

## Ocular Ergonomics for the Computer Vision Syndrome

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### Abstract

Computer vision syndrome (CVS) contains vision-related problems. These vision-related problems happen in the usage of all screened devices. Common signs of vision-related issues are eye strain, neck pain, headaches, tired eyes, irritation, burning sensation, dry eyes, and redness of eyes. All these issues appear due to the high usage of Computer screens. Computer use is becoming common. The accessible prices have increased productivity, and social modifications have governed computers, and a large proportion of the population is using mobile computing tools. However, it has also led to a risen number of patients complaining about ocular and non-ocular signs. Computer vision syndrome (CVS) can impact anyone who glances at computer screens for a long duration without rest. As for Computer vision syndrome (CVS) rising day after day, the sights related issues are also growing day after day. But we can slow down this rising problem by understanding Computer vision syndrome (CVS) prevention and recommendations. In this paper, we have tried to summarize significant recommendations and treatments for the deterrence and prevention of computer vision syndrome to remove CVS-related diseases.

**Keywords:** Computer Vision Syndrome; Computer Screen; Prevention; Recommendations; Ocular Problems

### Introduction

Computer Vision Syndrome (CVS), also referred to as digital eye strain that occurs when we use a computer or digital device for long periods. Anyone who keeps working on computers for some hours has possibly felt some of the harmful effects of prolonged usage of computers [1]. In the last 15 years, there has been a significant development in information technology. With the help of computer use, our life becomes effortless, and output increases tremendously. The computer has become an essential part of our daily life. We are using the computer as a piece of tool both at home and office. No doubt that the computer is helpful to us; however, it does relate to health-related problems. On average, most vision-related problems appear when we indulge in prolonged usage of computers [2]. For example, In Malaysia, the National Institute of Occupational Safety and Health (NIOSH) predicted that 61.4% of

workers who used computers suffered from neck pain, shoulder, and lower back pain. In comparison, others, i.e., 70.6%, complained of eye strain [3].

The Occupational Safety and Health Administration of the US Government (OSHA) clarifies computer vision syndrome (CVS) as a 'complex of eye and vision problems that are experienced during and related to computer use; so it is a repetitious problem that seems to be rising quickly, with some studies figuring that around 90% US employees using the computer for more than three hours experience symptoms. So it means that those who use prolonged periods of the computer may experience Computer induced vision-related problems such as eyestrain, headaches, blurred vision, dry eyes, neck, and shoulder pain. The American Optometric Association (AOA) has clarified CVS as 'complex of eye and vision

problems related to activities, which stress the near vision and are experienced after or during the use of computers.' It has been determined that CVS is characterized by seeable signs which occur from interaction with a computer screen and its environment [4]. In maximum cases, the symptoms occur because of the optical/visual needs of the job. Job work includes a range of activities involving reading, writing, typing. All these activities require posture and vision. Computers have assembled all these tasks to where most can be performed without shifting from desktop, thereby increasing quality, production, and efficiency. So from this, most people will be able to experience some CVS symptoms. Whenever we use to work on a computer screen, we will see some CVS symptoms. CVS symptoms may include dry eyes, eye strain, redness, burning sensation, blurred vision, headache, double vision, musculoskeletal problems [5].

### Pathophysiology of computer vision syndrome

These three potential mechanisms cause computer vision syndrome, i.e., extra ocular mechanism, accommodative mechanism, Ocular surface mechanism [6]. Extra ocular mechanism causes musculoskeletal signs such as pain, headache, backache, neck stiffness, and shoulder pain. These symptoms are well related to the unsuitable arrangement of a computer screen, which leads to muscle sprain.

Accommodative mechanisms result in double vision, myopia, blurring of vision, presbyopia, and accommodation failure. Most populations may have slight accommodative issues of binocular problems, which do not usually cause signs when indulging in the ordinary, less strenuous visual task. Still, these signs come after a prolonged usage of gadgets.

Ocular surface mechanism results in signs and symptoms such as dryness of the eyes, redness of the eyes, gritty sensation, and burning sensation after prolonged computer usage. These warnings may be multifactorial; among the common aspects found to be associated with dryness of the eyes and redness of the eyes, decrease in blink rate, decreased tear production due to the aging process, treatment such as antihistamines, and systemic medical disorders such as autoimmune connective tissue diseases also cause dryness of eyes [6,8,11].

### Visual effects due to computer screen display

#### Display quality

Pixels and raster (horizontal) lines mainly create images. The images by them lack sharp edges. The little blurred symbol makes an under-stimulation of accommodation and results in a lag of accommodation behind the screen. The accommodative lag is defined as the difference between willing demand and helpful response. Thus, lag is directly the residual refractive error. The resolution of monitors has enhanced drastically over the past decades [9,10].

#### Refresh rates

It is the number of times per minute the screens are repainted to create an image. If the refresh rate becomes too slow, the characters will begin to twinkle. It causes disturbance, fatigue, and headache. The crucial frequency is the refresh rate that human eyes don't differentiate the pulsating beams flicker as different entities. It is 30-50 Hz. Hence, it is suggested to have 75Hz that eliminates flicker at all brightness levels. Studies have clarified that increased refresh rates continuously reduce ocular symptoms and always help to improve the reading too. As compared to Cathode ray tube (CRT), Liquid crystal display (LCD) possesses high refresh rates. So LCD is a screen technology that lessens ocular disturbance.

#### Radiation

In the past, it was believed that the radiation emission from Visual display terminals (VDT) causes harmful impacts on users. Ionizing radiation results in human cellular changes and affects the chemical bonding, and changes the neutral molecules. But VDTs don't create hard x-radiation, beta rays, gamma rays, and alpha rays. VDTs generate lesser amounts of soft X-rays. But these rays are prohibited by the monitor's screen. Researchers have revealed no proof that VDT regulates hazards like spontaneous abortions, skin cancer, and ocular abnormalities due to ionizing radiation.

#### Lighting and glare

Serious lighting situations of the surrounding area of the computer can adversely impact the eyes of the users. Bright lighting always affects the visions. Bad lighting, though, creates glares and reflection. Glare and reflection possibly cause annoyance and vision tiredness. It causes delays in the reading period [6,12,13].

## Causes of CVS

Many causes contributed to CVS related difficulties -

- Prolonged computer usage: a long-lasting computer work period grows many complaints that remain, even if the work is finished
- Environmental factors: In simple terms, we can say that Environmental factors such as dry air, airborne paper dust, ventilation fans, laser, photocopy toner, electrostatic build-up, and building contaminants develop some CVS related symptoms.
- Lesser blink rate: We usually blink about 10 to 15 times per minute. But studies show when people are working at a computer, they tend to blink less than half that often. Computer use tends to cause more incomplete blinks, so the tear film is not spread across the entire cornea.
- Distance between eyes and computer screen: Distance between eyes and the computer screen is a critical risk factor for CVS. If the distance between the eyes and the computer screen is short, we might feel more challenging to accommodate—excess accommodation results in overwork on ciliary muscles, which manifest as eye strain and headache.
- Working in low lighting: Poor lighting always affects the work quality, especially when accuracy is required. Dim lighting can be a health threat—too much or too low light strains eyes, and it may cause irritation (burning, etc.) and headaches.
- Poor sitting posture: Poor sitting posture is also regarded as an essential factor for CVS. When we sit, stand, or lie in a poor posture for any duration of time, it always sets stress on joints, ligaments, and muscles. So it might cause pain and injury in the back, neck, and shoulder.
- Uncorrected or under corrected vision: People who already have eye trouble might be facing vision problems.

Using unsuitable computer glasses: Whenever we use inappropriate computer glasses for protection of eyes from the computer, it might be ineffective [13].

## Signs and symptoms of CVS

Computer vision syndrome can result in many signs and symptoms, including:

- Blurred vision
- Double vision
- Eye discomfort
- Eye fatigue
- Dry eye
- Eye itching
- Eye redness
- Eye tearing
- Headaches
- Neck and shoulder pain
- Neck stiffness
- Backache
- Myopia
- Presbyopia.

Mostly these symptoms are temporary. They automatically go away when you finish your work on the computer. But sometimes, you may have signs for a long time [13].

## Diagnosis of CVS

Through a comprehensive eye examination and assessment, CVS or digital eye strain can be diagnosed. With the help of testing, with particular emphasis on vision necessities for the computer or digital equipment may include:

- **Patient history:** To determine any symptoms the patient is experiencing and the existence of any health problems, patient history should be taken, like environmental factors and medications taken that may be contributing to the symptoms related to computer use.
- Visual acuity refers to your capacity to discern the shapes and details of the items you see. It's a measurement to analyze the extent to which vision may be impacted.
- **Refraction:** Always tests the possible lens prescriptions that would optimize your vision.
- Eye coordination and focus: for checking how eyes focus, move, and work together, one may require testing. To attain a clear, single image of what is being viewed, the eyes must change direction, move and work in unison.

These testing may be performed without eye drops to determine how the eyes respond under every day seeing situations. Dilating eye drops may be used in some cases to unmask the hidden eye power, which may be present in children and young adults. They temporarily prevent the eyes from changing focus while testing is done. With the help of these tests, an optometrist can define the existence of CVS or digital eye strain and recommend treatment options [16].

### Prevention of CVS

The most beneficial approach in the association of computer vision syndrome is to remove the causative element leading to CVS symptoms. Right strategies can prevent all these symptoms in computer vision syndrome in the workplace. The preventive measures include.

### Environmental factor modification

Environmental factor modifications: Lighting is the most critical flexible external ecological factor. High bright lights, overhead fluorescent lights, and windows always contribute to damaging glare. With the help of proper blinds and filters, these bright light sources need to be prevented. To minimize visual tiredness, there is a need to adjust the room arrangement so that an adequate level of lighting is acquired. Various age groups may require different light intensity to work with at around 50 years of age; workers tend to require twice the light levels of young adults to operate work. The slight imbalance between the surroundings and the computer screen is another vital factor to be analyzed. The use of screen filters can decrease the reflection and glare of the computer screen, but the screen filters should be utilized as an accessory and not a substitute for low lighting of the room. To give balance with room lighting and maximum visibility, screen brightness should be adjusted. With proper workstation adjustment, musculoskeletal issues relevant to head and eye postures can be avoided.

Many computer users repeatedly acquire an uncomfortable position to have a good view of the screen without understanding that it may lead to ocular and muscular stress after long work duration. Proper height of the seat, adequate distance from the screen, and adequate image size adjustment are all critical factors to be considered. It is advised that the eyes should be about 35-40 inches from the screen, and the screen should be located 10-20 degrees below or the center of the screen 5-6 inches below

eye level. To reduce ocular discomfort and improve performance, improved physical ergonomics of the computer workstation has been considered.

### Proper eye care

To enhance productivity and decrease ocular symptoms of stress, it is essential to take a short break, change of scenery, stretching the muscles, and a quick walk has been proved to improve productivity and reduce ocular stress symptoms. Eye strain takes place when we are working continuously for more than four hours long periods. Ocular strain and vision fatigue can be restored and relaxed by frequent breaks: proper optometrist review and assessment help workers with recurrent CVS symptoms.

Dry eyes secondary to reduced blink rate can be effortlessly managed using artificial tears or lubricating eye drops. Before using these eye lubricating solutions, patients are recommended to consult their doctor if they have any ocular symptoms, although they are available in the pharmacy. Employees who use contact lenses must be careful with any ocular sign, which started acutely, such as redness and pain. Pathologies following prolonged contact lens usage such as the cornea ulcer must be eliminated by proper ophthalmological examination before knowing that the symptoms are due to computer vision syndrome.

To correct refractive errors such as astigmatism, myopia, and presbyopia, it is essential to use proper corrective glasses, which can lead to improved poor work performance and also improve the low quality of life. Employees who have a medical illness such as connective tissue disease must get referrals to see ophthalmologists without the wait [16,17].

### Treatments, recommendations, and ergonomics of CVS

Treatment is always helped by making changes in the use of your computer screen. These changes include:

- **Rest eyes:** Always rest your eyes for at least 15 minutes after every 2 hours of usage of the computer screens. To relax eyes, one may use the 20-20-20 rule. This rule is determined as taking breaks every 20 minutes of computer use by staring at an object 20 feet away instead of the screen for 20 seconds. The American Optometric Association has recommended always take a break after every 2 hours of continuous computer use. It takes about 20 seconds for your eyes to relax.

- Generally, the preferred viewing distance between the eyes and the computer screen is 20 to 25 inches (50-65 cm). It is advised to increase the font size of characters. Always enlarge the text on your computer screens. So in simple words, we can say that when you enlarge the text on the computer screen, you should prevent the CVS symptoms. Computer screens are the culprit. Our eyes don't filter screen characters as well as they do conventional print. Screen characters are not well-defined, but printed material has well-defined edges. To remain focused on on-screen characters, our eyes required hard work.
- Reduce environmental glare: Glare is reflected light that jumps off surfaces such as computer screens and walls, and mobile phones. Direct light results in a high glow. To reduce glare, it's recommended to wear polarized lenses, anti-glare coating, wear blue cut lenses, adjust light level, and use automatic brightness on computers. Always maintain your monitor clean of dust, as keeping a dirty monitor will reduce its contrast, making it more challenging to read.
- **Use proper lighting:** Maximum office settings always use bright light; some people think brighter light is better. Unfortunately, that's wrong, but the solution to the harsh rays is simple. If you are used to working in bright sunlight, you might feel some symptoms. To treat them, you should adjust the light on the computer screen or wear tinted glasses.
- **Increased contrast of screen:** To reduce eye strain contrast of the screen should be increased. If contrast is low, then your eyes have to work harder to see.
- Monitor display quality: By using high-resolution LCD monitors quality of monitor display might be increased. With the help of high-resolution LCD monitors, we should be able to decrease the harmful effect of CVS.
- **Increase blinking rate:** To decrease the symptoms of CVS we should increase the blinking rate. High blinking keeps the cornea lubricated and protected. Increased blinking always brings nutrients, minerals, and other beneficial substances to the surface of the eye.
- **Sitting posture:** To decrease the symptoms of CVS, we should sit with a straight back, buttock touching the end of the seat, and shoulder pulled back. With the help of these postures, we should decrease the harmful effect of CVS.
- **Reference materials:** All these materials should be placed above the keyboard and below the monitor. If this is not reasonable, a document holder can be adopted beside the monitor. The goal is to position documents in such a way that the gaze needs to be shifted repeatedly from screen to document.

So by making such modifications, one can get rid of digital eye strain in many people.

Your healthcare consultant will also treat any health-related problems that can cause your digital eye strain. You may require to take steps to decrease dry eyes. These include:
  - To correct your vision, they advise you to use corrective spectacles.
  - If you have allergies, try to treat them.
  - They should advise you to use lubricating eye drops
  - They should also advise you to use a humidifier
  - Drinking more water.To increase tear production, they should advise you to take prescribed medicine [17-19].

### Conclusion

Computer vision syndrome is a new issue that has arisen in this century following the increased usage of computers. There is a correlation between ocular symptoms such as blurring vision, double vision, pain, redness, dryness. To reduce the symptoms of computer vision syndrome, prevention and treatment remain the main strategy. Modifications in the ergonomics of the working environment, proper eye care are essential strategies in preventing computer vision syndrome.

### Disclosure Statement

The author declares no conflict of interests.

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