# Influence of the Computer on Visual System

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## Abstract

***Aim***

The paper analyzes alterations of the visual function that occur in healthy subjects who spend several hours daily in front of a computer.

***Methods***

We studied a homogeneous group of 80 people, aged 20-60, with a 3-8 hours daily computer time, with no local or general diseases.

***Results. Discussions***

Working time ant refractive errors were correlated with pathological disorders of accommodation. Dry eye disease was present in all subjects.

***Conclusions***

Focusing a prolonged time on a display induces symptoms correlated with the time of working, the age and the refractive error of the subject.

*Keywords: computer vision syndrome, dry eye disease*

## 1. Introduction

Computer vision syndrome (CVS) describes a group of eye and vision-related problems that result from prolonged computer, tablet, e-reader and cell phone users [1-5].

Many individuals experience eye discomfort and vision problems when viewing digital screens for extended periods.

The level of discomfort appears to increase with the amount of digital screen use [6-8].

Symptomatology: headache, alteration of visual acuity, fatigue, eye pain, redness, dryness, diplopia, vertigo, neck and shoulder pain

## 2. Aim

The paper analyzes alterations of the visual function that occur in healthy subjects who spend several hours daily in front of a computer.

## 3. Matherial/methods

We studied a homogeneous group of 80 people, aged 20-60, with a 3-8 hours daily computer time, with no local or general diseases.

- 80 subjects, urban environment;
- Aged between 20-60 years;
- Computer time: hours daily;
- No local or general diseases;
- Questionnaire (symptoms related to the use of the computer).

## 4. Results and Discussions

***Accommodative Asthenopia and the Computer***

Continuously focusing on the computer display leads to the fatigue of the ciliary muscle with the decrease of the accommodation power. Presbyopia, hipermetropya with poor correction can increase the tiredness.

- 22 subjects (27.5%) accused asthenopia symptoms
  - 18 subj. >40 years old, presbiopya, no other refractive errors
    - Probably because of an inappropriate correction of the presbyopia
  - 4 subj. <40 years old, no other refractive errors (Fig. 1).

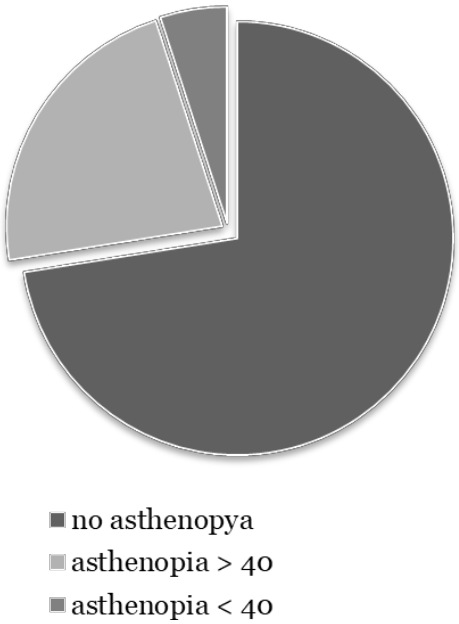


**Fig. 8.** Asthenopia correlated with age

***Spasm of Accommodation and the Computer***

Prolonged use of the computer can induce accommodative spasm with: low distance vision (initially transitory, especially in the afternoon, than permanent), ocular fatigue [7-9].

1 of 6 young persons who use daily the computer present symptoms of ciliary spasm.

Pseudomyopia caused by the spasm could be eventually overcorrected in these cases.

The risk of accommodative spasm decrease with age, due to the decrease of the accommodative power of the lens.

Maybe the interruption of the continuous focusing (20/20/20 rule) could reduce the risk of the spasm.

Symptoms associated to accommodative spasm occurred in 30 cases (37.5%), with an activity of over 3 hours daily in front of the computer

- 22 subj. <40 years – "frequent";
- 8 subj. >40 years – "rarely".

A daily computer activity longer than 3 hours and a under 40 age are risk factors for accommodative spasm (Fig. 2).

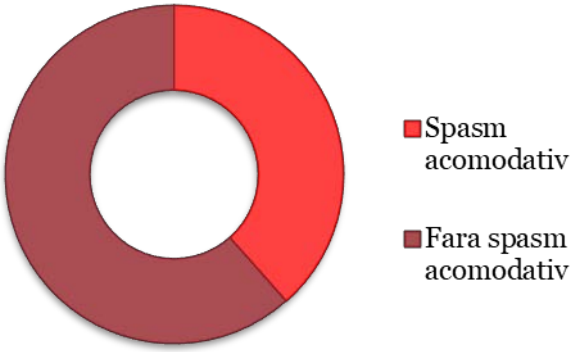


**Fig. 9.** Acommodative spasm presence in the studied group

***Refractive Errors and the Computer***

A refractive error associated with the computer work can generate problems especially if [10-12]:

- The error is not corrected or not properly corrected;
- There is insufficient correction of Hipermetropya;
- The myopia is overcorrected;
- There are errors of axis in Astigmatism;
- There is Anisometropia;
- Presbyopia is associated to a refractive error.

Installing of Presbyopia has a negative influence on computer users. Correction for the reading distance (25-30 cm) does not always match the correction for the display. The display is usually situated at longer distances – 40-80 cm.

- The correction is either:
  - Too high for the display;
  - Too low for reading.

These will lead to:

- Ocular pain, headache;
- Fatigue;
- Discomfort.

***Refractive errors. Presbyopia***

| | Hiperopya | Miopya | Astigmatism | Presbyopia |
|---|---|---|---|---|
| Total | 8 | 5 | 7 | 30 |
| CVS | 7 | 4 | 5 | 28 |

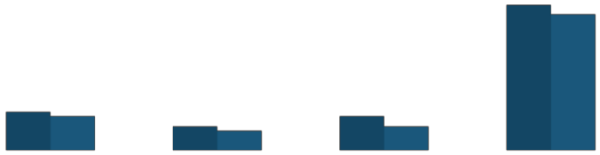

**Fig. 10.** Refractive errors and CVS

CVS was present in most of the glasses wearers (Fig. 3).

***Dry Eye and the Computer***

The main mechanisms involved in determining dry eye to computer users can be:

- A decrease of the rhythm of blinking due to the following of the display (the normal blinking range is 2-10 sec.; during reading it can increase 3-4 times) – film evaporation and eye dryness;
- A high position of the display - a larger opening of the eye;
- working environment (air conditioning, airflow, etc.).

Every subject reported the presence of some dry eye symptoms.

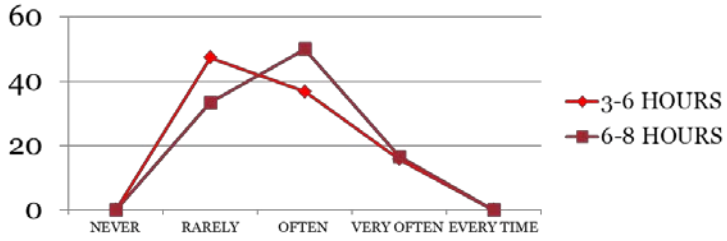


**Fig. 11.** Dry eye symptoms presence correlated with the time spent in front of the display

Dry eye symptoms: burning sensation, aching sensations, dryness sensation, redness, photophobia etc.

- 47% of users 3-6 h/zi – rarely
- 50% of users 6-8 h/zi – often

Symtomatology increases with the time of using the display (Fig. 4).

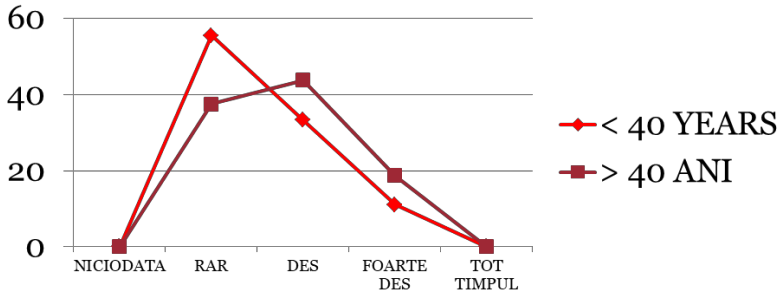


**Fig. 12.** Dry eye symptoms presence correlated with age

Dry eye syndrome occure in all ages with an increase after 40 years (Fig. 5).

***Display on Screen***

The following of a computer display is different of a written page because:

- Poor contrast;
- Brilliance, reflections of the display;
- Distance to the display longer than to a book or paper;
- Variable font size;
- The direction of view may be incorrect;
- Large amount of information.

Flicker of the image (old monitors) – unclear images, incorrectly overlapped – misinterpretation by the brain of the image – similar to diplopia – abnormal ocular movements in order to recover the false diplopia.

These will result in:

- Ocular pain;
- Headache;
- Blurred vision.

32% of the subjects claimed to have experienced symptoms related to the display

## 5. Conclusions

- Symptomatology of computer vision syndrome was present in subjects using more than 3 hours daily the computer;
- Asthenopia occurs often, especially in people after 40 years old;
- Ciliary spasm occurs more frequent under the age of 40;
- Dry eye syndrome is present in different forms at all computer users and increases with age;
- The display features contribute to the CVS.

To reduce the symptoms following measures would be helpful:

- Avoiding prolonged focusing to a display (breaks at 20-30 min.);
- Optimal correction of presbyopia;
- Optimal correction of the refractive errors (using cycloplegia);
- Conscious blinking;
- Lower positioning of the screen;

- Dry eye treatment;
- Adjusting the lightning parameters of the display.

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# Does the Size Matter in Small Gauge Pars Plana Vitrectomy Surgery

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**Purpose**

To summarise and compare the use of 23-, 25- and 27-Gauge pars plana vitrectomy (PPV) systems. Invention of smaller gauge vitrectomy systems with the advances in biomedical engineering have modified the strategies and techniques used in vitreoretinal surgery. We discuss advantages and disadvantages of these smaller gauge vitrectomy systems.

*Keywords: Small Gauge Vitrectomy, 27-G vitrectomy, 25-G Vitrectomy, 23-G Vitrectomy*

## 1. Introduction and History of Vitrectomy Surgery

Vitreous volume is about 4ml. In some high myopic eyes vitreous volume can reach up to 10ml. Most of it is water (99%). The main molecular compounds are hyaluronic acid and type II collagen fibrils [1]. Although the idea of vitrectomy hypothesised in late eighteen hundreds, first open sky victrectomy was done by Kasner using sponge and scissor in 1961 [2]. Then Machemer introduced pars plana vitrectomy in 1971 which was a big step in vitreous surgery [3]. The latest 27Gauge (G) vitrectomy system introduced by Oshima in 2010 [4].

## 2. Small Gauge Vitrectomy Systems

The term “Small Gauge Vitrectomy” defines 23G, 25G and 27G vitrectomy systems. External and internal diameters of these systems are shown in **Table 1**. Invention of smaller gauge vitrectomy systems with the advances in biomedical engineering have modified the strategies and techniques used in vitreoretinal surgery [5].

**Table 1.** Internal and External Diameters of Small Gauge Vitrectomy Systems

| GAUGE | EXTERNAL DIAMETER (mm) | INTERNAL DIAMETER (mm) |
|---|---|---|
| **23G** | 0.64 | 0.39 |
| **25G** | 0.51 | 0.29 |
| **27G** | 0.41 | 0.20 |

### *2.1 Instrumentation*

As the diameter size reduces the instrumentation gets more complicated. One good thing about 25G or 27G is you need less equipment for some procedures e.g. membrane dissection or delamination in diabetic tractinal detachment cases [6]. Disadvantages of smaller gauge instrumentation seems to be more than its advantages. As the diameter size reduces the instruments become more fragil and pliable [7]. Therefore, manipulation and reaching peripheral retina become more though. Although after a proper retrobulbar anesthesia there may be micro

movements of the eye. Rigid instruments helps to eliminate these micro movements to achieve akinesia especially in macular surgeries [8]. With the latest 27G it`s hard to achieve this comfort yet. One more instrumentation disadvantage is changing to a newer smaller gauge system costs a lot of money.

### *2.2 Entry and Wound Construction*

There are two main types of vitreous entry techniques; One step or Two steps. In one step technique there's a pre-loaded trocar blade and according to surgeon's preferences entry to vitreous cavity can be perpendicular or oblique at once [9]. In two steps technique there's a micro-vitreoretinal (MVR) blade without the trocar. In this technique surgerons first enter to vitreous cavity with MVR then place the trocar to sclerotomy seperately [10]. There are two types of oblique sclerotomy wound construction techniques. Radial-anteroposterior technique sharp edges of blade stays paralel to corneal limbus and after scleral entry surgeon moves anteroposterior.

With this technique circumferential scleral fibers only split from each other and after trocar ejection these fiber reattach easily and wound becomes more watertight and heals faster. One disadvantage of this technique is there's a theoretical lens or retina injury risk during the wound construction. On circumferential technique sharp edges of blade stays perpendicular to limbus and after scleral entry surgeon moves paralel to limbus. With this technique scleral fibers get cut and compared to radial tunnel technique circumferential technique is less watertight, but theoretically safer [8, 11-13]. In both oblique techniques it's recommended to enter sclera with an angle between 5-15 degrees to sclera. Then to move with the same angle through 50% of scleral depth.

After this step to change the angle 30 degrees and enter the vitreous cavity. It's also recommended to have longer intra-scleral tunnels to achieve less hypotony post-operatively [12, 14]. Most of retinal surgeons prefer one step, oblique, circumferential wound construction technique.

### *2.3 Fluidics*

The fluidics of vitrectomy systems is divided in to two: Infusion flow rates and Cutter flow rates. Physically when the diameter of a pipe reduces frictional forces increases thus volume flow decreases [15]. To overcome this situation infusion pressure can be set to high values (40-50 mmHg) but this can cause reduced ocular perfusion or ocular ischemia [9]. As an example of infusion flow rates; the internal diameter of 27G infusion cannula is half of the 23G infusion cannula. Thus 27G infusion flow rate is 12.5 times less than 25G infusion flow rate (**Table 2**) [16].

**Table 2.** Infusion Flow Rate Comparison of Small Gauge Vitrectomy Systems

| GAUGE | INTERNAL DIAMETER (mm) | FLOW≈DIAMETER$^4$ | COMPARISON |
|---|---|---|---|
| **20G** | 0.52 | 0.073 | |
| **23G** | 0.39 | 0.020 | 3.65x less flow than 20G |
| **25G** | 0.29 | 0.007 | 2.80x less flow than 23G |
| **27G** | 0.20 | 0.0016 | 12.5x less flow than 23G<br>4.30x less flow than 25G |

Similar rules are present for cutter aspiration vacuum rates. To compensate increased infusion flow rates, aspiration vacuum can be set to higher values as well e.g., range between 400-600 mmHg. After introduction of Dual Pneumatic or Twin Duty cycle cutters in smaller 25G and 27G systems have begun to be used by more surgeons. These cutters provide forward and backward cutting, doubling cut rates up to 16000 and duty cycle to be 92%. This means less vitreous traction