

Digital Visual Fatigue – Are We Prepared?

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ABSTRACT:

Digital visual fatigue or computer vision syndrome is becoming one of the common issues to be dealt by an eye specialist. The symptoms, identification of signs, reasons and methods to prevent ocular damage are the need of the hour. Today millions of children also use computers /smart phones on a daily basis. Very few studies are available to investigate the impact of digital devices on children eyes. This article aims to discuss the symptoms, reasons and methods to prevent computer vision syndrome and a tailored approach to attend the children getting affected on a regular basis.

KEY WORDS: Computer vision syndrome, e-readers, management



Symptom Category	Symptoms	Possible Cause
Asthenopic	Eye strain, tired eyes, sore eyes	Binocular vision, accommodation
Ocular surface related	Dry eyes, watery eyes, contact lens problems	Decreased blink rate (from normal 22/min to 7-10/min)
Visual	Blurred vision, slowness in focus change, double vision, presbyopia	Refractive error, accommodation, binocular vision, presbyopia correction
Extra ocular	Neck pain, back pain, shoulder pain	Computer screen location

According to International Classification of Diseases (ICDS 10) of WHO Visual fatigue or strain is defined as-A degree of visual discomfort typically occurring after some kind of prolonged visual activity and characterised by fatigue, pain around eyes, blurred vision and headache.

SYMPTOMS:

In case of digital visual fatigue, the symptoms can be categorized into four major groups

Main Reasons –

- 1) Due to Reflection and Glare from screen- When the screen is positioned in front of a window or a light source, it reflects of screen. As we move around (in case of mobile) glare changes and eyes again have to adjust for different lightings.
- 2) Due to screen flicker while refreshing screen- Every digital screen has to be refreshed because they do not have the capacity to hold a stable image on the screen. They just give illusion of a constant image. Usually the refresh rates of LCD and LED monitors are 125 to 250 Hz. In case of CRT monitors it was 50 to 60 Hz. Increase in refresh rates leads to decrease in image blur. Refresh rates of most of the mobile screens is around 60 Hz.
- 3) Due to PWM Brightness control- Brightness of the digital display can be altered to match both dim and bright environments. Traditional method to decrease brightness of display is Pulse Width Modulation (PWM) which works

by rapidly cycling on and off of backlights. (Usually at frequency of 180 to 240 Hz). This may cause screen flicker and visual fatigue.

- 4) Due to HEV Blue light - Digital displays emit High Energy Visible (HEV) Blue light that can lead to macular degeneration. These lights are also emitted by sun and LED bulbs but we don't stare at them!
- 5) Due to reduced working distance in monitors and smart phone as compared to paper print- Typical near working distance for paper print is 35 to 40 cm while for internet viewing it is average 32cm (19 to 60 cm) and for text message on smart phone is 36 cm (17.5 to 58 cm). This decreased working distance increases demand of accommodation and vergence (By 0.5 to 0.75 D).

Eye Strain Reduction Techniques-

- 1) *Anti-reflective coating and Glass colour tinting-* Present day monitors have anti-reflective coating to decrease glare while facing a light source. Glass colour tinting decides how much of the visible light reaches our eyes and how well we see other colours and contrast. Rose/Red colour tinting is said to increase contrast and block blue light. Many people feel that rose tinted lenses are more comfortable for long period of time
- 2) *Fuzzy Logic based Brightness control-* Automatic control of brightness is preferred where fuzzy controller takes intensity of atmospheric light (measured by a sensor) and

current screen brightness as input and modifies the screen brightness accordingly.

- 3) *Optimizing monitor's colour temperature-* Colour temperature affects picture quality and colour reproduction. If colour temperature is low, white objects appear redder. If colour temperature is higher, white objects appear blue. Open a blank white screen and adjust colour temperature of display to match colour temperature of environment. This will help reduce eye strain

Sunlight	Colour Temperature	Artificial Light	Colour Temperature
Clear sky	12000K	Day light Flourescent	6500K
Cloudy sky	6500K	White Flourescent	4200K
Average noon sunlight	5300K	Soft white Flourescent	3000K

- 4) *Good practices to reduce eye strain-*
- i) Maintain a comfortable working distance (ONE , TWO, TEN) One foot for mobile phones, Two feet for desktop and Laptop devices and Ten feet for TV screens.
 - ii) 20-20-20 rule- after every 20 minutes of work, look 20 feet away for 20 seconds
 - iii) Lighting levels should be 200 to 700 lux
 - iv) All screens and monitors should be dust free as dust causes glare
 - v) Refocusing from screen to print and vice versa should be avoided by using document holders attached to screen
 - vi) Artificial tear substitutes tend to relieve the symptoms of digital visual fatigue to some extent.
 - vii) Frequent voluntary blinking should be practised while working long hours on computer.

E-readers and Visual Fatigue –

E- Readers (KINDLE etc.) don't use light to light up pixels but rather E- Ink. They have electronic ink laminated to a plastic film substrate. E-Ink is simply arranged on the screen where pixels are and this creates image. E –ink readers display is "Reflective" i.e.no back light is used and ambient light from the environment is reflected from the surface (LCD display is "Emissive" i.e. light from a backlight is projected through a display towards eye).

So E –Readers don't need any light to lit up; no changes in contrast that eyes have to adjust. Also no glass to cause reflection or glare. Thus reading on an E reader is actually same

as reading a paper.

Then why are we not using E – ink screens for computer and other devices?

- i) They take long time to change screen. So they cannot support video or computer games.
- ii) They are currently available only in white and black colour although research is still on.

How are our children getting affected??

Today millions of children use computers /smart phones on a daily basis. Very few studies are available to investigate the impact of digital devices on children eyes. Children can experience many of the same symptoms as an adult. Some unique aspects of child using a digital device are-

- 1) **Limited degree of self awareness-** Most of the kids keep continuing their task, (eg. Playing games on mobile) till they get exhausted with very few breaks. So accommodation is "Locked in" to a particular target distance that can sometimes lead to accommodative spasm. They can also suffer from eye irritation (poor blinking causing poor tear film distribution).
- 2) **Adaptability of children-** A child using a computer or mobile with large amount of glare often will not think of changing the settings to make viewing more comfortable. Kids often accept blurred vision caused by refractive error because they think everyone sees the way they do.
- 3) **Using an adult computer-** A child sitting on father's computer has to look up much further than his father. Kids also face issues while reaching for keyboard causing neck , arm or back pain.

Mobile phone dependency is leading to negatively predicted attention, positively predicted depression, affect on social relations and academic achievements.

The child does not get enough sleep and remains irritable affecting his social development.

What should we do?

- 1) Regular eye examinations- at least annual including refraction and orthoptic exercises
- 2) Decrease the time in which child uses computer- ask for 10 minutes break after every one hour
- 3) Check position of computer- Screen should not be too high. Opt for adjustable chair, foot stool etc
- 4) Check lighting for glare on screen- windows and other light sources can cause glare; computer screen should be turned in other direction
- 5) No need to introduce technology too early , at least not before 3 years(Avoid giving VIRTUAL PACIFIERS OR ELECTRONIC BABY SITTERS)

- 6) Avoid exposure to devices at least 1 hour before sleep
- 7) Inculcate good habits like keeping meal time or parent –kid play time free and unplugged

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