Review Article

UNDERSTANDING AND PREVENTING COMPUTER VISION SYNDROME

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ABSTRACT

The invention of computer and advancement in information technology has revolutionized and benefited the society but at the same time has caused symptoms related to its usage such as ocular sprain, irritation, redness, dryness, blurred vision and double vision. This cluster of symptoms is known as computer vision syndrome which is characterized by the visual symptoms which result from interaction with computer display or its environment. Three major mechanisms that lead to computer vision syndrome are extraocular mechanism, accommodative mechanism and ocular surface mechanism. The visual effects of the computer such as brightness, resolution, glare and quality all are known factors that contribute to computer vision syndrome. Prevention is the most important strategy in managing computer vision syndrome. Modification in the ergonomics of the working environment, patient education and proper eye care are crucial in managing computer vision syndrome.

Keywords: Computer vision syndrome, ocular strain, ergonomics, prevention.

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INTRODUCTION

Over the past 20 years, there has been a great advancement in the information technology. The use of computer in every workplace has made life easier and increase output tremendously. Computer has become almost an indispensable piece of equipment both at office and at home. The introduction of computer no doubts has revolutionized and benefited the society; however it does associate with health-related problems. Musculoskeletal related complaints such as tingling and numbness of the fingers, cervical stiffness and backache are well known to be associated with prolonged usage of computer.[1] More recently, visual and ocular problems are reported as the most frequently occurring health problems among computer users.[2] In Malaysia, for example, a study conducted by the by National Institute of Occupational Safety and Health (NIOSH) indicated 61.4% of workers who used computers in their workplace suffered from lower back pain, shoulder and neck pain, while 70.6% of them complain of eyestrain.[3]

WHAT IS COMPUTER VISION SYNDROME?

The American Optometric Association defines computer vision syndrome as a complex of eye and vision problems related to the activities which stress the near vision and which are experienced in relation, or during, the use of the computer.[4] It is characterized by visual symptoms which result from interaction with computer display or its environment (Table 1). The main ocular symptoms reported by workers are eye strain, irritation, burning sensation, redness, blurred vision and double vision.[5] These symptoms are usually temporary and disappear at the end of the working day even though a minority of worker may experience continuity of symptoms after work. If no intervention is initiated, a majority of these symptoms will recur and also worsen in the future.[4,5]

Table 1. Common symptoms related to computer vision syndrome and its pathophysiological mechanisms

Mechanism	Symptoms
Extraocular	Neck stiffness
	Neck pain
	Shoulder pain
	Headache
	Backache
Ocular surface	Tearing
	Gritty
	Dryness
	Redness
	Gritty sensation
	Burning
	Contact lens related problem
Accommodative mechanism related	Blurring of vision
	Double vision
	Presbyopia
	Myopia
	Slowness of focus change

PATHOPHYSIOLOGY OF COMPUTER VISION SYNDROME

The symptoms experienced in computer vision syndrome are caused by three potential mechanisms: (i) Extra ocular mechanism, (ii) accommodative mechanism, (iii) ocular surface mechanism.[6] Extraocular mechanism causes musculoskeletal symptoms such as neck stiffness, pain, headache, backache and shoulder pain. These symptoms are well associated with improper placement of computer screen which lead to muscles sprain.

Accommodative mechanism causes blurring of vision, double vision, presbyopia, myopia and slowness of focus change. In one study it was reported that a transient myopia was observed in 20% of computer users at the end of their work shift.[6] Many people may have slight accommodative problem or binocular problems which do not usually cause symptoms when they are doing ordinary less strenuous visual task, but these problems are worsen in prolonged period of computer usage.[6]

Ocular surface mechanism causes symptoms such as dryness of the eyes, redness, gritty sensation and burning after extended period of computer usage. These symptoms may be multifactorial, among the common factors found to be related to dryness and redness of the eyes are cornea dryness, reduction in blink rate, increased surface of cornea exposure caused by horizontal gaze at the computer screen, reduction of tear production due to ageing process contact lens usage, medication such as antihistamines and systemic medical illnesses such as autoimmune connective tissue disease.[6-8,11]

VISUAL DEMAND WHILE WORKING WITH COMPUTER

There is a difference in visual demand when one is viewing the display on the computer screen compare to reading a printed text. An image which is produced on the screen is made up of thousands of tiny spots or pixels and rasters which collectively form the image. The margin of the image or a word is usually not sharp and this is worsening if the image or word is formed by minimal pixels, or what is known as low resolution. As the resolution goes down the image become poor in quality and the visual demand of a reader has to be increased in order to appreciate well the wording or image. The contrast (intensity of the light) of the word to the background, the glare of the computer screen and the reflection from the glass screen are all important factors determining the amount of visual demand one must put in order to perceive the image well.[9,10]

Refresh rate refers to the number of times (per minute) the computer screen is repainted to produce an image. When the refresh rate is too slow it causes a flickering screen. Studies have proven that a higher refresh rates is associated with less flickering thus decreases ocular symptoms and more user friendly. Extremely low refresh rates (high flickering) is known to be associated with headache, fatigue, irritability and epileptic seizures.[6]

Many people are worried that the computer screen like most electrical appliances emits radiation. Numerous published studies have shown that there is no evidence to support any direct link between the radiation levels emitted and the worker's health problems. Similarly there is no evidence that computer radiation contributes to significant cataract formation.[6,12,13]

PREVENTION OF COMPUTER VISION SYNDROME

The most important approach in the management of computer vision syndrome is eliminating the causative factor leading to the symptoms (Table 2). Many of the symptoms in computer vision syndrome can be prevented by proper strategies at the workplace. The preventive measures include (i) environmental factor modification and (ii) proper self eye care by the worker.

Table 2. Factors contributing to computer vision syndrome

Personal factor	Poor seating posture
	Improper viewing distances
	Improper viewing angle
	Ocular diseases
	Medical diseases
	Ageing
Environmental factor	Poor lighting
	Imbalanced of light between the computer screen and the surrounding
Computer factor	Poor resolution
	Poor contrast
	Glare of the display
	Slow refresh rate

Environmental factor modification

Among the most important modifiable external environmental factors is lighting. Bright lights, windows and overhead fluorescent lights often contribute to discomfort glare. These bright light sources need to be controlled with proper blinds, filters or adjustment of the room arrangement so that an acceptable level of lighting is obtained to minimize visual fatigue. Different age group may require different light intensity to work with, workers over 50 years of age tends to require twice the light levels of young adults to perform the same task.[14]

Imbalanced of light between the computer screen and the surrounding is another important factor to be considered. For example a dark background screens often require lower lights level so when other source of documents are also viewed at the same time additional reading lamp may be needed to prevent ocular strain. Use of screen filters can reduce glare and reflection of the computer screen, but it should be used as a supplement and not a replacement for poor lighting of the room.[10] Screen brightness and contrast should be adjusted to provide balance with room lighting and maximum visibility.

Musculoskeletal problems related to head and eye postures can often be prevented by proper workstation adjustment. Computer users often assume uncomfortable position in order to have a good view of the screen without realizing that the posture may lead to muscular and ocular stress after long duration of work. Proper distance from the screen, proper adjustment of the image size and proper height of the seat are all important factors to be considered. It is recommended that the eyes should be about 35-40 inches from the screen and that the screen should be placed 10-20 degrees below or that the middle of the screen 5-6 inches below eye level. Improved physical ergonomics of the computer workstation has been proven to reduce ocular discomfort and improve performance.[6,15]

Proper eye care

Taking a short break, stretching the muscles, change of scenery and a quick walk around the office have been shown to improve productivity and reduce ocular symptoms of stress. Working non stop for more than 4 hours has been associated with eye strain. Frequent short break can restore and relax the accommodative system of the eyes and preventing ocular strain and visual fatigue. Workers who have recurrent symptoms of computer vision syndrome are encouraged to get proper optometrist review and assessment.[16]

Dry eyes secondary to decreased blink rate can be easily managed by applying lubricating eye drops or artificial tears. Patients are advised to consult their doctor first if they have any ocular symptoms before applying this eye lubricating solution although they are available over the counter in pharmacy. Workers who are using contact lens must be more careful with any ocular symptom which started acutely such as pain and redness. Complications following prolonged contact lens usage such as cornea ulcer must be excluded by proper ophthalmological assessment and examination before one can say that the symptoms are due to computer vision syndrome.[16]

Use of proper corrective glasses for refractive errors such as myopia, astigmatism and presbyopia is important to prevent further deteriorating of the ocular symptoms which can lead to poor work performance and the poor quality of life. Workers who have history of medical illnesses such as diabetes mellitus and connective tissue disease affecting the eyes must get referral to see ophthalmologist without delay.

CONCLUSION

Computer vision syndrome is a new problem that has emerged in this century following increase usage of computer both at home and at work. There is a correlation between ocular symptoms such as pain, redness, dryness, blurring of vision, double vision and other head and neck sprains and computer usage. Prevention remains the main strategy in managing of computer vision syndrome. Modification in the ergonomics of the working environment, patient education and proper eye care are important strategies in preventing computer vision syndrome.

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