no convincing evidence to show that using VDTs is harmful to the eye. Intensive use of VDTs, however, may be associated with eye symptoms that can be alleviated by promoting the ergonomic use of VDTs and improving visual hygiene.

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