What is Computer Vision Syndrome?

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Since computer use is such a visually demanding task, vision problems and symptoms have become very common in today’s work place. Most studies indicate that computer operators who view their video display terminals (VDT) report more eye related problems than non VDT office workers. NIOSH Survey (National Institute of Occupational Safety and Health) has reported that visual symptoms occur in 75-90% of VDT workers as opposed to 22% musculoskeletal disorders (carpel tunnel syndrome) in computer users.

A series of visual symptoms which are a by-product of excessive viewing of VDT screens without proper attention to practical visual hygiene is called Computer Vision Syndrome (CVS).

This new found entity, frequently described in the lay press and world wide web has now been accepted in medical literature.

The cause of these visual complaints are a combination of individual visual problems, poor work place conditions and improper work habits. Prolonged work on the computers has been associated with diminished power of accommodation, removal of near point of convergence, and deviation or phorias for near which are transient. The symptom of CVS have been divided into 4 categories 1) Asthenopic, 2) Ocular surface related, 3) Visual and 4) Extraocular.

Eyestrain (Asthenopia) : A subjective complaint of uncomfortable, painful and irritable vision. In the VDT environment, eyestrain in all its manifestations can be caused by a number of different environmental and visual conditions. The symptoms of eyestrain manifests as headaches, focusing difficulties, burning, tired and aching eyes, dry eye symptoms, double vision or blurred vision, light sensitivity, neck or shoulder pain, changes in colour perception and pain in and around the eyes.

Headaches

Headaches are discomfort symptoms for which most computer users seek medical advice. Characteristics of headache in computer users are its frontal location or one sided headache occurring in the middle or end of day. The patients are fine in the morning and the headache exhibits a different pattern during weekdays and weekends. Tension and stress, numerous eye conditions, improper work place conditions etc (glare, poor lighting, improper workstation setup) are responsible for this symptom.

Blurred Vision

Blurred Vision in a computer user could be due to a variety of factors such as refractive error, improper prescription lenses, age related focusing problem (presbyopia), dirty screen, poor quality monitors, poor viewing angle and reflected glare from the screen.

Dry and Irritated Eyes

Tear secretion covers the eye surface and maintains moisture for normal eye function. Tears also help to maintain oxygen balance of the external eye structures and to maintain the optical properties of visual system. Blinking facilitates resurfacing of precorneal tear film. Blink reflex rate varies depending on the activity that you are engaged in. The blink reflex rate becomes faster.
when you are active and slower when you are sleepy or concentrating. While you are at work on the computer, the blink rate reduces considerably because of your concentration on the task and relatively limited range of ocular movements.

In addition the size of palpebral aperture widens on up gaze to view the VDT. This results in greater evaporative dryness and greater number of incomplete blinks both of which predisposes to dry eye symptoms.

**Neck Ache and Back Ache**

“The eye leads the body” and hence nature has designed our visual system to be so dominant that we are forced to alter our body posture to accommodate for any deficiency in the way we see. In many office situations, if the vision of a worker is compromised he must adapt his posture to ease the strain on the visual system.

If an older worker is using single vision glasses, which are designed for a 16” viewing distance, they must lean towards the screen, which is 20°-25° away in order to clear the image.

If the older worker is using bifocals, which are designed to see near objects in the lower visual field, they must tilt their heads backwards and lean forwards to put the viewing section of the lenses into proper position to see the screen.

These situations will cause obvious physical problems. (Table 1)

**Light Sensitivity**

Discomfort due to glare is largely caused by disparities in brightness in the field of view. Overhead light fixtures, bright open windows, dark background display screen, white paper on the desk, light coloured desk surfaces, desk lamps directed towards the eyes, all cause reflected light (or glare) to fall on the computer users’ eye.

**Double Vision**

When viewing a near point object, the eye muscles “converge” the eyes inward towards the nose. Convergence allows the eyes to maintain the alignment of the image on the same place on both retinas. When we lose the ability to maintain the “lock” between the 2 eyes, they misalign and aim at different points in space. If both eyes continue to transmit the image back to the brain, we will experience double vision.

Individuals with **COMPUTER VISION SYNDROME** may complain of any or all of the following symptom after a days’ work (Table 2).

**TABLE 2**

<table>
<thead>
<tr>
<th>List of common complaint for which a computer user seeks medical aid</th>
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<tr>
<td>1. Headache during or after working at the computer</td>
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<td>2. Overall bodily fatigue or tiredness.</td>
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<td>3. Burning Eyes</td>
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<td>4. Distance vision is blurry on looking up from the computer.</td>
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<td>5. Dry, tired or sore eyes</td>
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<td>6. Squinting helps while looking at computer</td>
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<td>7. Neck, Shoulder or Back pain</td>
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<td>8. Double Vision</td>
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<td>9. Letters on the screen run together</td>
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<td>10. Driving / Night Vision is worse after computer use</td>
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<td>11. ‘Haloes’ appear around objects on the screen</td>
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<td>12. Forced to interrupt work frequently to rest the eyes</td>
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**Why Do Eye Strain Occur While Viewing The Characters on VDT (Videodisplay Terminal) or Computer Screen?**

The human focusing system responds very well to images that have well defined edges with good contrast between the background and letters.

Characters displayed on the computer screen are made up of many dots or pixels. Pixels are the result of electron beam striking the phosphor coated rear surface of the screen. The resolution of the images made of pixels is measured in dots/inch. Each pixel is brightest...
at the centre with the brightness decreasing towards the outer edges.

When a light meter with a small aperture is passed across a pixel, with the light amplitude being charted against luminance we get a light amplitude graph as shown in Fig 1 which compares the difference between a sharp edged print and fuzzy edged pixel. The characters in the LCD screen have sharper edges than those on the VDT monitors and are hence more comfortable to view.

Fig 1: LIGHT AMPLITUDE GRAPH drawn using a lightmeter showing the difference between the appearance of a pixelated image and printed character. The eyes have a hard time focusing continuously on the pixel characters on the computer screen. An effort is made to focus on the plane of the computer screen but usually they cannot sustain that focus. Hence they relax to a point behind the screen termed as RPA (Resting point of Accommodation) or dark focus. The RPA is different for different individuals but for almost every one it is further away than the working distance to the computer. (Fig: 2)

Thus the eyes are constantly relaxing to the RPA and then straining to refocus on the screen. When the eyes have to do that for several times a day they naturally get tired.

Many people suffering from blurred vision at the computer are in their 40’s or older. You probably only notice this problem at the computer because your monitor falls into the intermediate zone of your vision (as opposed to the near and the far), which you ordinarily don’t use much.

Middle aged and older people also have a little trouble with the ciliary muscles that control accommodation: the eyes ability to switch focus quickly (from the key board to the monitor and back). This “lag of accommodation” can lead to eyestrain and blurred vision.

Computer monitor are often too close to the user because of the space constraints or lack of understanding of how the eye functions while working on a computer. Some young people whose near point is around 16 inches compensate for the closeness of the monitor with out significant eyestrain. Other who have binocular problems, uncorrected hyperopia and astigmatism have significant eyestrain and symptoms.

Constant effort is needed to focus near objects and to sustain accommodative spasm in which the focusing muscles lock into position and the eyes will not relax easily. This will lead to myopia (near sightedness) or pseudo myopia (When these eyes are examined they will accept minus powered concave lenses but when the eyes are dilated and the focusing muscles relaxed, the true prescription is reached). If this over focusing is not corrected, the pseudo myopia can become structuralized.

Examination for CVS:- There is a definite examination sequence for patients with visual and related complaints following prolonged computer use.

1. The most important finding for writing a “Computer Specific” prescription is the Manifest Refraction at distance.
2. Check for correction at 40 cm near point and also take care to asses whether the patient is comfortably and consistently binocular. If not asses the need for prisms to achieve binocularity.
3. Asses the patient’s computer working distance.
4. You can then make the patient sit at his actual working distance in front of a computer screen and based on your 40 cm near point evaluation, adjust the power by trial of loose lenses on the trial frame till he’s comfortable.
5. There are reliable methods (PRIIO VISION testers) developed to duplicate the light characteristics (pixelated image) of the computer screen, allowing the patients eyes to react in exactly the same way as when he sits in front of the computer. Trial of
glasses carried out at the patients working distance also help in arriving at the correction he needs to wear to avoid eyestrain.

**COMPUTER LENS DESIGN**

After obtaining the basic computer-distance–related sphero-cylinder prescription for your patient you are left with several choices to choose from after discussing the various options with your patient.

The computer monitor falls in the intermediate zone of vision. Normally regular glasses with out near vision addition are used for viewing objects at a distance, while the reading glasses help correct near vision. Bifocals correct both near and far vision while trifocals and progressive only have a small portion or the intermediate viewing, not large enough for comfortable computer work. Thus computer work requires the use of glasses which provides a larger intermediate zone viewing area.

One choice might be to select a single vision lens for the computer glass. This serves well for a person who works in a small cubicle all day with a distance visual demand of no greater than 4 feet. If the person needs to look around or across the room the simple vision lenses will not be adequate.

If your patient has previously worn a flat top segmental bifocal lens, you could prescribe an occupational trifocal design. The newer trifocals have a 14 mm x 35 mm ribbon intermediate segment with an add power set at 2/3 of the distance power. These lenses provide the width of field which is desirable in a computer environment.

Patients who are not comfortable with trifocals can be prescribed bifocals with either intermediate and near correction or intermediate and distance correction.

Ideally an occupational progressive $^{15,16}$ lens that corrects near, intermediate and up to a point for distance (allowing the wearer to see a distance of about a room’s length) can be prescribed (Fig. 3 and Fig. 4). This lens tends to be poorly suited for regular wear. Commercially available occupational progressives are

1) TECHNICIA: has a wide intermediate field to facilitate computer viewing. The near zone is 25 mm wide and the add progression is such that 75 % of the full add power is achieved at a distance of only 9 mm below the major reference point (MRP). This lens also has a small distance viewing area at the very top of the lens, so that the patient can see the office environment without a blur. Peripheral distortion is minimized by placing most of the unwanted astigmatism in the nasal portion of the lens.

2) SOLA “ACCESS” lens:- This is a double progressive lens which offers clear viewing for both computer and distance with minimal peripheral distortion.

3) SHAMIR OPTICALS “OFFICE” Lens / (DESKTOP Lens):

4) VARILUX (INTERVIEW Lens)
“TO COAT” or “NOT TO COAT”? To answer those questions, you must know something about the patients’ working environment. If work is done at home, without fluorescent lighting and with windows where the amount of light that is let in can be controlled, the only coating you might consider is the anti reflection treatment of the lens (AR)\(^1\) (Fig. 5).

AR coating increases the efficiency of the lenses as a refracting medium. However the AR coating is still more difficult to keep clean even with the newest technology applications.

However, if work is done in a typical office setting with too bright fluorescent lighting you might want to consider two additional coatings along with the AR mentioned above.

400 nm Coating (UV Coating) : Most daylight or cool white fluorescent tubes have output that is rich in harsh, short wavelength light. This blue light is difficult for the human eye to focus due to its scattering characteristics. The UV coating eliminates blue component light to atleast some extent \(^2\).

Tint coating : In most offices the fluorescent lighting is too bright. A 10 % absorbing tint can reduce the eyestrain associated with such high light levels. In addition to the degree of tint, the hue of the tint can also help improve the visual performance. Amber coloured tint selectively reduces the illuminance for rods and cones.

Thus if your office has fluorescent lights you might want to consider both these options as well. UV coating can cut down on the amount of blue light that reaches the eye as can amber tint and hence makes focusing a lot easier.

9 steps to reduce computer eyestrain have been suggested by the National Institute of Health and Occupational Safety. These include

1. Regular, yearly complete eye examination.
2. Use proper lighting: Avoid excessive bright light coming from outside and excessive bright light inside. When you are using the computer your ambient lighting should be around 50 % of that in a regular office.
3. Minimize glare: Glare from the wall, reflective surfaces and computer screen can cause eyestrain. If possible paint the walls of the room a darker shade with a matte finish. Install an anti reflective screen for your computer. Reduce exterior lighting by use of blinds. Using anti glare-coated goggles will also help reduce the eyestrain (Fig. 6).
4. Adjust brightness of computer screen: Adjust also the contrast, text size and colour for optimum comfort. Match the computer screen to the brightness of the environment. The contrast between the background and on screen characters should be light.
5. Take frequent breaks: Full time computer users should take a 10 minutes break every hour to reduce eye strain.
6. Refocus your eyes: Look away from the computer screen every 10-15 min and focus on a distant object for 5-10 seconds. It also lets you blink, which wets your eye.
7. Blink more often: When staring at the computer, people blink less frequently- (about 5 times less than normal according to studies). Tears coating the eyes evaporate rapidly during the long non-blinking phases and cause dry eyes. Office buildings may have excessively dry atmosphere, which reduces
tearing. For significant dry eye symptoms prescription of artificial tears may be helpful. It's a good idea to blink every time you hit the “ENTER” key.

8. Modify workstation: Use a copy stand placed adjacent to the monitor if you need to look back and forth between the print on the written page and the computer. Purchase ergonomic furniture to assume proper screen location and posture.

9. Exercise even while sitting:
Sitting, stretching and joint rotating exercises have been advised for computer users

The results of a study on knowledge, awareness and practices in Indian ophthalmologists with reference to Computer Vision Syndrome showed that all doctors who responded to the questionnaire were aware of CVS. The main mode of treatment was by using tear substitutes in 50.7%. Ophthalmologists in this study were not prescribing any special spectacle nor did they have any preference for a specific type of glass or special filters. Computer users were likely to be prescribed sedatives/anxiolytics and advised frequent conscious blinking than non computer users.

Computer Vision Syndrome is a diagnosis of exclusion as almost everyone uses computers. Hence an universally acceptable diagnostic and grading system needs to be established and the tendency to label any vague collection of symptoms as CVS needs to be discouraged.

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